Why Story Matters: A Review of Narrative in Serious Games

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Abstract
Literature has shown that immersive learning environments such as digital edu-
cational games and simulations often incorporate storytelling elements in their
designs as narrative can be an effective way of making learning more meaningful
to students. The purpose of this study is to review the literature on the role
narrative can play in the experience of a learner engaging in learning games and to
synthesize research on features of story that have demonstrated success in
these learning environments. The findings have shown that distributed narrative,
intrinsically integrated fantasies, empathetic characters and virtual agents, and
adaptiveness or responsivity are four characteristics of game narratives found
to be effective. Several learning game analyses were performed to illustrate
how these games used narrative to foster greater immersion, engagement,
motivation, and learning. Finally, a narrative design strategy for serious games is
suggested which integrates the effective narrative features as shown in the exam-
ple games, along with two analysis frameworks, Game Discourse Analysis and
Narrative Centered Informant Design. The findings of this study should provide
much-needed insights to designers and researchers who are involved in creating
immersive learning environments.

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Introduction and Relevant Literature

Every civilization throughout history has at some point relied on storytelling to understand and express their human experience (Krawczyk & Novak, 2006). Some educational theorists believe that narrative is the primary method by which we organize our interpretations of reality (Bruner, 1991). In the words of Dickey (2011), *Narrative structure is a pervasive part of human cognition; it is the means by which humans frame and recount daily experiences* (p. 456). For this reason, it is only natural that learning and narrative go hand in hand. Stories are easy to follow, and they are comprehensible because they introduce events in a familiar manner (Negrete & Lartigue, 2004). Curriculum can even be viewed as a kind of narrative itself, with teachers as the storytellers communicating pedagogical content knowledge to students (Gudmundsdottir, 1991). Narrative is often used as a design feature by designers of immersive learning environments to make the systems effective.

Serious games, as an example of immersive learning environments, are digital games designed to achieve ends beyond entertainment alone (Susi, Johannesson, & Backlund, 2007) and used for educational purposes (Djaouti, Alvarez, Jessel, & Rampnoux, 2011; Rieber, 1996). They offer an alternative medium for teaching and learning that can help students build traditional and digital competencies (Gros, 2007). Games can immerse learners in complex situations involving ill-defined problems with multiple solutions (Westera, Nadolski, Hummel, & Wopereis, 2008). A study on games in education has shown evidence that they can help students develop skills as varied as personal and social abilities, language and literacy, mathematical skills, creativity, knowledge and understanding of the world, and physical development (McFarlane, Sparrowhawk, & Heald, 2002). Serious games have the potential to be a strong learning tool; however, they must be well-designed and take into account both pedagogic goals and an understanding of game design (Kenny & Gunter, 2007). In contrast to entertainment games, serious games include the goal of delivering learning content to the player, and this essential purpose should be considered at every stage of design and development (Mildner & Mueller, 2016).

Central to the discussion of narrative within the educational sphere is the meaning with which it is thought to endow learning. *Meaning* is a term that is used liberally across educational literature. While cognitivism encourages meaningful information structures within memory and constructivism prioritizes individual meaning-making, both learning theories deem meaningfulness a necessary prerequisite for lasting learning to occur (Ertmer & Newby, 1993). Drawing from cognitive science and constructivist learning theory, Hirsh-Pasek et al. and colleagues (2015) identified four fundamental pillars of learning environments: active, engaged, meaningful, and socially interactive. *Meaningful* referred to learning that is purposeful and that holds personal relevance to the learner. These four pillars are crtical in order to make a learning environment or an educational product successful.

According to Barab, Sadler, Heiselt, Hickey, and Zuiker (2007), *the content of narrative is self-evidently appealing: we lose interest in a world without story* (p. 61). Narratives such as novels, comics, plays, and other stories hold the potential for making science more meaningful to students (Negrete & Lartigue, 2004). From a cognitive science perspective, narratives maintain the attention of the reader because they are less authoritative, and they leave room for freedom of interpretation and negotiation of meaning. Other scholars have posited that science education can be made more meaningful through narratives that humanize it and contextualize it through connections to technology and society at large (Barab et al., 2007). Narrative's facilitation of meaning-making could also make it a valuable tool within the framework of discovery learning (Rowe, McQuiggan, Mott, & Lester, 2007).

Digital game narratives, including those in serious games, are diverse and numerous, ranging from realistic everyday contexts (e.g., Barab et al., 2007) to those that take place in fantasy worlds and spaces (e.g., Parker & Lepper, 1992). Importantly, game stories are set apart from narratives in other media in that they are more interactive, less fixed, and frequently controlled by the player (Qin, Rau, & Salvendy, 2009). In the commercial games industry, teams of professionals such as game writers and narrative designers are tasked with applying dramatic writing principles to interactive virtual experiences (Krawczyk & Novak, 2006). However, there is currently a lack of sufficient research connecting narrative and learning in the context of serious games. The goal of this study is, therefore, to review relevant literature so as to shed light on narrative design of serious games to enhance the immersion, engagement, motivation, and learning gains of those who play them.

The following two research questions guided this review:

- In what ways can narrative impact the experience of a learner in a serious game?
- What narrative features have been associated with immersion, engagement, motivation, and positive learning outcomes in a serious game?

Method

This literature review used the analysis framework by Hart (1999) and examined empirical educational and technological research, including quantitative, qualitative, mixed-methods, and design-based studies. In the following, we present relevant findings on the ways in which narrative can help shape the learner experience in serious games. We then examine some of the narrative features and storytelling elements that have demonstrated success with game users.

Data Source and Analysis

The focus of this review is digital game narratives used in games for educational purposes. Two steps were used for the selection of appropriate articles. First, Google Scholar, along with the databases Springer, The ACM Digital Library, ResearchGate, ScienceDirect, APA PsycNET, and the university online database were utilized to conduct a search. The key words used in the search included *narrative*, *story*, *serious games*, and *interactive learning environments*, and a combination of them. Other search terms such as *narrative-centered learning environments* and *virtual agents* emerged from the literature and led to additional articles. The references of the found articles provided another venue to locate studies. About 44 papers of interest were found.

In the next phase of the selection process, abstracts of the articles collected in the first phase were evaluated for their applicability to the focus of the review. The selection criteria used here were as follows: (a) Research in which quantitative, qualitative, mixed-methods, or design-based data were collected; (b) research with pertinence to educational technology or other closely related fields; and (c) research with a strong connection to some aspect of narrative. The selection focused on peer-reviewed journals but also included conference or workshop proceedings to contain as many relevant studies as possible. Details of studies were compiled in an annotated bibliography and grouped by the methodology they employed. During this process, articles that did not meet the aforementioned criteria were excluded. As a result, a total of 26 empirical studies remained for analysis. The selected studies are interdisciplinary from different fields, including educational technology, psychology and the learning sciences, instructional design, human–computer interaction, information and communication technology, cyberpsychology, and artificial intelligence (AI). Table 1 and Table 2 present the journals and conference proceedings where these studies appeared.

To address the research questions, the findings of each study were analyzed. Thematic analysis was used to locate themes and patterns within the data and to sort them into categories corresponding to the two research questions they answered. The first author coded each study to identify the themes and patterns which were reviewed by the second author to ensure the trustworthiness of the coding process.

Findings and Discussion

The Role of Narrative in Serious Games

In what ways can narrative impact the experience of a learner in a serious game? The research reviewed in this study explores the experiential impact of serious game narratives across four dimensions: immersion, engagement, motivation, and learning gains. That is, technologically mediated experiences should

Table 1. List of Journals Included in This Literature Review, in Order of Frequency.

Journal name	Number of articles
Journal of Computer Assisted Learning	2
Journal of Personality and Social Psychology	2
Intl. Journal of Human–Computer Interaction	1
Cyberpsychology & Behavior	1
Computers & Education	1
British Journal of Educational Technology	1
Interacting With Computers	1
International Journal of Continuing Engineering Education and Life Long Learning	1
ACM SIGCSE Bulletin	1
International Journal of Artificial Intelligence in Education	1
Journal of Science Education and Technology	1
The Journal of the Learning Sciences	1
Games for Health: Research, Development, and Clinical Applications	1
Journal of Health Communication	1
International Journal of Human–Computer Studies	1

Table 2. List of Conference Proceedings Included in This Literature Review, in Order of Frequency.

Conference or workshop	Number of articles
International Conference on Intelligent Tutoring Systems	2
Proceedings of the SIGCHI Conference on Human Factors in Computing Systems	2
AIIDE	1
Proceedings of the Third International Joint Conference on Autonomous Agents and Multiagent Systems—Volume 1	1
International Workshop on Intelligent Virtual Agents	1
Proceedings of the Workshop on Narrative Learning Environments, AIED	1
Proceedings of the Workshop on Intelligent Educational Games at the 14th International Conference on Artificial Intelligence in Education	1

Note. AIIDE = Artificial Intelligence and Interactive Digital Entertainment; SIGCHI = Special Interest Group on Computer–Human Interaction; AIED = Artificial Intelligence in Education.

be designed to be positive, providing fulfillment and a sense of being valuable and worthwhile (Hassenzahl, 2010).

Narrative and immersion. One element of games that has appealed to players across time is the idea of getting lost in the game world. This experience of time loss and disconnecting from the real world is referred to as *immersion*, but a clear understanding of this variable does not yet exist in the research (Jennett et al., 2008). Flow, cognitive absorption, and presence are three components thought to make up immersion (Jennett et al., 2008; Qin et al., 2009). Most relevant to game narrative research is the concept of presence. Presence is commonly understood as the perception of being transported into a virtual environment (VE; McQuiggan, Rowe, & Lester, 2008) and experiencing the VE rather than one's physical location (Witmer & Singer, 1998).

How can a narrative help to immerse a player in the game environment? According to a cyberpsychology study by Wood, Griffiths, and Parke (2007), time loss is common in video games, with 99% of respondents ($N = 280$) stating they had lost track of time while playing a game. In this online survey, plot-driven stories were one characteristic frequently linked with time loss in games. For example, one participant felt most absorbed playing games with *strategic components that contribute to a narrative*, explaining further: *I get caught up because I want to solve the current problem in order to find out more of the storyline and explore a new environment* (p. 41). These qualitative findings suggested that video game players believed story elements have made an impact on their experience of immersion in the games they play.

While some researchers have framed immersion in a game as time loss, others have looked at its subcomponents such as the aforementioned construct, presence.

Notably, a quantitative study of Crystal Island demonstrated a significant effect of narrative on student presence in the game environment (McQuiggan, Rowe, Lee, & Lester, 2008). Crystal Island is an inquiry-based learning environment centering around a science mystery related to microbiology and genetics. In this experiment, the entire eighth-grade population of a middle school in North Carolina was assigned to groups. The narrative condition group played the complete Crystal Island game containing a positioning scenario and characters with rich personalities and backstories, while the minimal-narrative condition group played the same game stripped down to only the most basic narrative to support the curriculum. Students' reported presence in the story world of Crystal Island was significantly higher in the narrative condition than in the minimal-narrative condition. Presence was measured using the Presence Questionnaire (Witmer & Singer, 1998), which contains subscales of involvement/control, naturalism of experience, and quality of interface. These results implied that having a presence in a serious game can positively impact the immersiveness of the player experience.

In addition to effects of narratives on immersion, the immersive qualities of narrative have also been found to influence beliefs and attitudes about subject matter. In communication theory, *transportation* or immersion into narrative worlds (Green, Brock, & Kaufman, 2004, p. 311) refers to a media consumer's experience of cognitive, emotional, and visual absorption in a narrative and its characters. A series of social psychology studies by Green and Brock (2000) revealed that participants with a higher level of transportation (as measured on the transportation scale they developed and evaluated) held more favorable attitudes toward protagonists and the overall persuasiveness of the narrative. Such findings suggested that narratives can play a role in how immersed players feel in a VE, and conversely, that immersion can impact how users react to a game narrative.

Narrative and engagement. Engagement can be behavioral, emotional, or cognitive; it refers to a user's interest in a task and their attention on it (Hirsh-Pasek et al., 2015). There is some overlap between the concepts of immersion and engagement in that in some research, flow is thought to be an aspect of engagement rather than immersion (Rowe, Shores, Mott, & Lester, 2011). However, while immersion is generally considered an experience of transportation and time loss in a VE (Jennett et al., 2008; Qin et al., 2009), engagement more often refers to enjoyment of a user experience (Hallinen, Walker, Wylie, Ogan, & Jones, 2009; Waraich & Brna, 2008). In other words, games could be immersive, pulling the user into the game world, which causes it to be engaging for students. Researchers in the field of educational technology have shown interest in how gamification and serious games can augment engagement in the learning experience. Game-based learning has been associated with increased engagement across a variety of different topics using different devices (Annetta, Minogue, Holmes, & Cheng, 2009; Huizenga, Admiraal, Akkerman, & Dam, 2009). However, the majority of these studies compared learning in serious games with regular project-based instruction and did not specifically look at the role narrative may have played in contributing to this student engagement.

A study by Hallinen et al. (2009) shed some light on this area. Their study looked at the addition of game and narrative elements to an intelligent tutoring system designed for teaching French language. In the narrative game environment, students played the part of a journalist editing newspaper articles and choosing the correct forms of verbs. Researchers also inserted game elements such as time pressure, levels, and points. Students expressed significantly more engagement (ratings on *engaging*, *enjoyable*, and *easy to use*) in the game condition than in the nongame condition. A key limitation of this study was that narrative and game elements were not separated for comparison but considered together in one version of the intelligent tutoring system compared with traditional computerized instruction. While it is difficult to extricate narrative from gamification here in drawing conclusions, it seems that narrative provided

a meaningful structure in the concept of the journalist's office, without which gamification could not have been easily applied.

Curiosity is another term often used to refer to engagement. A qualitative case study by Dickey (2011) examined how adventure-styled narrative fostered argumentation writing through curiosity in a game-based learning environment called Murder on Grimm Isle. Within this narrative, students investigated a crime by gathering evidence and determining the culprit. Data from observations of in-game and in-person student interaction, questionnaires about the use of the game, and informal interviews intimated that the storyline enhanced participants' curiosity and sustained it throughout the narrative. Curiosity and engagement in a serious game were also elicited in students using the narrative technique of Game Discourse Analysis (GDA) in a study at a university in the Netherlands (Wouters, Van Oostendorp, Boonekamp, & Van der Spek, 2011). GDA functions by implementing foreshadowing and backstory, thereby manipulating the flow of information to encourage curiosity about what will happen next in a story. Here, GDA was employed in the serious game, ReMission, in which players travel through the bodies of cancer patients to fight disease and infection. The use of GDA was associated with greater self-reported curiosity. An experiment by Park, Lee, Jin, and Kang (2010) showed similar findings: Players who had been exposed to a pregame story about the main character rated their enjoyment of the game significantly higher than those who had not. Interestingly, evaluation of the game was mediated by presence, suggesting another relationship between immersion and engagement.

Narrative and motivation. The literature reviewed also revealed a relationship between serious game narratives and motivation to learn. Motivation—and particularly, intrinsic motivation and extrinsic motivation—is a frequently discussed topic in educational research. While extrinsic motivation is associated with an external reward that drives behavior, intrinsic motivation arises out of inherent interest in a task for its own sake. Motivation is essential in a technology-based learning environment because often learners will not use software that does not capture their attention (Rowe et al., 2007).

In a classic study, Lepper and Malone (1987) outlined their taxonomy of intrinsic motivators toward learning with computer games: challenge, curiosity, control, and fantasy. One study of Crystal Island researched student motivation in the game using the work of Lepper and Malone (1987) as a launching pad, seeking to determine how narrative might impact 14 American eighth-grade students' motivation to play (Rowe et al., 2007). In this inquiry-based learning environment, the player explores a research outpost on a volcanic island and solves a science-themed mystery as members of the research team begin to fall ill. Ultimately, the player wins the game by collecting scientific data and deducing the cause of the disease. Crystal Island employs Lepper and Malone's (1987) four factors in the hopes of increasing student motivation, and both focus group

and individual interviews revealed that students found these narrative elements motivating. For example, they were motivated by the *curiosity* of conflict and red herrings. They preferred the *control* in interactive scenarios to nonplayable cutscenes. Through *fantasy*, they were motivated to engage in richer conversations and develop relationships with characters. Finally, many students expressed feeling motivated by the *challenge* of minigames that tested their ability. Although this study was limited by its exclusive focus on Lepper and Malone's (1987) taxonomy, students' commentary did suggest that narrative in Crystal Island motivated them intrinsically across these dimensions.

Fantasy narratives in particular have been found to increase the student motivation in some cases. Although games have changed greatly in the last 20 years, a classic psychology study found that fantasy in computer-based instruction positively impacted their motivation (Parker & Lepper, 1992). Researchers compared four different versions of an educational computer-based activity designed to teach third and fourth graders the basics of the Logo programming language. The control condition presented problems using basic drawings and geometric shapes, while the fantasy versions applied three different narratives: pirates, detectives, or astronauts. Students expressed significantly more interest ($p < .001$) in the fantasy versions than the control, and they were also significantly more likely to choose to play the three fantasy versions of the activity. The narrative embellishments Parker and Lepper (1992) added were subtle, supporting the idea that plots need not be high concept to engender intrinsic motivation in learners.

A narrative designed by learners themselves was found to enhance the student motivation in a multimedia-rich interactive learning environment (ILE) called the Binary Arithmetic Tutor (BAT; Waraich & Brna, 2008). Here, researchers applied the Narrative Centered Informant Design (NCID) framework, directly involving the users in writing plot points and characters to heighten the motivation of students who found the subject of computer architecture dry and difficult to approach. The majority of the students using BAT reported that they enjoyed it and attributed their motivation to the story.

According to the findings of these studies, serious game narratives can motivate students through intrinsic motivators such as *curiosity* and *challenge*. Students may also be more interested in games with fantasy stories (Parker & Lepper, 1992) and as a result more motivated to learn. Motivation could possibly be highest when learners select narratives themselves.

Narrative and learning gains. Research discussed earlier indicated that narrative can make the learner experience in a serious game richer by way of immersion, engagement, and motivation. However, as Parker and Lepper (1992) speculated, *What difference, then, does it make if learning is more fun?* (p. 628). Studies showed evidence suggesting that the existence of narrative may be associated with greater learning outcomes in serious games. For example, Parker and Lepper (1992) examined motivation using fantasy stories and learning Logo.

On both an immediate test and a retention test, third graders in fantasy conditions exhibited significantly greater learning gains than in a no-fantasy condition ($p < .05$). A significant difference appeared in the delayed test as well. It appears that a fantasy narrative alone made a marked impact on student learning in this serious game. In Waraich's (2004) evaluation of the ILE for teaching computer architecture in higher education, both pre- and posttest results indicated that unlike comparison groups, students who were exposed the narrative-rich ILE called BAT improved their scores. These two sets of findings suggested that serious games with prominent narratives could offer learning benefits across multiple age groups and experience levels.

Rowe et al. (2011) also examined whether engagement in a narrative-centered learning environment would be associated with learning. A group of middle-school students ($N = 153$) played the Crystal Island game for teaching microbiology. Overall, student engagement was strongly linked to greater learning gains and problem-solving in the game. All three measures of engagement (presence, situational interest, and final game score) were significantly related with posttest score when controlling for background knowledge in microbiology. These results challenged the belief that engagement and learning gains in a serious game are at odds (Mayer & Johnson, 2010).

Research on serious games Murder on Grimm Isle and Quest Atlantis illuminated to some extent the process by which the immersion, engagement, and motivation generated by narrative in serious games may impact learning. Dickey (2011) observed how engaging with a murder mystery in the adventure game Murder on Grimm Isle translated into argumentative writing skills in her students. According to Dickey, transfer of game-based experiences into prewriting may have been achieved through the engagement and motivation afforded by the mystery narrative. The results of Barab et al.'s (2007) study of Quest Atlantis using both naturalistic inquiry and outcome measures also implied that the narrative in this serious game helped students learn. The storyline in this Quest Atlantis unit centered on an environmental problem occurring in Taiga Park, a decline in the fish population with several key stakeholders. After engaging with the narrative, all students in a fourth-grade gifted class appeared to balance economic and ecological issues and acknowledged the complexity and nuance of the situation at hand. Outcome measures substantiated that student learning took place as well in that the class mean on the pretest was 1.7, and the mean on the posttest was 4.0, a statistically significant change ($p < .001$). Considered holistically, the results of these studies using quantitative, qualitative, and mixed methods suggest that immersion, engagement, and motivation may be mediating variables that bolster this effect.

Features of Effective Game Narratives

Research has shown the important role narratives can play in serious games to promote learning. In this section, we discuss the findings from the literature on

what narrative features have been associated with immersion, engagement, motivation, and positive learning outcomes in a serious game.

Distributed narrative. A collective theme from the serious games discussed earlier is that narrative is not located in one place but rather is distributed across the ILE through environmental storytelling. In Crystal Island, bits of the story can be pieced together from objects such as posters in the camp buildings or books in the library (Rowe et al., 2011). Similarly, Barab et al. (2007) described how *inscriptions*, such as diagrams, tables, and charts, are used in Quest Atlantis to extend the narrative. For example, a handwritten scroll is left on the ground for players to stumble across in the game, and this artifact gave students in their classroom study an opportunity to compare their interpretations of its meaning. Another benefit to inscriptions was that they encouraged students to make connections back to the fictional Taiga population they were studying and the underlying socioscientific narrative. Distributed narratives are an alternative to stories that are presented to the learner solely in one location of a game. Dispersing narrative across multiple channels or formats using inscriptions and artifacts could reduce the cognitive load on students posed by large amounts of reading.

Endogenous fantasy and intrinsic integration. Intrinsic motivation was discussed earlier in this review in relation to serious game narratives. Malone (1981) argued that fantasy supports intrinsic motivation, especially when the fantasy is *intrinsic to gameplay* because it relates more to how a skill might be used in a real-world setting. Analogously, Rieber (1996) explained how fantasy in a learning game could be either *exogenous* or *endogenous* to the content of a game. According to him, exogenous fantasy is frivolous because *any content can be superimposed on top of this fantasy* (p. 50). Endogenous fantasy, by contrast, is more suitable for educational purposes because it weaves pedagogical content together with the fantasy so that one cannot exist without the other. In these types of games, if a student is interested in and motivated by the fantasy, they will consequently be interested in and motivated by the learning content.

Habgood and Ainsworth (2011) adapted Malone's (1981) idea of *intrinsic fantasy* into *intrinsic integration*, emphasizing the key assimilation of pedagogy into the game's fantasy and mechanics. The authors looked at the impact of intrinsic integration of fantasy on students' learning outcomes and their choice of game (a measure of intrinsic motivation) in their math game called Zombie Division. In the intrinsic version of the game, 7- to 11-year-olds mathematically divided opponents in order to defeat them. In the extrinsic version, combat was not related to math, but instead, math multiple choice questions were sprinkled in-between levels. Students who played the intrinsic version showed a significantly greater improvement in math learning. In addition, students spent seven times longer choosing to play it than the extrinsic version ($p < .001$). Braingame

Brian, developed by researchers in the Netherlands for executive function training in children with attention-deficit hyperactivity disorder and cognitive control problems, is another example of effective intrinsic integration (Prins et al., 2013). The narrative of this game is merged seamlessly with the gameplay and learning content, as the main character Brian helps the villagers in his fictional town solve problems by completing training tasks that are disguised as the player inventing machines. In a pilot study of 40 children clinically diagnosed with attention-deficit hyperactivity disorder, those using Braingame Brian significantly improved their symptoms, possibly by way of intrinsic motivation. The results of these studies support both the educational and motivational benefits of intrinsically integrated narratives and gameplay in serious games.

Empathetic characters and virtual agents. While endogenous and intrinsically integrated narratives can bolster the motivation of learners, strong characters can pull the learner into the story by way of immersion. Characters to whom learners relate have potential to influence their attitudes and decisions. For example, experiments by Kotler, Schiffman, and Hanson (2012) revealed that children were more likely to indicate a preference toward a food that their favorite character liked.

In creating characters for serious games, one factor to consider is the empathy of the relationship between the player and the nonplayer characters (Paiva et al., 2004). In 2007, Rowe et al. performed a study of the narrative-centered learning environment Crystal Island in which students expressed a desire for deeper characters with whom they could interact and develop relationships. The following year, McQuiggan et al. (2008) found that empathetic exchanges with characters in Crystal Island positively impacted the player experience. Participants were randomly assigned to control or empathy conditions. In the empathy condition, three game characters asked students how they were feeling and offered empathetic responses. The control condition was exactly the same, except that the characters skipped asking the student about their emotions and proceeded directly to offer exposition. In both middle-school and high-school populations, researchers observed a strong significant effect of empathetic characters on (a) presence ($p < .01$) and (b) involvement and control ($p = .0005$). In addition, students who described themselves as empathetic (high score on the Interpersonal Reactivity Index) reported significantly greater presence when interacting with empathetic characters. Based on these findings, it appears that empathetic characters can improve the player experience in multiple ways. Empathy may be an important aspect of the link between a player and the immersion they experience in a game.

Studies suggest that we interact with virtual agents in much the same way as we interact with real people. In one study of virtual humans (Johnsen, Raij, Stevens, Lind, & Lok, 2007), there was a significant correlation, $r(33) = .49$, $p < .005$, between the way in which medical students interviewed virtual patients

and how they interviewed human actors trained to portray patients. A virtual storytelling environment called FearNot! made use of this human quality of virtual agents by applying it to antibullying education (Aylett, Louchart, Dias, Paiva, & Vala, 2005; Paiva et al., 2004). FearNot! presents a third-person scenario to students in which they can witness emotionally charged bullying events in virtual dramas (Paiva et al., 2004), triggering their empathy toward characters. In FearNot!, the player can offer advice to the characters. To strengthen the empathy in this relationship, characters act autonomously in response to the players' recommendations (Aylett et al., 2005; Paiva et al., 2004). In an initial evaluation of students' perceptions, 86% said that they felt sorry for one of the characters and 72% said that they felt angry at one of the characters (Paiva et al., 2004). It appeared from this survey that virtual agents could indeed be capable of eliciting empathetic responses in players in a learning environment.

The idea of virtual agents as companions to learners has also been raised by researchers. In a study by Ryokai, Vaucelle, and Cassell (2003), a virtual agent named Sam was designed to be a literacy-learning companion to preschoolers. Sam was created with Vygotsky's (1978) zone of proximal development in mind; she speaks in a more advanced form than the child to provide scaffolding. In this study, 28 five-year-old girls played with the virtual character and took turns with her telling stories. Researchers coded the stories children told, looking for instances of particular expressions and patterns of speech. The results showed that playing with Sam had a main effect of $F(3,24) = 68.04$ ($p < .01$) on children's use of quoted speech and spatial and temporal expressions. While the duration of the study was too short to conclude that participants learned these expressions from Sam, it did suggest that this virtual agent may have given children an opportunity to practice more advanced linguistic patterns. In addition, the children reacted positively to Sam and seemed to regard her as a storytelling partner. Not only did a virtual character seem to enhance the student immersion in a learning environment, but she may have also supported learning goals through her social aspects.

Adaptive and responsive storytelling. According to the literature, learners may also be more compelled by stories that are personalized to them. Lepper and Malone's (1987) *control* factor may play a role in why adaptive and responsive narratives are appreciated by game players. Students in a narrative-centered learning environment may feel a heightened sense of agency and freedom when their decisions impact the outcome of the narrative (Rowe et al., 2007). Mateas and Stern (2005) described how agency is often thought of as *the holy grail of interactive story* (p. 5) because it gives players control over the structure of the entire experience. However, it is also highly challenging to implement because it necessitates technical systems that can be receptive to the actions of the player. AI, which is steadily gaining prominence across the educational landscape, could play a sizable part in how responsive learning environments can be created in future projects.

Thue, Bulitko, Spetch, and Wasylishen (2007) developed an interactive drama using AI and tested player reactions to it. Using a branch of AI known as player modeling that learns player preferences, the researchers created a *Little Red Riding Hood* interactive narrative. One story was adaptive to the individual player's style, and the other was fixed. Ninety university students played the game (either fixed or adaptive) then rated their experience across dimensions like entertainment, replay value, interest, and creativity. According to confidence levels, multiple subcategories of users enjoyed the adaptive game more and felt more agency than the players of the fixed version. Adaptive storytelling was also popular with users of the antibullying program FearNot! (Aylett et al., 2005). The program's narrative is unscripted and emerges from a flexible, real-time experience. In total, 11 third and fourth graders in a Portuguese school participated in a small-scale evaluation of FearNot! Compared with the scripted version, students found conversations to be more interesting and the characters more believable. These results suggested that certain player types can find a greater sense of control and enjoyment in adaptive stories.

Similarly, a Wizard-of-Oz study of Crystal Island (Lee, Mott, & Lester, 2010) showed how different students can interact with a game story in a variety of ways. This individual difference may warrant a more personalized approach to narrative in serious games. The Wizard-of-Oz design left interactivity in the hands of a human confederate (the *wizard*) rather than a complex technical system to explore what responsiveness in a narrative-centered learning environment might look like ideally. Wizards worked with learners as they solved the science mystery and dictated how the narrative events would unfold by triggering them on a *narrative dashboard*. Narrative profiles of players were created, defined by the time they spent in five phases of the narrative (exposition, complication, escalation, climax, and resolution). Learning gains were found across two clusters of students, but Cluster A performed higher on a posttest than Cluster B. Cluster A spent more time on data collection, science reading, and inquiry during the climax phase; Cluster B completed these activities during the complication and escalation phases. The findings of this study shed insights for designing environments for learners in need of scaffolding to better understand the material.

A Proposed Narrative Design Strategy for Serious Games

This review of literature has shown that in addition to the four narrative features discussed earlier, two game analysis frameworks are useful in designing games for learning: GDA (Wouters et al., 2011) and the NCID framework (Waraich & Brna, 2008). GDA implements foreshadowing and backstory so as to manipulate the flow of information in such a way that promotes curiosity about what will happen next in a story. NCID is a learner-centered methodology focusing

on target learners (Waraich & Brna, 2008). Through this method, representative users can share their insights on the kinds of game stories they enjoy and even contribute to writing characters and plotlines to be used in the learning game. In the game ReMission, GDA was utilized to pique students' curiosity and enhance their engagement in the experience (Wouters et al., 2011). NCID was employed in the creation of the BAT to boost student motivation (Waraich & Brna, 2008). Research has shown both methods, when applied to serious game narratives, can yield greater learner enthusiasm for the subject matter which ultimately leads to more engagement and promotes learning.

Given the findings of this literature review, we propose a narrative design strategy that integrates the four critical narrative features and two narrative analyses as a coherent design strategy to enhance the learning game narratives (see Figure 1).

This proposed design encompasses four features shown to be important from the literature: distributed narrative, intrinsic integration, empathetic characters, and adaptive storytelling. First, narratives can be broken up into smaller units and distributed across various locations in the game in the style of Crystal Island, Quest Atlantis, and Murder on Grimm Isle. These bite-sized bits of
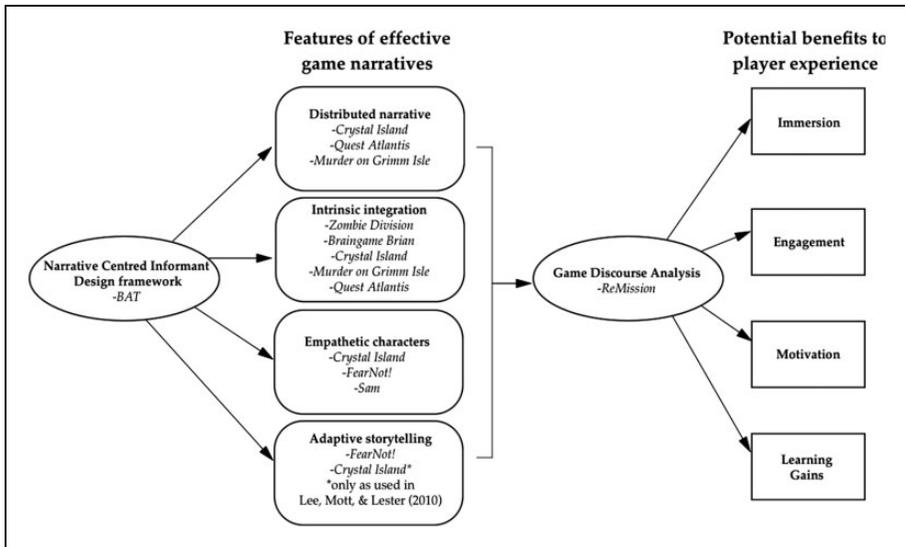

Figure 1. A recommended narrative design strategy for serious games incorporating narrative features and narrative analyses. NCID should be applied at every stage of narrative design, and then GDA can be used to manipulate the flow of information once narrative features have been implemented. Games reviewed in this study that exhibit those features are indicated in italics. BAT = Binary Arithmetic Tutor.

narrative can be presented to the learner in *narrative events* to promote curiosity and reduce the cognitive load on students. Next, the examples of serious games described in this review of literature employed endogenous, intrinsic, or intrinsically integrated fantasies. For example, endogenous fantasy is a vital element of Crystal Island because the scientific mystery storyline is the skeleton of the whole game, without which learning objectives would have no context (Rowe et al., 2007). In general, game developers can achieve intrinsic integration by creating a strong connection between a game's core mechanics and its learning content (Habgood & Ainsworth, 2011). This feature has been linked with higher intrinsic motivation and improved learning outcomes. Empathetic characters and virtual agents, such as those in Crystal Island and FearNot! have been found to positively impact the player's experience of immersion in a learning game. Students may enjoy forging relationships with these characters, and virtual peers can serve as learning companions to model positive skills and behaviors. Finally, adaptive and responsive narratives allow players control over the unfolding story of the game, which may augment their engagement. Player modeling or narrative profiles are two possible forms of tailoring narratives to the individual learner and offering scaffolding to students in need of help. Findings from the literature demonstrate that a player experience rich with immersion, engagement, and motivation will likely yield learning gains.

These narrative features are to be considered through the lens of learner-centered NCID methodology (Waraich & Brna, 2008) and crafted into a storytelling structure. GDA (Wouters et al., 2011) is then applied to enhance the narrative's potential for engaging students. GDA can alter the flow of information by rearranging the sequence of prewritten narrative events. This process can stimulate student curiosity through foreshadowing (in trailers and opening scenes of the game) and backstory (in the mid-game plot). A successful application of this technique can be seen in the game ReMission.

This proposed design strategy combines empirically supported narrative features and analyses to guide the serious game narrative design process. While the features are discrete storytelling elements relating to plot and characters that can be individually added to a game story, the analyses are systematic processes that engage with the game narrative as a whole. It is hopeful when developers use these components in tandem, they can write strong game narratives that have the potential to benefit the player experience by way of immersion, engagement, motivation, and learning gains.

Summary

This review of literature sought to examine research evidence of using narrative as a tool for greater meaning-making in designing immersive learning environments. Literature has shown evidence about the relationships between serious game narratives and immersion, engagement, motivation, and learning gains. Many of the

studies reviewed suggested a strong narrative would make an impact on player experience. Design features such as distributed narrative, endogenous and intrinsically integrated fantasies, empathetic characters and virtual agents, and personalized narratives (adaptive or responsive) were shown to be potentially powerful storytelling features. Based upon these findings, we proposed a serious game narrative design strategy that synthesized four narrative features with two narrative analyses found to be effective in the literature.

However, this review of literature is limited in that some of the studies included were published about 10 years ago. Given a systematic review connecting narrative and learning in serious games is lacking in the literature, we hope designers who deal with new technologies such as virtual or augmented realities can gain some insights from the work that has been done in the past.

Serious game narratives can provide meaningful structures to learning that are frequently quite memorable. Who could forget the globe-trotting art thief in *Where in the World Is Carmen Sandiego?* or the perilous adventures that took place in *The Oregon Trail*? In the words of DeLoura (2001), *Given that games can teach people, why aren't there more fun educational games available?...As an industry, we could be making games which take the boredom out of school for the next generation of students* (p. 6). Story is far more than simply an add-on to serious games but an integral piece of the puzzle when creating an immersive, engaging, and motivating learning experience.

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