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How can a foundation be outlined for a successful serious game to increase reading engagement

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Abstract

This study aims to support a mandatory reading of a novella for high school students by a serious game. The study includes 41 students. The first class is included in the experimental study, which uses a serious game to read the novella. The second class served as the control group and engaged only in analog reading. The evaluation is based on a questionnaire with reading, user, and narrative engagement items. Furthermore, the assessment consists of in-depth interviews with teachers and students. The findings positively affected students' engagement in the experimental group. Primarily focused attention and reward are higher in the experimental group. However, there was no difference in the narrative engagement between the two groups, indicating that the story (digital or not) is well explained. The qualitative findings revealed positive comments, especially for the reading engagement and the story world. The novelty in this study is the outlined game design process, guided by elements in the foundation, game design, prototyping, and implementation. For the game design, we outlined how to transform the principles from Sweetser and Wyeth to applied design implementations. An important aspect was to illustrate the protagonist with schizophrenia.

1   Introduction

The use of serious games to promote learning is already a well-established educational practice, and there is much research supporting the idea that serious games have positive outcomes for learning [1-5]. There are many different user groups, contexts, and various game designs. Furthermore, there are also various research approaches when investigating serious games to promote learning [6, 7]. There is especially substantial evidence that serious games are more engaging and motivating than traditional classroom instruction [8-10], in which Mayer labelled as the value-added approach [6]. However, when looking at serious games for promoting reading engagement, the literature is scarcer. There is international concern about reading engagement among young adults [11, 12]. In Denmark, only 8.4% of Danish 15-year-old students have a high level of reading, and 16% of Danish teens, aged 15, are reading at a very low level [11]. Furthermore, male students struggle more with reading engagement compared to female students [11, 13]. This lack of reading engagement may partly explain why male students in particular lag behind female students in Danish high schools, a fact that poses challenges for male students in later educational

opportunities and access to the labor market [13]. In Danish high schools, the average grade difference is 0.5 points (based on 7-point grading scale) in favor of female students [14]. However, in the subject Danish, female students' grades are 1.4 points higher on average [14]. Over the past few decades, young adults have changed their habits, reading less fiction and spending more time reading online [12, 15–17]. In Denmark, 20 % of young adults do not read fiction [18], which is equivalent to other international reports [11, 12, 19]. On average, across OECD countries, 37% of young adults (students) report that they do not read for enjoyment at all [11].

Reading has always been encouraged through complex and diverse practices. However, there is a huge concern that young adults do not read well enough to cope with the increasing literacy demands of an information society and future labor market [11]. Reading fiction among young adults appears to be positively associated with higher performance on reading assessments [11]. Reading is a skill with many graduations of proficiency, and comes with lots of complexity, and studies on reading engagement have demonstrated significant relations between affective engagement and behavioral engagement in reading [20-22].

This study aims at supporting a mandatory analogue reading of a novella in two Danish high school classes with a digital serious game. The novella is *A Love Story*, written by the Danish poet and writer Naja Marie Aidt, who won the Nordic Council's 2008 literature prize. A Love Story is taken from Aidt's novella collection The Watermark, published in 1993. Aidt's published work is part of the curriculum in Danish literature, as outlined in the learning objectives regarding mandatory readings in the style of postmodernism. We ask the following two research questions in this paper:

RQ1: How can a foundation be outlined for a successful serious game to increase reading engagement?

RQ2: Can a serious game be designed to increase reading engagement in Naja Marie Aidt's novella *A Love Story* as part of the mandatory reading in Danish literature at Danish high schools?

In this study, we aim to propose both a theoretical framework and an applied design to 1) provide practitioners with a foundation and implications when developing a serious game for increasing the reading engagement in an educational context, and 2) analyze the engagement in a mandatory text read in Danish high schools by using serious gaming. In addressing these research questions, we are capitalizing on the games' abilities to promote engagement [3, 23-27]. It is important to emphasize that this study is not about interventions for reading skills, syntactic awareness, morphological awareness, reading speed or other competences in direct reading comprehension [28]. This study is focusing on reading engagement to promote interest, absorption, and having a good time when 15–16-year-old teens are reading a mandatory text as part of their homework. Common characteristics of such games promoting engagement and interest are the inclusion of rewards and goals to motivate the players, as well as to have a narrative context that is relevant to the narrative plot and to include interactive cues that prompt learning and provide feedback [27].

The paper is structured as follows: Section 2 covers previous literature and examples of serious games for promoting reading engagement. There is an emphasis on the importance of motivation, teacher involvement, and cognitive load. Section 3 presents the game design. There is a focus on how to include elements in the foundation, game design, prototyping, and implementation. Furthermore, there is a description of how game theory specifically is applied to design a game for increasing the reading engagement in Naja Maria Aidt's novella *A Love Story*. Section 4 presents the methods, including the subsection participants, procedure, and data analysis. Sections 5 and 6 presents the findings and discussion, and section 7 concludes the paper.

2   Serious Games for the Promotion of Reading Engagement

The increasing attention that video games have for learning has also been accompanied by academic attention to the educational value of games to promote reading engagement [23-26]. The previous examples of serious games targeting specifically the promotion of reading engagement [23-26] have all included and emphasized the importance of motivation, teacher involvement, emotional engagement, and minimizing cognitive overload.

A) Motivation. Engaging in reading, both in serious games and in other media (analogue included), requires the reader to be motivated [21]. This involves, for example, important elements within the text's content, comprehending the text, gaining new knowledge, and social interactions with used knowledge and/or lessons learned from the text [21, 22]. Furthermore, to design a motivating reading experience in a serious game, scholars have already emphasized aspects of intrinsic motivation, such as curiosity, a desire for challenge, and involvement [26, 29–32]. However, the success of a serious game for reading purposes depends on players' motivation to start playing the game and spend their time, effort, and energy. Hence, players' intention to interact with the game is crucial [33]. It is assumed that the experiences of flow [34] and enjoyment [35] are crucial in this process. When players have mastered specific challenges, they develop a greater level of skills that can be used and improved with more complex challenges in other levels or games [7, 8, 29]; this can have a positive influence on intrinsic motivation in serious games [22, 23]. Serious games in a traditional learning context do have the advantage of possible extrinsic motivation from a teacher or learning progression. However, this means that the serious games with its learning content need to invoke motivation at different levels for both the students and the teacher.

B) Teacher involvement. A very important aspect for having a successful serious game promoting reading engagement for a group of high school students is to include the teacher. Scholars have already argued that teachers are key to the success of game-based learning [3, 36, 37] as a tool to motivate students and promote deep learning. Thus, it is important to provide the teachers with the necessary gaming knowledge and skills so the teachers can integrate game-based learning effectively and efficiently in their classes [3, 7, 36, 37]. If the teacher does not find the game-based learning useful, it will not be provided to the students, as the teacher is the crucial gatekeeper. The teacher is also the one who provides the important instructions for the game in a pedagogical approach. The teacher can include game-based learning within their teaching progression and can include the content of the game within specific in-class discussions and learning. An important aspect when designing serious games for improved reading engagement is to include the teacher at an early stage. The teacher can provide valuable evaluative information, insight regarding the students, the specific learning outcomes, and the content, and can serve as the students' gatekeeper for access to information.

C) Cognitive load. Reading engagement in serious games incorporates other forms of engagement. Positive emotions affect the engagement of the reader—either positively (interest) or negatively (boredom). Cognitive load can be part of engagement as a reader exerts his or her mental effort to comprehend the text-based element of a digital game [22]. However, other cognitive activities that distract the reader (media or contextual disturbances) can negatively affect the amount of information the reader can gain or recall [38]. There is a common understanding that the cognitive load is very complex as it also involves interest, motivation, happiness, fun, anger, empathy, tension, anxiety, and other affective states, any of which could affect a gamer's involvement or effort to continue playing [39, 40]. In the creation of a serious game, the designer should consider the cognitive load on players. A learning curve that is too steep regarding either game mechanics or the learning material can quickly cause a severe reduction in player engagement [28, 41, 42].

3   Game Design

The serious game in this case was designed in Unity using C# for Windows, Mac, and Linux. The protagonist in the novella *A Love Story* is Louisa, who lives alone in a very messy apartment. Louisa has schizophrenia with symptoms including hallucinations (hearing voices), delusions, and disorganized thinking. It is a first-person simulation game, as the player should experience the narrative from the protagonist's point of view and be engaged in the story in a 3D environment. The plot of the story and the game are as follows: 1. Introduction (analogue text read): The reader is introduced to Louisa, her life, and her messy apartment. Louisa goes shopping. 2. Game start: After shopping, Louisa locks her door with five chains and goes into a clawfoot tub with very hot water. 3. Louisa recalls her time as a squatter with her ex-boyfriend (named Ole). Louisa receives a letter with income support from municipal social security. She can hear the fruit flies talking. 4. Louisa recalls when a big bumblebee entered her apartment and terrified her so that she had to hide in the bathroom. Since then, she has not let in fresh air (End of the game). 5. End (analogue text read): A neighbor is asking about insect problems in the building. The next day the police and social authorities use force to have Louisa hospitalized (implicitly told).

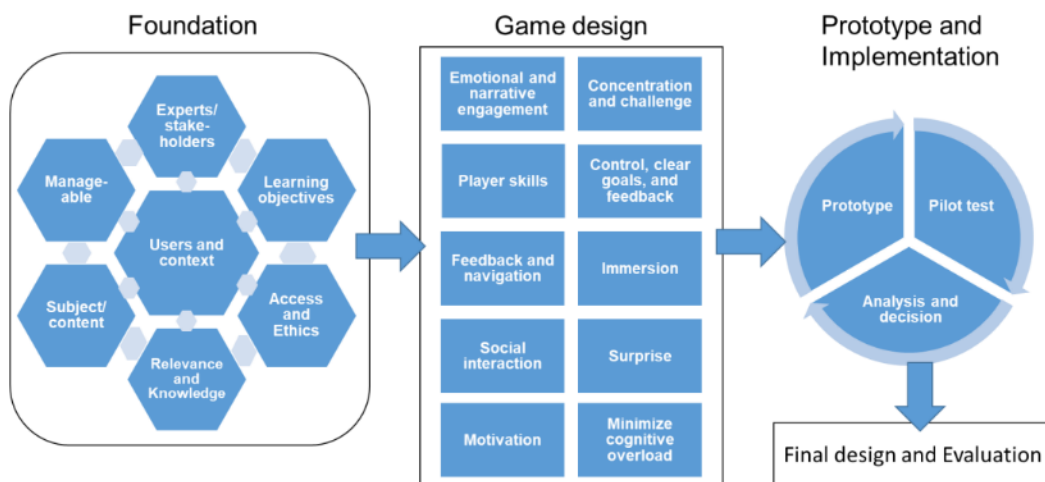The design process of the game is guided by the foundation as outlined in Figure 1.

Figure 1. *Elements in the foundation, game design, prototyping, and implementation*

We used this model outlining the foundation for the creation of the serious game. There are already many approaches with suggestions on how to design serious games for educational purposes [43-47]. In O'Neil et al. [43, pp. 62], there is an example of validity ontology for the process of modeling in-game user behavior. In their model (with included elements from Standards for Education and Psychology), there is also an emphasis on the importance of validity, starting with the definition of users and ending with the interpretation of outcomes and resulting consequences. For the same reason, we have also inserted the users into the center of the foundation and the user evaluation as the endpoint. However, we would like to put emphasis not only on the users, but also on the importance of the context (Figure 1). Before designing the game, important elements to be answered in context include whether the serious game is used at specific times in the learning progression, specific times of the year, used in-class, as homework. This context also includes the dynamic constructs that surround the serious game, taking both time and space into account. As also stated elsewhere in the literature [43], it is important to outline the learning objectives at a very early stage. In this study, this outlining involves the teacher. We mentioned the importance of this involvement in section 2. The teachers (as the experts in

learning) also provide the students with access and could provide relevance and knowledge for this study. The teachers helped to create a fitting a manageable scope, explained the current lack of reading engagement, especially relevant for male students, and settled on a fitting literary work that could be useful for improving reading engagement. Furthermore, the teachers suggested the game to be an experience with the visual representation of the environment from the perspective of the schizophrenic protagonist. For this reason, we also included the mixed perspectives of a clean and messy environment to illustrate the schizophrenic perspective (Figure 2).

Figure 2. *Mixed perspectives to illustrate the schizophrenia perspective*

The teachers mentioned that one of the critical schizophrenia scenes to be illustrated in the game could be the following description in the novella (here shortened): "Once a big bumblebee entered through the window. It was summer. Why was the window kept open? The bumblebee rumbled through the rooms, shouting at her that she was a pig, a dirty sick person with bad taste…she ran out to the bathroom to hide… Since then, she has not let in the fresh air." Surprises are considered an essential factor that influences the effectiveness of serious games in education [5, 56]. As a surprise in the game, we introduced the entrance of a giant bumblebee (Figure 3) with a high buzzing sound, chased the protagonist, and shouted, "you are a pig" (in Danish - du er et svin). The player must hide in the bathroom, as the novella says.

Figure 3. *A surprise in the game by a big bumblebee*

It demanded some considerations regarding how to convert the text passage into the game with still being true to the story, having a surprise, and being realistic to illustrate the perspective of a schizophrenic protagonist.

The game design was developed by inspiration from the principles for player enjoyment in games, suggested by Sweetser and Wyeth [35]. In Table 1 we outline how to transform the principles to specific and applied design elements in the game. We would though like to supplement Sweetser and Wyeth's principle by also adding emotional and narrative engagement, surprise, motivation, and cognitive load.

Table 1. *Game design principles, and how it was implemented*

Game design principle	How it was designed
Emotional and narrative engagement	This was designed by mixed perspectives of clean and messy enviroments to illustrate the schizophrenia perspective (Figure 2 and Figure 3).
Concentration and challenge	To keep the students concentrated, the game was developed with several stimuli from different sources, including a voice over. The students need to complete five challenges/ tasks, in a specific order, to progress and finalize the story and the game. The first task (lock the door with five chains/ sæt kæder på døren) is at the very start of the game (Figure 4), and this quest log is stated in the upper right corner of the screen.
Player skills	The students should be able to start playing the game immediately after a short in-game introduction. A pilot test with 5 participants (students enrolled from another high school) made sure that the game can be played by different skilled players and avoiding anyone getting stocked in the game.
Control, Clear goals, and feedback	The controls (the commonly used WASD) are introduced at the beginning of the game (Figure 4). The visual representation of the WASD controls is shown in the graphical user interface (GUI) when the students start the game. To provide clear goals, the objectives were visible on the screen at all times (Figure 4, upper right corner). To provide feedback, the students always knew how many out of the five tasks they had completed (as in Figure 4, with 0 tasks completed out of 5). If needed, the students could press "Q" for feedback and guidance to continue.
Immersion	The game was designed as 3D environment, to be as realistic as possible. Since the students already have read the beginning of the novella (analogue reading) they have an idea what the environment is. The visual game design tries to match the described environment in the novella (Figure 2-4). The game involved the students by different interactions in the game. These interactions will happen with objects the player moves close to (e.g., a radio) and presses the interact button. The text elements (the readings) in the game were implemented through interactive and digital storytelling elements - for example as letters dropped through the letter slot or included as a diary.
Social Interaction	The game is not a multiplayer game, but there are intended lots of social interactions as in-class discussions about the story – and the game narrative.
Surprise	In the novella's narrative plot, we use a surprise with a sudden entrance of a giant bumblebee with a high buzzing sound (Figure 3).
Motivation	A very dramatic face (inspired by the Scream, the painting and famous composition by the Norwegian artist Edvard Munch in 1893) should quickly grab the students' attention. The initial game title 'Skizo' was also made to motivate students to play the game. However, the game title was later changed to 'A love story' to better reflect the main learning objective, which was to provide an example of postmodernism from the author Naja Marie Aidt.
Minimize cognitive over-load	Cognitive overload is avoided by presenting the controls through a tutorial at the beginning of the game (Figure 4) and by using these controls throughout the game. The pace of the game is slow and interactions are made clear through an instruction overlay. Further, the voice over also helped to guide and overcome the reading.

Figure 4. *The tasks and controls are introduced*

4   Methods

4.1   Participants

The participants are students from a Danish high school and are all the age of 17 or 18. One class functioned as a control group for the evaluation, provided with the written novella and evaluation criteria, but without playing the game (only analogue novella read). The control group consisted of a class with 11 students (7 male and 4 female). The other class (experimental group) consisted of 31 students (20 males and 11 female). Both classes have natural science as their major (the students specialize in math, chemistry, physics, and biology). All participants gave informed consent and were informed that they could withdraw from the study at any time and their participation does not influence their grade. In addition, all participants are given anonymized ID numbers, and all data are labeled with these IDs. We applied special considerations when recruiting teenagers, in accordance with Danish data law, the international code of conduct and ethical approval from the high schools.

4.2   Procedure

An important focus of this study is to involve the teachers who teaches the students about *A Love Story*. This is done by following a participatory design approach [48] in which the end-users includes both teachers and students, also within a substantial work of pilot testing. The pilot testing was made with five students outside the experimental- and control group. The teachers serve as gatekeepers who facilitated and controlled the reading process in areas such as the curriculum's aims, focus, knowledge, skills, and analysis. Therefore, the teachers are involved as co-designers very early in the process.

This study uses a mixed method approach consisting of both a questionnaire and interviews. The questionnaire was inspired by three items from the Reading Engagement Index [20], followed by five items from the User Engagement Scale - short form [49], and lastly two items from the narrative engagement scale [50]. The questionnaire consisted of in total ten items on a 5-point Likert scale. The interviews followed a semi structured interview guide; and six students and two teachers were interviewed. The students for interview were all from the experimental group and were selected by students' interest for participating in the

interview, and by quota sampling for having an equal distribution of females (ID 1, 2, 4) and males (ID 3, 5, 6). The interviews were performed using in-depth interviews [51] with the following seven themes in the interview guide: Aesthetics, Generic game, Involvement, Focus attention, Novelty, Usability, The schizophrenic perspective,

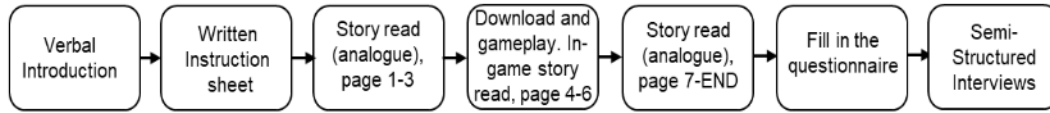The experimental group followed the procedure as outlined in Figure 5.

Figure 5. *The procedure for the experimental group*

The control group included in this study is from a class at high school A, following the procedure as outlined in Figure 6.

Figure 6. *The procedure for the control group*

4.3   Data analysis

Researchers analyzed the questionnaires using cumulative frequency and the non-parametric Mann-Whitney U Test. The Mann-Whitney U Test was used to find out if there was a significant difference ($p \leq 0.05$) between the control and experimental group. The interviews are analyzed by traditional coding [51] following four steps: organizing, recognizing, coding, and interpretation. The interviews are transcribed verbatim to be organized and prepared for data analysis. Two independent researchers then coded and labelled the data in categories/subcategories, followed by content analysis and interpretation [51].

5   Findings

5.1   The quantitative findings

As revealed in Table 2, the perceived reading engagement is significantly ($p=0.0001$) higher in the experimental group than in the control group (Mean difference: 0.51, SD difference: 0.26). Especially item 3.1 (The time I spent reading the novella just slipped away), 3.2 (I was absorbed in the novella), 3.4 (My experience reading the novella was rewarding), and 3.5 (I felt interested in the novella) scored higher in favor of the experimental gaming group. Item 3.1. is with the highest mean difference (0.90) and item 3.4 with the second highest mean difference (0.74). Looking only at the rewarding items (3.4 and 3.5) there is significant difference between the two groups ($p=0.0090$) in favor of the experimental group. The items in the narrative engagement included the following questions: There were times where I did not understand the story, and I had difficulties following the plot in the story (Table 2). There was a lower score ($p=0.7830$), for the experimental gaming group in the narrative engagement (SD: 1.10) compared to the non-gaming control group (SD: 0.67) (Table 2). There was found some differences in the reading index ($p=0.0473$), especially for item 1.2 (I get easily distracted while reading) with a 0.56 mean difference between the control group and experimental group.

Table 2. Quantitative findings. Con=Control group. Exp=Experimental group

1 = Strongly Disagree. 2 = Disagree. 3 = Neutral. 4 = Agree. 5 = Strongly agree	Con/ Exp	1	2	3	4	5	Total	Mean	Mean Diff	SD Con	SD Exp	SD Diff	p-value
1. Reading index									0.49	1.23	1.11	0.12	0.0473
1.1 I read often for leisure	Con	0	3	4	2	2	11	3.27					
	Exp	0	6	15	5	5	31	3.29	0.02				
1.2 I get easily distracted while reading	Con	2	4	2	1	2	11	2.73					
	Exp	1	9	5	12	4	31	3.29	0.56				
1.3 I am good at reading	Con	1	2	2	3	3	11	3.45					
	Exp	2	3	10	14	2	31	3.35	0.10				
2. Narrative engagement									0.09	0.67	1.10	0.43	0.7830
2.1 There was times where I did not understand the story	Con	0	4	7	0	0	11	2.64					
	Exp	6	7	9	9	0	31	2.68	0.04				
2.2 I had difficulties following the plot in the story	Con	1	5	4	1	0	11	2.45					
	Exp	5	12	6	7	1	31	2.58	0.13				
3. Perceived reading experience									0.51	0.67	0.93	0.26	0.0001
3.1 The time I spent reading the novella just slipped away	Con	1	4	3	3	0	11	2.73					
	Exp	0	3	9	15	4	31	3.65	0.90				
3.2 I was absorbed in reading the novella	Con	1	3	4	2	1	11	2.91					
	Exp	2	1	12	13	3	31	3.45	0.54				
3.3 I was frustrated meanwhile reading the novella	Con	0	2	3	6	0	11	3.36					
	Exp	2	7	13	8	1	31	2.97	0.39				
3.4 My experience reading the novella was rewarding	Con	1	5	4	1	0	11	2.45					
	Exp	1	4	15	10	1	31	3.19	0.74				
3.5 I felt interested in the novella	Con	0	5	1	4	1	11	3.09					
	Exp	0	3	10	16	2	31	3.55	0.46				

5.2   The qualitative findings

Interviews reveals that most participants are very satisfied with the game. The coded interviews (Figure 7) reveal four themes: controls, the story world, the reading engagement, and challenge/skills. The content analysis (Figure 7) reveals that most of the positive comments concerns reading engagement (30 positive/ 3 negative), but they also positively address the match between challenge and skills (20 positive/ 6 negative)), and the story world (10 positive / 6 negative).
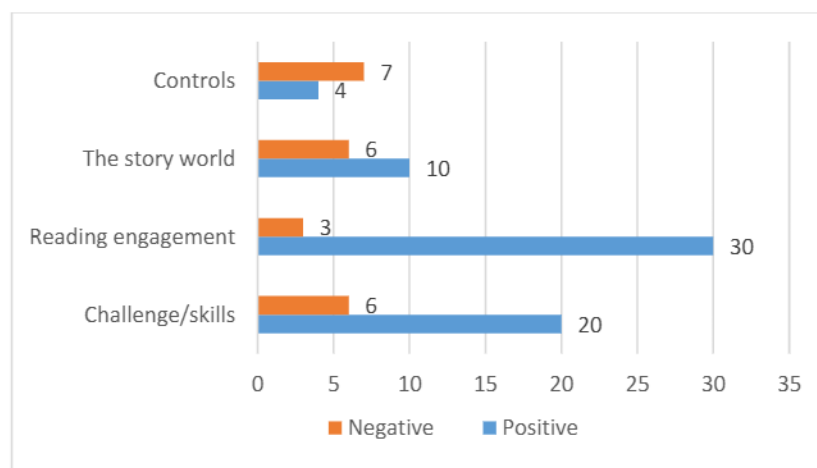

Figure 7. *Content analysis of coded interview statements*

No participants express any hindrance in progressing in the game, and only a few (especially the more experienced gamers) feels that the in-game quests should be more challenging. All participants express their excitement about the game experience, and several states that it exceeded their expectations. Many participants express that they paid

more attention to the details of the story when experiencing it through the game rather than the analog text reading. The most frequent critical comments concern the controls (Figure 7); these includes minor bugs and complaints that the mouse is too sensitive. In Table 3 we outline examples of quotes (students' perspective) as the foundation for the coded content analysis (Figure 7). It is interesting that, within the story world, some participants find the game too scary, but also realistic and creative (Table 3).

Table 3. *Examples of interview quotes (students' viewpoints)*

	Positive	**Negative**
Challenge/ Skills	The quests were good and should not be more difficult (ID3: Male). I like the simplicity of the game (ID1: Male). The quests match the format (ID5: Male).	It could have been much more difficult e.g. making completing the quests more complicated (ID6: Male).
Reading engagement	I liked reading the letters (ID1: Female). I can actually recall what I read (ID5: Male). I would love to do more reading like this (ID3: Male). It made me understand the story much better (ID2: Female). Great supplement to the book read (ID5: Male). Would like to read the ending after the game (ID2: Female). Would for sure recommend this game as supplement to in-class readings (ID 3: Male). It makes the reading much more exciting (ID2: Female).	I did not pay much attention to reading the novella nor the letters in game (ID2: Female). Did not feel like reading the text in the game (ID2: Female).
The story world	Awesome, Pretty and fun (ID 1 Female). Realistic and creative (ID2: Female). I was positively surprised (ID 2 Female). I got a shock with the bee, well done (ID4: Female).	A bit too scary for me (ID2: Female). The in-game story should be longer (ID5: Male). The bee was a bit strange (ID4: Female).
Controls	No problems of controls, it was perfect (ID 1 Female). Very straightforward and well known (ID3: Male). I had control (ID2: Female).	The mouse was too sensitive (ID4: Female). Shift and space did not respond as expected (ID3: Male).

The interview with the teachers revealed positive comments about using the game in Danish Literature classes. However, their main concern was some details in the game that could take away the opportunity to interpret the story by the students themselves.

The game also provides the interpretation of the story by the game designer, which you can freely do, but it gives some clues to the students, which I would not normally do… Games can do something different than the analogue text. The difference is that when you read a story, everything takes place inside your mind, and you must create the images inside your head. However, when you play a game, someone else interprets the scenery for you (Teacher 2).

It can't do the same because old stories can appeal to the students to create their conception, how it looks, what the characters are like, how those descriptions are just

words, so when you re-mediate the narrative, you serve these interpretations which the text itself allows the reader to create. Still, when you see the visual scenery, you are done with how the apartment looks, and it excludes your fantasy (Teacher 1).

6   Discussion

It is interesting that the reading index is higher in the control group but is at the same time less engaged than the experimental group. As reading index questions related to self-reported reading skill and frequency of leisure reading this indicates that the control group both reads slightly more and is better at it.

The lower score in narrative engagement for the experimental gaming group remains unclear. It might be explained by the way the questions from the narrative engagement scale are translated into Danish. Possible explanations can also be within common desires to know how the story is going to unfold [33] (digital or not), with common curiosity, suspense, excitement, and involvement in the story and character [20, 35]. It is a well-told novella with some embedded emotions (both positive and negative) for the protagonist with schizophrenia. The included masturbation descriptions in the analogue story might also have an impact for the narrative engagement, especially taken the participants' ages into account. There were interesting discussions for the game design, whether we should implement the descriptions of the masturbation scenes in the game or not. However, for ethical reasons we decided to include these sensitive descriptions much more implicit in the game, as in contrast to the original text.

Regarding narrative engagement and understanding the plot of the story it is worth mentioning that when reading analog, it is easier to go back and read parts of the story that are difficult multiple times. Due the voice over and the visual effects it is not as easy to go back and repeat parts of the story in the game. This difference could negatively affect the understanding of the story and plot for the experimental group in the game.

From the qualitative findings it seems that using games as an element of generating positive interest in reading has potential. The positive interest might be explained by the complex use of multiple modes, 3D environments, and specific interactions that a game provides in contrast to an analog story. This positive interest is also reflected in participants' answers about whether the reading experience was rewarding.

A factor that could play a big role in an experiment such as this one and is important not to neglect is the novelty effect as a source of bias. Reading via serious gaming might also have led to decreased interest and declined reward perception if it was already a common practice for reading mandatory texts. This finding might simply be a response to analog reading as a routinized stimulus: the game may have easily built positive interest and perceived reward due to its novelty. We found it very important not to exclusively offer either analog reading or reading through gaming. The two media should complement each other (along with other learning styles) to change and adapt in the face of novel effects. However, they should also grant students and players opportunities to learn and read in different ways by using and providing various skills and competences.

Among the pre-requisites for successful collaborative planning with teachers, it is needed to create a common language, but also to make a good onboarding, which could include visualization of game ideas; the story ideas; and clear roles. The teachers are the experts in teaching the subject, we are the experts in games. The teachers emphasized the importance of being professional and providing the game environment with considerations, as it controls the perceptions. It is important to remember that serious games also work with messages and provide specific perceptions and interpretations based on their design and textual messages. This means, that the elements in the game, also controls how the students perceive the environment and the characters.

7 Conclusion

In this study, we implemented the novella *A Love Story* in Danish Literature classes (for high school students) using a transmedia storytelling approach by supplementing the analog text reading with readings and storytelling delivered via a serious game. The results revealed a significantly higher perceived reading engagement for the students in the experimental groups, reading parts of the novella by playing the game, than the control group not playing the game as part of the reading. Further, in the interviews, all participants stated that they could see the potential benefits of supplementing analog text reading with a serious game to improve reading engagement. However, some participants suggested that the reading elements, rather than the completion of specific quests, should receive more attention in the game. Both this study and previous research identified positive effects of serious games used to supplement and improve reading engagement, but this approach also faces some barriers. The main barrier is uncertainty regarding how to develop a successful serious game that engages students and fulfills specific learning objectives in a curriculum. These objectives need to be very clear from the beginning during the research design and game design processes. It is vital to know what the game is intended to achieve and specifically how it can supplement the text reading. It is also crucial to involve the teachers in the design process. Although we followed the methods of the participatory design approach, it was difficult to include the teachers at the applied level of improved matching between the text and game. The problem could be that we, as game researchers and designers, did not explain the foundation, framework, opportunities, and game design limitations clearly enough.

The story in the game was well told, and the learning outcome was achieved through increased engagement. However, future work is needed to create significant evidence of and insight into regarding students' reading engagement via transmedia storytelling. First, researchers need to include a much larger number of students from classes across various high schools during the data collection process. Second, they need to collect additional identifying details about the readers, including their reading confidence levels. Third, there is a need for longitudinal studies that include well-defined data obtained through repeated measurements over time. Fourth, there is also a need for improved study designs that include comparable experimental and control groups. One of the strengths of this experimental study is its included experimental and control groups. However, in practice, it was difficult to match classes in terms of number of students in the classes, level, and curriculum progression. In the literature [52-55], there are various examples of how to evaluate serious games. However, when performing evaluations in very specific contexts with real users, it can be difficult to conduct a perfect research evaluation. Logistics, time constraints, gatekeepers, legislation, lack of a proper post-test, technical issues, and resources can be barriers that prevent perfect evaluations. In addition, randomization is often impractical for evaluating serious game in a fieldwork context. It could also be unethical to randomize students in the same class, with some playing the game, and some not; this should also be avoided because of the potential learning effects.

The inclusion of serious games is still both diverse in its outcomes and understudied as a transmedia subject for increased reading engagement. Future studies should be focused on designing various game options to accommodate diverse students and reader types. There is also a need for further validtaed approaches with suggestions on how to design serious games for educational purposes that provided improved learning outcomes.

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