Fiction or Reality – Which Game Story Promotes Learning Outcome More?

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Digital Game-based Learning (DGBL) has achieved several positive results in recent years, e.g., increased fun, motivation, or learning outcome. However, many DGBL applications fail, which makes an isolated consideration of individual game elements and their influence on learning necessary to better design future DGBL applications. One widely used game element is the game story. As there is little research on how a game story should be designed to promote learning, this paper conducts an experiment comparing a fictional game story with a realistic one. The results show that both game stories lead to a significant objective knowledge gain. In terms of learning outcome, both game stories achieved similar results.

Keywords:
game story, serious game, presentation skills, motivation, learning outcome

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1 Introduction

With the introduction of the term digital game-based learning (DGBL) by Prensky (2001), the topic of combining games and learning has received a lot of attention in both research and practice (Breuer, 2010). Studies show that the use of game elements for educational purposes leads to positive effects such as increased motivation, engagement, creativity, or fun (Oliveira et al, 2023; Grogorick, 2021; Prensky, 2003). There are two forms of DGBL design: Gamification and serious games. Gamification is the integration of individual game elements into a non-game context (e.g., education) (Deterding et al., 2011). An example is the teaching concept 'GamEducation,' i.e., individual game elements are integrated into an existing lecture to create a 'gameful experience' in learning strategic decision-making and planning of digital businesses (Siemon and Eckardt, 2017). In contrast to gamification, a serious game does not simply integrate individual game elements into an existing environment, such as an existing lecture. Instead, a serious game is a complete game with fixed rules and objectives (Deterding et al., 2011). One example is 'Adapt or Die' to learn business model development (Schlimbach and Robra-Bissantz, 2022). The two forms of integrating game elements into education, gamification and serious game, are not always clearly distinguishable, so the terms are often used synonymously. However, both forms create a situation where learners expect fun and enjoyment and are thus motivated, promoting learning outcomes as the overriding goal (Grogorick, 2021; Manzano-León et al. 2021).

Nevertheless, many DGBL applications fail because learning is not fun. The reason for this is that DGBL designers focus on the achievement of learning rather than creating an environment that, in addition to the achievement of learning aims, also provides an intense gaming experience characterized by motivation and fun (Zichermann and Cunningham, 2011; Eckardt et al., 2018; Van Roy and Zaman, 2017). In order to support learning as effectively as possible, the development of DGBL focuses not only on the design of the application in general but also on the concrete design of individual game elements (Grogorick, 2021). The game story is a commonly used game element (Hamari et al. 2014). While not all DGBL applications use an accompanying game story, storytelling is still relevant to the learning experience and provides a context for processing learning content (Clark et al., 2016; Kapp, 2012). Studies conducted so far show contradictory results as to whether or not the integration of a game story positively impacts learning and engagement.

Some studies argue that learners use their cognitive capacities to process the game story instead of the learning content (Wouters et al., 2013; Adams et al., 2012). Other work has found that manipulating the game story influences learning. For example, a complex game story has a negative effect compared to a minimally designed game story (McQuiggan et al., 2008), or triggering surprises in a game story leads to a greater depth of knowledge processing (Spek, 2011; Hoeken and van Vliet, 2000). As the effects of manipulated game stories are still unexplored (Wouters et al., 2013), we want to address this topic in this paper.

Game stories are often fictional or based on reality (Nicholson, 2015). In commercial computer games, research has shown a realistic storyline has an inspiring effect, making the game more attractive to players (Olson, 2010). But other studies have also demonstrated the positive effect of fictional game stories, as one can become completely immersed in them and forget about 'real world' problems (Fullerton, 2014). In an educational context, for example, Kruse et al. (2014) chose a story and characters for learning mathematics due to the popularity of vampire series and films. However, many students did not identify with this and felt that they were not taken seriously, which led to a high drop-off in the use of the application. In addition, Eckardt and Robra-Bissantz (2018) evaluated a serious game for learning information literacy skills, in which students on a technical course take part in a fictional research expedition that more closely resembles a real-life story. Although this application achieved positive results regarding the learning outcome (Eckardt and Robra-Bissantz, 2018), these are not clearly attributable to the choice of the game story. Another study used an analog board game to investigate whether a fictional or a realistic storyline was more motivating to learn and found no significant differences regarding the motivational effect (Eckardt et al., 2019).

As previous results are mixed and a direct comparison between a fictional and a realistic story in learning has, to the best of our knowledge, only been done with a non-digital board game, this paper will report the results of a comparative study using a DGBL application, testing a realistic versus a fictional story. Therefore, the research question (RQ) of this paper is as follows:

RQ: How does the learning outcome differ between a fictional and a realistic story in digital game-based learning?

By answering our RQ, we aim to provide new knowledge about the learning outcome of fictional and realistic game stories in DGBL and inspire game story design in future DGBL applications. Overall, we would like to contribute to the improvement of game story design and thus supporting to solve the problem of DGBL's failure. Our paper is structured as follows. First, we start with the research background, addressing the story as a game element and the learning outcome concept. Second, we explain the design of our serious game with a fictional and realistic story. Third, we present the study we conducted, starting with an explanation of our experimental design, before going on to explain and then discuss our results. Finally, in our conclusion, we summarize our findings and show possibilities for further research.

2 Research Background

2.1 Game Story

Storytelling is highly relevant to the learning experience as it provides a narrative context for processing and applying learning content (Kapp, 2012). In general, stories are part of the real world. However, they create an artificially perceived fictional world in the minds of those who immerse themselves in them. For example, a game creates an imaginary world in the player's mind. Players gain new knowledge while immersed in the story by using their previous experience to transfer it to the story's meaning, thereby gaining new knowledge and skills that are relevant to real-life situations (Lugmayr et al., 2017). Integrating storytelling also enriches classroom activities. For example, storytelling can be one of the most relevant learning experiences, as shown by its implementation in HIV and AIDS education (Duveskog and Sutinen, 2013). The learning experience is shown through the consumption of the story. The story moves forward whenever learners have made learning progress (Lugmayr et al., 2017).

There are two ways to create a story in a learning application: fictional or realistic. Many films we watch in the cinema or on Netflix, and even games such as Super Mario, where Princess Peach has to be rescued again and again, have a fictional plot with people or characters that do not exist in real life. These are called fictional stories. The opposite of this is a realistic story. The realistic story actually happened, and the protagonists really existed (or still exist) (Andrews, 2010).

Overall, storytelling serves to structure individual actions and characters so that they have meaning (Kapp, 2012). Accordingly, the player's experience should become meaningful, leading to a narrative presence with which the player can identify (Laschke and Hassenzahl, 2011). This narrative presence is seen as an element of immersion that can lead to a positive willingness to use an application (Ryan et al., 2006). For DGBL, this means that the integration of stories can contribute to learners wanting to learn with the developed application because the DGBL application creates a sense of immersion. When learners want to learn with an application, they are also motivated, which can positively impact the learning outcome (Grogorick, 2021).

2.2 Learning Outcome

A successful game story supports the creation of a meaningful learning outcome. Therefore, we now consider the learning outcome and how it can be operationalized. Defining and measuring the variable learning outcome is difficult because many factors influence it (Kerres, 2001; Häussler, 2007). In general, learning outcome can be described as the result of all didactic activities and therefore means more than memorizing facts, events, or processes, to which it is often reduced, as shown by conducting numerous written knowledge tests (Kerres 2001; Adam, 2004). Kerres (2001) defines several factors that influence the learning outcome. Those relevant to the measurement carried out in this paper are listed below and then explained in more detail:

- Objective learning success or objective knowledge, measured at different time intervals.
- Subjective satisfaction with learning behavior and outcome, i.e., subjectively perceived knowledge gain.
- Emotional responses in terms of motivation to learn and identification with the learning application or game story.

Objective and Subjective Knowledge. In general, Probst et al. (2006) define the concept of knowledge as the totality of knowledge and skills that individuals use to solve problems. According to them, it is only through the combination of information and its application that knowledge is created, which in turn can become a skill (Mescheder and Sallach, 2012). In defining knowledge researchers distinguish

between objective and subjective knowledge. A person's actual stored knowledge, also called factual knowledge, describes objective knowledge (Brucks, 1985). Factual knowledge is often collected by answering questions to verify what has been learned (Johann, 2008). Subjective knowledge is the assessment of a person's knowledge in a particular area. This knowledge assessment can be made by oneself or another person (Brucks, 1985).

Motivation. Emotional responses, such as learner motivation, can be measured using different models. One model for measuring learners' motivation is the ARCS model by Keller (1987). ARCS is an acronym for four factors that promote motivation, which we explain in the following: attention, relevance, confidence in success, and satisfaction. Arousing and maintaining the learner's interest is the attention dimension. As part of the learning process, learners need to be shown how the skills they are learning will be helpful to their everyday or professional lives. The dimension of relevance summarizes this aspect. Raising learners' expectations of success is important and can be achieved, for example, by making learning objectives clear. As a result, learners develop a sense of control over their own learning outcome, to which the motivational dimension of confidence in success refers. Satisfaction and motivation are closely related. If learners are satisfied with the learning application, they will be motivated to learn.

Identification. Identification with the learning application or game story is another emotional response. It is characterized as a mental process in which the user takes on a character's perspective and thus imagines that character's experiences, emotions, and perceptions (Konijn and Hoorn, 2005). In the design of a DGBL application, the narrative context determined by the story of the game is one element that significantly influences the end user's identification with the game (Reeves and Read, 2009).

3 Serious Game for Learning Presentation Skills

The DGBL application of this paper focuses on learning presentation skills. Effective presentation skills are essential for all students as they are associated with individual career opportunities and benefits (Chaney and Green, 2002). In both versions (fictional and realistic), the serious game has the same content for better comparability (e.g., aims and structure of convincing presentations). The DGBL

application is a browser-based board game. Browser games have the advantage that they are easily accessible to students; for example, users do no not need to install additional software (Costu et al., 2009). The digital board game is more like a serious game, as it has fixed rules and objectives (Deterding et al., 2011).

First of all, players can choose an avatar. In the fictional story of the game, the characters are fantasy creatures called 'Badanklas.' As a Badankla, the player wants to improve the village and therefore intends to present an idea to the Great Council of Badanklas. Knowing that he/she does not have the best presentation skills, the Badankla wants to improve them before the presentation to convince the Great Council of his/her idea. The realistic game story is about a student that aims to finish his bachelor thesis and wants to work on his presentation skills before the oral defense. A game story with a theme closely linked to learning aims (as we do with presentation skills) can enhance the impact of a narrative (Wouters, 2013). Figure 1 shows the board game.

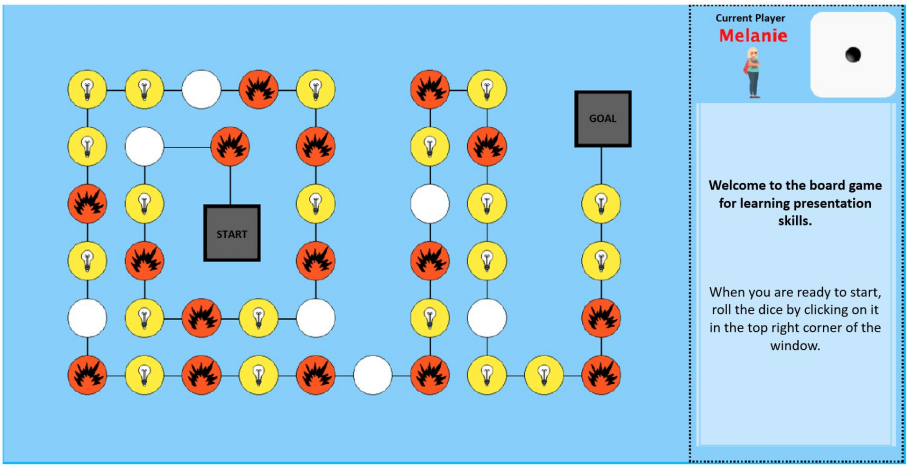

Figure 1: Screenshot of the Board Game

Up to four learners can play the digital board game at the same time. They are initially on the 'Start' field. Each player rolls a die and, depending on the number they roll, moves one step closer to the goal. The goal represents the final of the storytelling by applying the learned presentation skills in giving a presentation. On the way to the goal, players will come across event and knowledge cards. Players can draw event

cards when they land on squares with explosions. The event cards are designed to fit and relate to the story of the game. For example, an event card might say in the fictional story, 'Your Badankla friends tell you that your presentation is getting better and better. Take two steps forward.' In the realistic story, it might say: 'You take a break and go for a run. Afterward, you feel much fitter mentally. Take one step forward.' In contrast, participants can draw knowledge cards when they land on squares with lamps. Each knowledge card contains new learning content that will be presented to all players.

Figure 2 summarizes the game elements used in the DGBL application. With the exception of storytelling, all game elements are designed identically in both versions of the game so that the influence on learning outcome depends as much as possible on the choice of the story (fictional or realistic).

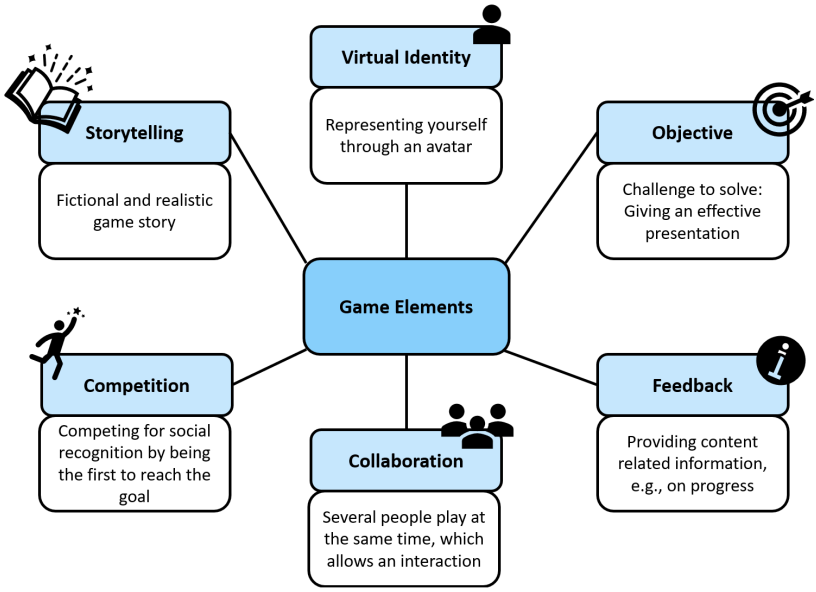

Figure 2: Game Elements of the Board Game

4 Fictional or Realistic Game Story: Study on Learning Outcome

4.1 Study Design

We conducted a controlled experiment under laboratory conditions lasting about approx. 30 minutes to evaluate how learners assess the two variants. The participants were randomly assigned into two groups (fictional vs. realistic game story) at the beginning of the study. The experiment begins with the completion of an online questionnaire to assess learners' prior knowledge. After a short explanation, the serious game follows, either with the fictional story (group 1) or the realistic story (group 2). After playing the serious game, the participants have to complete a post-test with questions on knowledge and emotional reactions (identification and motivation) to assess the learning outcome. Figure 3 shows the research process in summary.

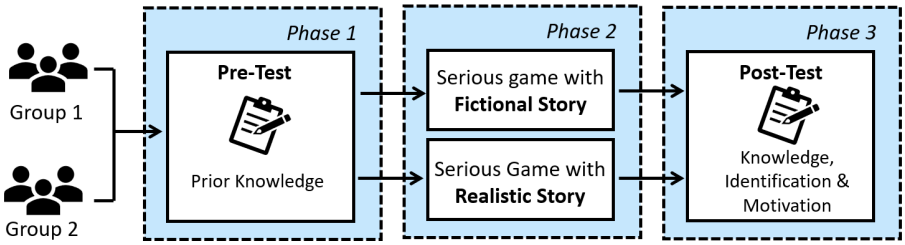

Figure 3: Study Design

We assessed the learning outcome using the factors defined by Kerres (2001) (see Chapter 2.2). We evaluated subjective knowledge according to Flynn and Goldsmith (1999). Our study includes knowledge questions and free-text questions to measure objective knowledge, as these allow the evaluation of a high processing depth of knowledge (Kibler and Eckardt, 2018; Biggs, 1999). We asked eight knowledge questions, e.g., about the aims of presenting or about recognizing different steps in the process of presenting. We measured motivation based on the ARCS model (Keller, 1987) using a scale by Chen and Chan (2008) adapted to the DGBL context. The scale divides motivation into attention, relevance, challenge, and satisfaction. The item "I am looking forward to the next session to use this game" (satisfaction) is not part of the questionnaire because participants only use the application during the experiment. Moreover, we used the identification scale according to Homburg

et al. (2009). We measured subjective knowledge, motivation, and identification using a 5-point Likert scale (1 = strongly disagree, ..., 5 = strongly agree). Regarding the evaluation of objective knowledge, a value between zero (all questions answered incorrectly) and one (all questions answered correctly) corresponds to the result.

4.2 Study Results

52 learners participated in the experiment (24 male and 28 female). Of these, 27 participants chose the realistic game story, and 25 chose the fictional one. The average age was 24 years. In the following, we report the experiment results by giving each construct's mean values (MV) and standard deviations (SD). In addition, we conducted a Student's t-test for independent samples to test whether significant differences exist between the assessment of the fictional and realistic game story for the respective constructs ($\alpha = 0.05$). Table 1 shows our experiment results.

Table 1: Experiment Results Fictional Story vs. Realistic Story

Construct	Fictional Story		Realistic Story		t-Test	
	MV	**SD**	**MV**	**SD**	**T**	**P**
Objective Knowledge (Pre-Test)	0.34	0.43	0.37	0.44	0.69	0.49
Subjective Knowledge (Pre-Test)	2.54	1.05	2.46	1.00	0.54	0.59
Objective Knowledge (Post-Test)	0.56	0.47	0.54	0.46	0.38	0.71
Subjective Knowledge (Post-Test)	2.49	1.00	2.32	0.95	1.23	0.22
Attention (Motivation)	3.12	0.96	3.01	0.85	0.9	0.19
Relevance (Motivation)	3.03	0.95	2.95	0.91	0.59	0.28
Challenge (Motivation)	3.18	0.99	3.02	0.88	1.25	0.11
Satisfaction (Motivation)	3.01	1.2	2.98	0.89	0.23	0.41
Identification	3.25	1.15	3.13	0.91	0.82	0.21

First, we tested in a pre-test whether there were differences in prior knowledge (subjective and objective) between the two experimental groups (fictional vs. realistic story). We found no significant knowledge differences in the pre-test. Regarding the

post-test, the two groups had only minimal differences in objective knowledge. However, the mean value for subjective knowledge gain was higher for the fictional story group (2.49 > 2.32), although not significantly ($p > 0.05$). Regarding the motivation effects according to the ARCS model as well as the identification, the fictional game story was also consistently rated slightly better than the realistic game story, although we found no significant effects. In addition, the mean value for the fictional story for motivation and identification was consistently above the scale mean (mean value > 3.00), so learning with the game story tended to be perceived positively. Overall, the participants perceived the fictional story slightly better after completing the experiment.

In addition, we conducted further t-tests to check whether the participants perceived a subjective or objective knowledge gain after playing the serious game ($\alpha = 0.05$). Table 2 presents the results of the knowledge gain analysis.

Table 2: Results Knowledge Gain

Construct	Pre-Test		Post-Test		t-Test	
	MV	**SD**	**MV**	**SD**	**T**	**P**
Objective Knowledge (Fictional Story)	0.34	0.43	0.56	0.47	4.89	< 0.01
Objective Knowledge (Realistic Story)	0.37	0.44	0.54	0.46	3.95	< 0.01
Subjective Knowledge (Fictional Story)	2.54	1.05	2.49	1.00	0.35	0.37
Subjective Knowledge (Realistic Story)	2.49	1.00	2.32	0.95	1.05	0.15

The results show that the participants subjectively perceive no gain in knowledge. For instance, the mean values of the post-test after learning with the serious game are even slightly worse for both forms of the game story than for the pre-test (not significant). However, we found a significant objective knowledge gain for both game stories ($p < 0.01$). Therefore, participants assumed they had not gained any knowledge, but their responses provided evidence that they had objectively gained new knowledge.

4.3 Discussion of Results

Objective knowledge improved significantly after the learning process in both the realistic and fictional game story. This was not the case for subjective knowledge. The reason for this may be an inaccurate self-assessment, which can be explained by a person's level of competence. According to this, incompetence often leads to overestimating one's own abilities, whereas increasing competence (in this case, increasing objective knowledge) leads to an underestimation of one's own level of knowledge (Kim et al., 2016). This phenomenon has also been shown in other studies of knowledge assessment in an educational context (Tashiro et al. 2021; Eckardt et al., 2019).

The comparison of the learning outcome, measured by knowledge (objective and subjective), motivation, and identification, shows no significant differences in both versions (fictional and realistic story). Both versions were perceived identically, except for slightly different mean scores. A study that also compared a fictional with a realistic game story shows similar results, but these refer to an analog serious game (Eckardt et al., 2019). In our study, we confirmed these results in the digital context. Furthermore, other studies that have analyzed whether the inclusion or exclusion of game stories impacts the learning outcome have also found no significant differences (Sailer and Homner 2020; Wouters et al. 2013). A possible reason could be that the storytelling element has less influence on the learning outcome in the context of DGBL than other game elements (e.g., feedback or collaboration). Therefore, the design of the element (e.g., fictional or realistic) or even its presence is not crucial. This finding is also supported by other studies concentrating on an isolated analysis of the impact of individual game elements. For example, the presence of collaboration has the same positive significant impact on the learning outcome as the combined integration of collaboration and competition (Eckardt and Finster, 2019). However, further studies are needed to confirm this, exploring both different designs of individual game elements and the integration or exclusion of individual game elements and their influence on the learning outcome. The need to consider the impact of individual game elements in isolation has also been highlighted in other studies (e.g., Khosrawi-Rad et al., 2021; Landers et al., 2017).

5 Conclusion and Future Research

In this paper, we presented a DGBL application in two versions (with a fictional and a realistic game story) for learning presentation skills. We evaluated it in terms of their learning outcome. In this analysis, we focused on the impact of static game stories on the learning outcome. Future studies could therefore explore the impact of dynamically designed game stories on the learning outcome or compare dynamic and static game stories. Dynamic stories allow for more autonomy and choice (Fullerton, 2014), which positively impacts learning according to self-determination theory (Van Roy and Zaman, 2017).

We contribute to answering our RQ by testing our serious game in an experiment with 52 students, whereby both versions were primarily rated similarly. Our findings provide new insights for both practice and research. On the one hand, we show that the choice of the game story (fictional or realistic) has no impact on the learning outcome, thus contributing to the isolated consideration of the impact of individual game elements and their manipulation. On the other hand, our results aim to inspire practitioners to design their own DGBL applications, as they can freely choose between realistic and fictional storytelling to achieve a learning outcome.

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