Learning and Enjoyment in Serious Gaming – Contradiction or Complement?

Ulrich Wechselberger

University of Paderborn
Center for Educational Research and Teacher Education
Warburger Str. 100
33098 Paderborn, Germany
Phone: +49 5251 60-5484
ulrich.wechselberger@uni-paderborn.de

ABSTRACT

Research has mainly neglected to examine if the possible antagonism of play/games and seriousness affects the educational potential of serious gaming. This article follows a microsociological approach and treats play and seriousness as different social frames, with each being indicated by significant symbols and containing unique social rules, adequate behavior and typical consequences of action. It is assumed that due to the specific qualities of these frames, serious frames are perceived as more credible but less entertaining than playful frames – regardless of subject matter. Two empirical studies were conducted to test these hypotheses. Results partially confirm expectations, but effects are not as strong as assumed and sometimes seem to be moderated by further variables, such as gender and attitudes. Overall, this article demonstrates that the educational potential of serious gaming depends not only on media design, but also on social context and personal variables.

Keywords

Serious games, framing, enjoyment, learning, credibility, symbolic interaction

INTRODUCTION

Serious games are meant to combine playful entertainment and serious learning. For decades, serious game designers and educators intended to use the affective properties of games for student motivation (Sykes 2006) and to improve learning by didactical principles used in game design (cf. Gee 2007, 30–43). But how well do these two aspects match when combined in learning media? This issue can be addressed from three perspectives: media design, cognition and social interaction.

Media design and ludology have investigated the balance of entertainment and learning in edutainment and serious games mainly in terms of design and development aspects. Although some authors criticize that edutainment products often fail to harmonically combine learning and entertainment (Bogost 2012, 242; Klopfer and Purushotma 2012, 606), both aspects are not fundamentally incompatible. For example, Habgood and Ainsworth (2011) present a generic concept of intrinsic integration and found empirical evidence

that such intrinsic integration supports learning in serious games. Furthermore, Hebisch and Wechselberger (2012) introduce a more detailed and concrete gameplay model for matching subject matter and gameplay.

Only a few researchers have asked to what extent entertainment and learning in edutainment media are compatible in terms of human *cognition*. Salomon (1984) for example observed that, regardless from the objective nature of the media, young students' anticipation of self-efficacy and the media's perceived demand characteristics differed: Television was considered more realistic than print and self-efficacy was higher while watching television than reading. Furthermore, readers invested more mental effort than television watchers. Lower levels of mental effort, on the other hand, correlated with fewer inferential learning. In short, even though both media types featured an identical amount of information, students of the television condition invested less mental effort due to their prior expectations of television. As a consequence, they achieved less.

Possible effects of *social aspects* (such as social frames and meaning) on learning and entertainment have mainly been neglected. This article regards serious gaming as social action and discusses its motivational and didactical potential from both a sociological action theory and an empirical perspective. Unlike Salomon's work, this study investigates not only effects on learning, but also on entertainment. Secondly, it focuses on learning with regards to media credibility and reception instead of media demand characteristics and invested mental effort. In the third place, this study examines not only the effects stemming from different media types with identical content, but also of different social frames with identical media.

THEORY

Play as Symbolic Interaction and Framing

This study builds upon the perspective of Symbolic Interactionism which is based on three premises:

> The first premise is that human beings act toward things on the basis of meanings that the things have for them. [...] The second premise is that the meaning of such things is derived from, or arises out of, the social interaction that one has with one's fellows. The third premise is that these meanings are handled in, and modified through, an interpretative process used by the person in dealing with the things he encounters (Blumer 1969, 2).

In other words, serious gaming is rather a matter of the socially induced, subjective meaning a person applies to a serious game than of the mere design of serious games.

These premises of Symbolic Interactionism (amongst with other approaches on Microsociology, such as Schütz' Phenomenological sociology and Garfinkel's Ethnomethodology) have been adopted by the German sociologist Hartmut Esser (2000; 2001; 2002). According to Esser, successful social interaction depends on all actors' identical anticipations of the situation's goals and further course of action. This is achieved by the exchange of gestures which indicate the intentions of an actor and his or her counterpart. Gestures that refer to the same mental ideas of a situation and course of action are called

significant symbols. They are particularly efficient during social interaction. Human language is the most important and powerful system of significant symbols. According to Esser, social interaction occurs in loops with each loop consisting of several steps. Firstly, each individual interprets his or her surrounding by attributing a cognitive schema to his or her social situation ("framing"). This process depends both on how clearly a situation's significant symbols match the individual's notion of social frames (forming the probability of the frame) and on the subjective evaluation of positive and negative outcomes associated with that frame (constituting the frame's value). The latter derives from the interplay of social rules (that regulate consequences of actions) and the individual's goals and preferences. Individuals select the frame with the highest product of probability and value. Secondly, an individual decides how to act in a previously selected frame. Since every social frame comes with its respective rules, some actions ("scripts") are suitable and profitably in that frame, while others are inappropriate and may provoke penalties. Hence, deciding what to do in a previously interpreted situation also depends on its frame-specific value and its adequacy. Also here, the script with the highest product of adequacy and value is selected. In daily routine, when situational symbols are usually significant and social rules are deeply internalized, both frame and script selections occur automatically and unconsciously. For example, picture a young boy being tackled by his friend. Since he recognizes his friend smiling and approaching with reduced physical force (frame probability and significant symbols), he might interpret the current situation as the invitation to a harmless and playful fight instead of a serious attack (frame selection). Everything is "just a game". The boy finds great joy in playing with his friend, but also fears to get hurt or hurt his buddy (frame and script values). As a result, he might decide to counterattack his friends' approach with reduced force, as many times before (script adequacy), rather than turning down the invitation or violently retaliate (script selection). As long as there are no disturbances (such as unexpected feedback by his friend), the boy is likely to hold on to his interpretation of the situation and his actions. Both boys know they are just playing and that it only *appears* as if they were fighting (cf. Bateson 1972, 185).

Play frames come with certain rules that govern all actions in these frames: Firstly, according to Caillois (2001, 4–9), play is voluntary and cannot be commanded without being spoiled. Secondly, play is separate from reality and daily routine. It takes place within agreed borders. In the third place, play is unproductive in the sense that it does not create any goods or works. Furthermore, play is make-believe which means that rules of reality are no longer relevant in play frames and that play comes with its own laws.[1] These qualities form the rules and values of play frames. Due to them, play is often regarded as the direct opposite of seriousness (Huizinga 1950, 5).

In short, play and seriousness are opposed frames with different rules that are indicated by significant symbols, e.g. characteristic words. From the perspective of this study, serious or playful gaming is rather a matter of social context and framing than the medium itself: One and the same learning game or simulation can be either playful or serious. Social rules associated with play and seriousness define not only adequate behavior in such frames, but also their potential outcomes and values. The next section focuses on these potential values.

Effects of Framing on Entertainment and Reception

Since framing a social situation as play or seriousness influences an individual's interpretation of this situation and his or her actions, the question arises how this may affect both learning and entertainment in serious gaming.

Entertainment

When it comes to play and entertainment, many authors consider aforementioned characteristics of play frames as important factors for game play motivation and entertainment. For example, Caillois (2001, 6) states that play would forfeit its fun and enjoyment if it was no longer voluntarily, because during play one takes his or her mind off all worries and escapes daily routine. Also, Sherry et al. (2006, 217) discovered that a common motive for playing games is to relax and escape from responsibilities. Klimmt (2006) argues that game enjoyment is based not only on mechanisms of game play (such as interactivity or narrativity), but also on play frames:

> Play is attractive due to its separation from other actions and their implications (e.g. responsibility, time pressure, pressure to perform with severe sanctions in case of failure [...]). Thus, to play means to acquire freedom and to break out of functional contexts of daily routine (Klimmt 2006, 65, own translation).

Hence, play allows recreation and the recovery of motivational, emotional and physical resources. If it were not for the features of play frames such as voluntariness, unproductiveness as well as the absence of pressure and consequences, this would be impossible. As a result, framing serious gaming as play might result in higher levels of entertainment than framing serious gaming as seriousness.

Reception

Furthermore, framing possibly has influence on learning with serious games. This study focuses on knowledge acquisition rather than formal dimensions of learning and takes over a constructivist perspective. From this point of view, knowledge acquisition is more than the mere transfer of information from sender to recipient. It rather implies that information has to be interpreted, evaluated, filtered and transformed before it becomes part of one's knowledge. Of particular interest for this study are the processes of evaluation and filtering as well as one's "decision" whether to either adopt or disregard a piece of information. Esser (2000, 270–273) refers to this procedure as the *reception of information*. He argues that, besides the importance of the information, a key factor for successful reception is the credibility the recipient attributes to the sender: If a person considers a source as not credible, he or she will probably refuse to accept even important information from that source. While sender and media credibility have been widely investigated in media psychology and communication research (as a moderator variable of persuasion and with focus on its dimensions and differences between various media types, cf. Janetzko 2008; Kiousis 2001), the relation of media credibility, framing and learning in educational contexts has barely been examined.

Since individuals act towards (and choose to receipt information embedded in) serious games on the basis of meaning and meaning is the result of framing, the question arises if play and serious frames differ in perceived credibility. As mentioned earlier, play is sepa-

rated from reality, has its own laws, is make-believe and does not intend to produce anything useful. Hence, it seems plausible that media credibility of serious games framed as play remains behind credibility of serious games framed as seriousness. Therefore, as credibility supposedly has a major impact on content reception and learning, framing might indirectly affect learning with serious games.[2]

Interim Conclusion

To sum up, human actions in social situations are based on symbolically mediated frames and the rules attached to these frames. Situational symbols referring to play frames supposably lead individuals to the assumption that the interaction with others in this situation is voluntary and separated from daily routine and reality, that things in this situation are not as they seem and that there are neither negative nor positive consequences. As a result, when it comes to serious gaming, the question arises if framing indirectly affects learning and entertainment in serious gaming, regardless of the objective design qualities of the serious games: Both reception and enjoyment are (at least to some extend) based on qualities, rules and values of play or serious frames.

Two studies conducted by the author approximate this theoretically derived idea from an empirical perspective. Study one examined if similar learning occasions with identical content and different learning media representing different frames affect entertainment, perception of credibility and learning outcome. Study two investigated if different situational frames with identical serious games have an effect on entertainment and perception of credibility.

STUDY ONE

Hypotheses

Study one investigated if two different methods – a playful game-based training and a traditional instruction – for the same educational content (the starting procedure of a testing plant) affect entertainment, attribution of credibility and application of content. The following hypotheses were tested:

  H1: Participants will rate a playful a serious game as more entertaining than a traditional instruction.

  H2: Participants will perceive a serious game as less credible than the instruction.

  H3: In a practical test situation, individuals that participated at a traditional instruction will display more transfer of learning than players of a serious game.

Method

Participants

The study was conducted at the Industry Automation division of a German engineering and electronics company. The sample group consisted of 16 employees (two female, 14 male) who voluntarily participated in the study. Average age was 35.94 years ($SD =$ 9.11).

Procedure and Materials

Prior to the study, the participants' age, gender, prior knowledge about and attitude towards both the subject matter and serious games were collected by a questionnaire. On this basis, participants were assigned to one of two parallelized sample groups (experimental group and control group). After a short introduction on the day of the study, each participant was individually trained on how to power up a testing plant. Depending on group membership, the training consisted either of an interactive, serious adventure game with mainly explorative and only a few instructional components in a virtual, interactive, three-dimensional representation of the plant (experimental group) or of a classical instruction within the real plant by a technical administrator (control group). Both trainings contained the same type, amount and order of information. Both learning approaches differed mainly in terms of significant symbols referring to learning: The game-based training barely featured any significant symbols indicating a learning context. Instead, the subject matter was "subtly" embedded into the game structure, leading to a more "informal" (cf. Wechselberger 2009) and game-like experience than usual trainings. For example, the player did not receive any explicit instruction about how to activate a plant module with its respective computer panels. Instead, he or she played a mini-game within the game-based training: When being pushed, each of the panel's buttons triggered a unique musical note. Once the player figured out that the buttons had to be pushed according to the major scale, the respective module was activated and an animation was displayed (for details cf. Rilling and Wechselberger 2011, 293).The traditional training, on the other hand, was quite representative for its kind and mainly consisted of classical, explicit instruction. It provided a high amount of significant symbols branding the approach as a teaching scenario. After the training, enjoyment and credibility were measured by a questionnaire. Eventually, each participant was asked to autonomously start up the real plant while being supervised by the plant's administrator.

Measures

Game enjoyment was measured by seven items loosely adopted from Klimmt (2006, 123–124). They featured a 4-point Likert scale, with higher values representing higher levels of enjoyment. Principal component analysis with Varimax rotation revealed three factors with Eigenvalues > 1 that altogether accounted for 91 % of the variance. These dimensions had acceptable, respectively good reliability and were easily interpretable. They were transferred into three unweighted index variables: attraction ($\alpha = .76$), immersion ($\alpha = .92$), and satisfaction ($\alpha = .78$).[3]

Credibility was operationalized firstly as a multidimensional construct and measured by six items[4] containing a 6-scale Likert response format. Principal component analysis with Varimax rotation revealed one factor with an Eigenvalue > 1 that accounted for 82 % of the variance. Reliability was excellent ($\alpha = .96$). Therefore, an index variable named credibility (multi) of unweighted means was calculated. Higher values represented higher perceived credibility. Secondly, credibility was operationalized by two items derived from the Roper question (cf. Gaziano and McGrath 1986, 452). Participants specified which option, in case of conflicting information, they trusted more: the training they participated in or an alternative.[5] After dummy coding and calculating into an index variable named credibility (Roper), higher variable values represented higher levels of perceived credibility.

During the practical test, an observer noted all hesitation phases and, if participants got lost or were about to do something potentially dangerous, all interventions by the super-

vising administrator of the plant. Implementation of subject matter was operationalized as a hesitation index (the number of hesitation spans longer than five seconds) and an index of need for help (the amount of small hints or corrections provided by the administrator).

Results

Results are shown in table 1. For significance testing, an independent samples t-test with a 5 % significance level was conducted.

In terms of entertainment (H1), as assumed, participants of the serious game condition rated both attraction (medium effect size) and immersion (large effect size) higher than participants of the traditional instruction. Contrary to expectations, satisfaction was rated lower in the serious game condition (medium effect size). Only the difference in immersion was statistically significant.

		Mean	SD	p	d
Attraction	instruction	5.50	.78	.26	.61
	serious game	5.86	.18		
Immersion	instruction	3.38	1.19	> .01	1.70
	serious game	5.00	.58		
Satisfaction	instruction	5.81	.26	.28	.59
	serious game	5.36	1.10		
Credibility (multi)	instruction	5.54	.39	.02	1.28
	serious game	4.45	1.14		
Credibility (Roper)	instruction	.88	,64	,04	1,12
	serious game	.25	,46		
Hesitation	instruction	4.38	2.77	.06	1.10
	serious game	2.13	.84		
Need for help	instruction	2.25	1.39	.13	.82
	serious game	3.25	1.04		

Table 1: Mean differences, standard derivations, p-values and effect sizes for entertainment, credibility and transfer of learning.

As expected, participants of the serious game condition rated credibility significantly lower than participants of the instruction group (H2). This applied for both of the index variables (Roper and multi) (cf. figure 1). Effect sizes were large.

Results for implementation of subject matter (H3) were inconsistent. Contrary to expectations, test subjects that participated in the instruction group hesitated longer than their colleagues that played the serious game. On the other hand, as assumed, members of the serious game condition needed more help than members of the control group. For both findings, effect sizes were large but statistically insignificant. Also, neither hesitation nor need for help showed significant correlations ($\alpha = .05$) with any of the credibility scales, which indicates that transfer of learning and perceived credibility were independent.
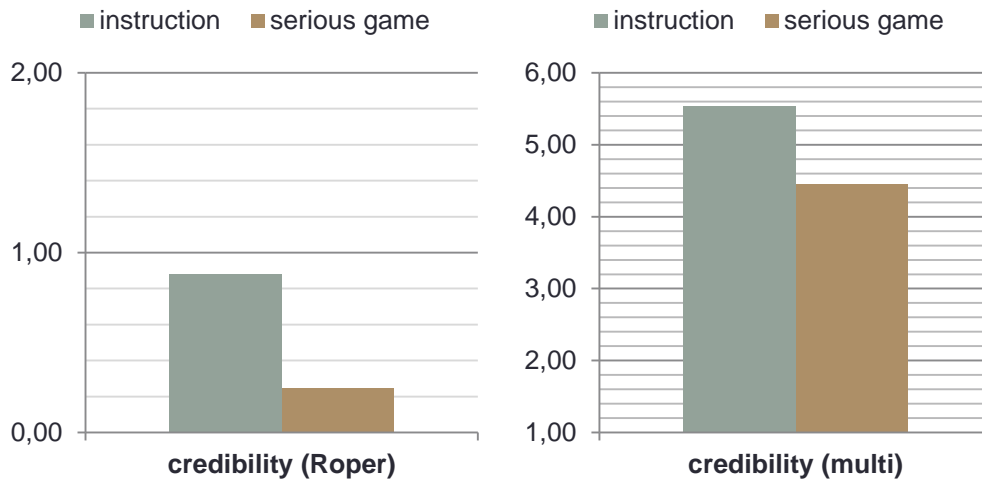
Figure 1: Differences in perceived credibility between classical instruction and serious game in study one. Findings were statistically significant.

STUDY TWO

Hypotheses

Study two investigated if symbolic cues indicating different social frames (play and seriousness) affect both entertainment and attribution of subject matter – regardless from the actual serious game. The following hypotheses were tested:

H1: Participants in the playful frame will rate a serious game as less credible than participants in the serious frame.

H2: Participants in the playful frame will be more entertained while playing the serious game than participants in the serious frame.

Method

Participants

The sample consisted of 54 German junior high school students between 12 and 15 years with an average age of 13.51 years ($SD = .81$). 64 % of all participants were male.

Procedure and Materials

One week prior to the study, the students were told by their teachers that they were about to participate in one of two independent studies: either a learning software test or a computer game test. Students answered a questionnaire collecting some demographic variables and their attitude towards learning games, threw a die and noted the result on their questionnaire. After collecting all questionnaires, the teachers informed their students that everyone with an even die value would attend the computer game evaluation and everyone with an odd value the learning software test. In fact, all students were to interact with the same serious game. The real purpose of this procedure was to randomly assign participants to either the experimental or the control group.

On the day of the study, both groups were separated and guided into different computer rooms. Here, both conditions received nearly identical instruction, except for key words that were expected to function as significant symbols referring to different frames. For the experimental condition, key words referring to play and for the control group, key words referring to seriousness were used (cf. table 2). After the instruction, the students visited different websites (depending on their group either imitating the website of a learning software developer or a computer game studio) (cf. figure 2) that forwarded all participants to one and the same serious game, regardless from experimental condition. In this game, participants had to memorize elements in their correct sequence (e.g. the chronology of German federal chancellors). After completing three missions (i.e. ten to fifteen minutes later), participants were forwarded to an electronic questionnaire that measured entertainment and perceived credibility of the serious game.

	Control condition (seriousness)	**Experimental condition (play)**
Conductor of the study	An organization producing learning software for students	A game developer studio designing games for adolescents
Research question	How can a computer be efficiently used as a learning tool in the classroom?	How can a computer game be designed in order to be as entertaining as possible?
Target audience	Students	Gamers
Task for the participants	Test the didactical design; work the learning program; finish with a high grade	Test the game design; play with the game; finish with a high score

Table 2: In the experimental and control condition, instruction was nearly identical. Only key words (serving as significant symbols) that pointed to either play or serious frames were experimentally varied.
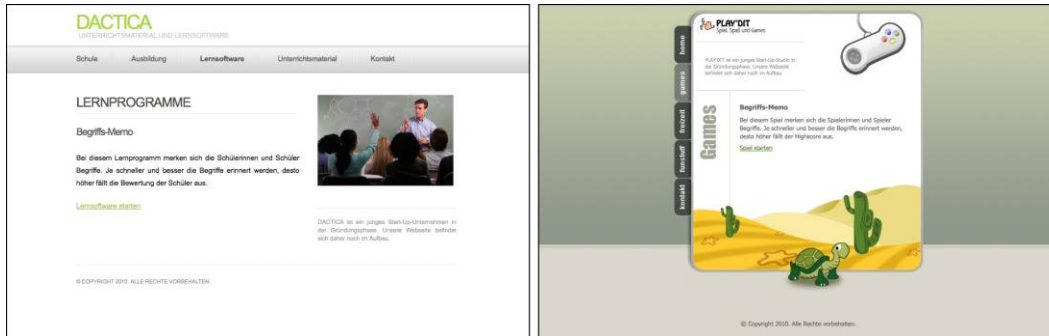
Figure 2: Screenshots of both websites (serious condition left, playful condition right) leading to one and the same serious game.

Measures

Perceived credibility was assessed by two items[6] derived from the Roper question (cf. Gaziano and McGrath 1986, 452). Participants had to choose which option they would trust more, given that the software they tested and an alternative source contained conflicting information. After dummy coding and calculating into an index variable, higher values represented higher perceived credibility.

As in study one, enjoyment was operationalized on the basis of Klimmt (2006, 123–124). This time, eight items[7] featuring a 4-point Likert response format were used. Higher values represented higher levels of enjoyment. Unlike in the first study, principal component analysis with Varimax rotation revealed only one factor with an Eigenvalue > 1. It accounted for 69 % of the variance and had good reliability ($\alpha = .93$). Therefore, an index variable of unweighted means of all items was calculated, representing enjoyment.

Gender was used as the first control variable. It was significantly correlated with the credibility index ($C = .42; p < .01$), and thus it was used as a second factor when testing the effect of framing on perceived credibility.

The second control variable, attitude towards learning games, was measured by three items[8] featuring a 5-point Likert response format. Higher values represented a more positive attitude. The scale showed acceptable reliability ($\alpha = .65$), and an index value was calculated as an unweighted mean of the three items. The index variable was significantly correlated with enjoyment ($r = .28; p = .05$). Hence, participants were post-hoc divided by a mean split of the attitude variable into one group with positive and one group with negative attitude towards learning games. When testing the effect of framing on enjoyment, attitude served as the second factor.

Results

Descriptive results for credibility (H1) are shown in table 3. Results for enjoyment (H2) are displayed in table 4. A two-way analysis of variance was conducted, the first factor being the experimentally manipulated social frame and the second factor either gender (H1) or attitude towards learning games (H2). A 5 % significance level was applied.

| Condition	Gender	Credibility (Mean)	SD
Serious	female	1.25	.5
	male	1.48	.75
	total	1.44	.71
Playful	female	.86	.54
	male	1.46	.66
	total	1.15	.66
Total	female	.94	.54
	male	1.47	.71
	total	1.29	.7

Table 3: Descriptive effects of experimental condition and gender on perceived credibility. Findings were statistically insignificant.

Condition	Attitude	Enjoyment (Mean)	SD
Serious	positive	2.91	.59
	negative	1.80	.66
	total	2.29	.83
Playful	positive	2.66	.67
	negative	2.55	.89
	total	2.61	.76
Total	positive	2.77	.63
	negative	2.13	.85
	total	2.45	.81

Table 4: Descriptive effects of experimental condition and attitude towards learning games on enjoyment. Attitude had a significant main and (in combination with experimental condition) interaction effect on enjoyment.

As expected, credibility (H1) was rated lower in the playful condition than in the serious condition. Effect size was only small and results were statistically insignificant ($\eta_p^2 =$ .02; $p > .05$). Furthermore, in both conditions, female participants attributed less credibility to the serious game than male participants. This main effect was of small size and insignificant ($\eta_p^2 = .07$; $p > .05$). While male participants showed only low differences in credibility rating between both test conditions, female participants rated the game less credible in the playful condition than in the serious condition. The interaction of gender and experimental condition was not significant and effect size was small ($\eta_p^2 = .02$; $p > .05$).

As predicted, participants of the serious group enjoyed the game less than participants from the playful condition (H2). This main effect was only small and insignificant ($\eta_p^2 = .03$; $p > .05$). In addition, attitude towards learning games had a strong and highly significant effect on enjoyment ($\eta_p^2 = .16$; $p < .01$). While in the playful condition enjoyment ratings of participants with positive and negative attitude towards learning were close, they diverged in the serious condition (figure 3). This medium-sized interaction effect was highly significant ($\eta_p^2 = .12$; $p = .01$).
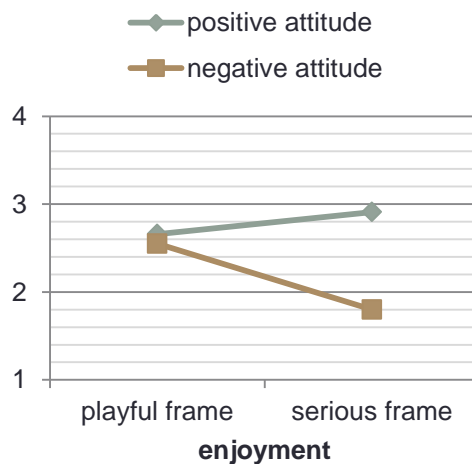
Figure 3: Effects of framing and attitude towards learning games on enjoyment in study two. Impact of attitude and interaction effect was statistically significant.

DISCUSSION

Summary

This article investigated how the social context affects the educational potential of serious games. It was argued that in social situations, significant symbols can refer to either play or seriousness. By those symbols and based on social rules, different frames with different goals and courses of action are indicated, and diverging anticipations are provoked: Hypothetically, individuals expect play frames not to lead to any negative consequences but also not to contain any information relevant for real life. In contrast, serious frames

presumably are associated with negative outcomes (such as pressure and sanctions) but also assumed to contain useful and authentic information.

On this theoretical background it was empirically investigated if within serious gaming, symbols referring to play frames provoke more entertainment and less perceived credibility than symbols referring to seriousness. In study one, the medium teaching the same subject matter was varied (a playful serious game with few vs. a traditional instruction with many symbols indicating a learning context). The study methodologically followed Salomon's (1984) approach, but it was based on a different theoretical basis: It did not build on a priori anticipations of media demand characteristics and their impact on invested mental effort. Instead, it focused on symbol-based anticipations of social frames and scripts and their effect on perceived credibility and play-based entertainment. In study two, only key words in an otherwise identical introduction as well as the pretended conductors of the study were varied (the serious game was identical in both conditions). On one hand, study two was methodologically oriented on the approach of Tversky and Kahneman (1981), since it focused on the effect of verbal significant symbols. On the other hand, while Tversky's and Kahneman's work was based on economic theory and investigated the process of decision-making, study two built on the same concept as study one.

In study one, the learning scenario had a significant effect only on perceived credibility. As expected, despite nearly identical amount, selection and order of learning content, the serious game was perceived as less credible than the instruction. Thus, results support the hypothesis that serious vs. playful framing affects human information processing in serious gaming. Nevertheless, it cannot be ruled out that this effect was also due to the circumstance that the serious game took place in a *virtual* (yet highly realistic) representation of the plant, while the instruction was performed under *real life* conditions. Interestingly, framing had no significant effect on implementation of subject matter. Also, credibility and practical performance were not significantly correlated. Thus, the relation between perceived credibility and application of subject matter may in general be weaker than expected. Alternatively, given that participants in the playful condition had rated the training's credibility prior to their first contact with the real plant, they might have revised their judgment at the moment they were able to compare the virtual model with the real plant. At last, with regards to enjoyment, experimental conditions only affected immersion. This comes as no surprise and should not be over-interpreted, since immersion is a concept only possible in alternate environments such as the serious games.

In study two, social context did not have any significant impact (neither main nor interaction effects) on perceived credibility. As to entertainment, attitude towards learning games had a significant main and (in combination with framing) an interaction effect on enjoyment. Contrary to framing (which was provoked by experimental setting), negative attitude does not necessarily need to be the cause for variance in entertainment: It is also possible that the results indicate a confounding effect. This would mean that both prior negative attitude towards learning games and enjoyment of the actual serious game could e.g. be the results of unpleasant prior experiences with edutainment (e.g. pressure for performance, sanctions in case of failure etc. despite the alleged edutainment purpose) and negative anticipations about learning games. Furthermore, the (insignificant) interaction effect of gender and social frame might be due to development and socialization status: At the age of 13–14, females are more mature than males and therefore possibly more sensitive to "adult" concepts like social frames, credibility and symbolic interaction (especially in formal learning contexts).

Methodological Implications

Planning and conducting both studies led to some methodological considerations. Firstly, since effects were not always large and sample sizes were quite low in both studies, statistical power was rather low. For example, in study two statistical power for testing the effect of framing on perceived credibility was only 15 % (according to SPSS), leading to an 85 % likelihood for falsely rejecting hypotheses. Hence, even accurate hypotheses had a relatively low chance of being supported by significant test results. As a result, missing statistical significance should at this point not be overrated: Respective hypotheses are not disproved, they are just not supported. Replication studies with larger samples sizes might clarify open questions.

Secondly, both studies deliberately resigned to do treatment checks (i.e. measure which frames participants selected after being exposed to the situations' symbols), as this would probably have influenced framing and thus distorted results. According to Esser (2001, 268–273), framing mostly occurs unconsciously and automatically, and both studies avoided to interfere with this subconscious process in order to maintain as much external validity as possible.

At last, measuring enjoyment did not succeed flawlessly. Though study one and two used relatively similar items, scales displayed different factorial structures and reliabilities. Klimmt (2006, 143), whose scales served as an orientation for this study, reported similar problems. Nevertheless, the items seemed as the first choice: Most other scales for measuring game enjoyment address entertainment mechanisms based on interactivity (e.g. Klimmt et al. 2009) and narration (e.g. Hefner et al. 2007) rather than on characteristics of play frames. A reliable questionnaire assessing such play frame-based enjoyment remains a desideratum for research.

Conclusions

In short, framing does, of course, not have the sole effect on learning and enjoyment in serious gaming. But it is probably an intervening variable. Many descriptive results and some statistical test outcomes support previous assumptions. But findings were not as unambiguous as expected, at least with regards to significance testing. Altogether, the approach used in this study appears to be on the right track. Nevertheless, it could use some refinement. Primarily, the effect of significant symbols on entertainment and credibility might not be as monocausal and linear as assumed. Given the unforeseen interaction effects on game enjoyment in study two, it seems important to take the intervening influence of personal attitudes and experiences into account. With regards to the (insignificant) interaction of gender and framing, one might also consider to investigate the influence of development status and socialization.

What practical conclusions could be drawn from this study? Firstly, in industrial training, lower attributions of credibility might reduce outcome-based motivation to use serious games in the first place. On the other hand, this might be compensated by higher expected task-based motivation, such as immersion-based entertainment, especially when lower perceived credibility does not necessarily reduce transfer of learning. Secondly, as to classroom instruction, framing learning games as seriousness might strongly decrease enjoyment for students with negative attitude towards such media. Since in study two, framing had no negative effect on the males' and only insignificant as well as small influence on the female's perception of credibility, one probably needs to focus mainly on the target audience's attitude towards learning games: With homogeneously negative attitude,

it appears best to put serious games in playful frames. With widely positive attitudes, a serious frame seems reasonable. Instructors who do not wish to take any risks regarding credibility might want to separate the females from the males. Nevertheless, if the interaction effect of framing and gender on credibility is not a coincidence and based on socialization and developmental state, playful frames might become harmful with older target audiences.

Generally, this study suggests that serious games might not be the "wonder weapons" some game-based learning evangelists claim them to be. One rather has to account for moderating factors, such as social context and personal attitudes. Game-based learning skeptics, on the other hand, might take the here presented study as an indication that learning and entertainment are not necessarily incompatible. Results suggest that plain judgments, be it against or in favor of serious gaming, may be too bold. Esser (2000; 2001; 2002) stresses that the formal logic behind frame and script selection is identical amongst all individuals and that the quality of frames, scripts and social rules highly depend on culture and sub-culture. Hence, while in serious gaming learning and enjoyment might to some extend be a contradiction for example in German-speaking countries, they do not necessarily be antagonists e.g. in Anglo-American civilizations. The educational potential of serious gaming might therefore also be a culture-specific matter.

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ENDNOTES

1 Caillois also mentions that in addition, play is uncertain and sometimes governed by rules, but those aspects do not play an important role for this article and will thus not be explained in detail.

2 In order to avoid misunderstandings, I would like to reemphasize the focus of this article on information and knowledge acquisition in serious gaming. As argued, for this kind of learning, seriousness is regarded as a prerequisite for adequate content interpretation. In contrast, other kinds of play-based learning involve abstract cognitive and affective skills rather than knowledge acquisition and are therefore assumed not to be influenced by the perceived credibility and seriousness of the situational frame. On the contrary: Many developmental psychologists (e.g. Piaget 1951, Sutton-Smith 1978, Leontjew 1968) stress the importance of make-believe and as-if (which can be regarded as opposites of realism and credibility) in child play not only for processing experiences and resolving affective conflicts, but also for the training of creativity and cognitive operations. To sum up, while make-believe and as-if are beneficial for some kinds of children's play-based learning, they are assumedly unfavorable for knowledge acquisition in serious gaming.

3 Attraction: "I gladly participated in the training", "To me, the training was completely uninteresting" (reverse coded), "Participating in the study was an appealing task". Immersion: "During the training, I did not notice was happened around me", "I completely immersed into the training". Satisfaction: "To me, the training was boring" (reverse coded), "I was unsatisfied with the training" (reverse coded).

4 Balance of content, functional expertise, didactical expertise, depth, seriousness, and comprehensibleness.

5 "Given conflicting contents, whom would you trust more: the training or a competent colleague?", "Given conflicting contents, whom would you trust more: the training or the manual of the plant?"

6 Item 1: "Imagine you have to arrange German states according to their size for a test. You have read on the internet that Saxony-Anhalt is larger than Rhineland-Palatinate, but in the [game]/[learning software] you were told opposite. Whom do you trust?" (based on experimental or control condition, either the term "game" or "learning software" was used). Item 2: "A good classmate asserts that in truth, the chronological sequence of the Chancellors was different. Whom do you trust?"

7 "Interacting with the [game]/[learning software] made me feel relaxed", "Interacting with the [game]/[learning software] was a pleasant divertissement", "The [game]/[learning software] was a welcome diversion from class", "The [game]/[learning software] was a pleasant pastime", "The [game]/[learning software] was exciting", "Interacting with the [game]/[learning software] was an appealing task", "I would have liked to interact longer with the [game]/[learning software]", "The [game]/[learning software] awoke my interest". Based on experimental or control condition, either the term "game" or "learning software" was used.

8 "To me, learning games are boring", "Learning games are not real games", "I can learn a lot with learning games" (reverse coded).

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