frontiers | Frontiers in Virtual Reality

ORIGINAL RESEARCH
published: 16 June 2022
doi: 10.3389/frvir.2022.847120

Using Self-Determination Theory to Explore Enjoyment of Educational Interactive Narrative Games: A Case Study of *Academical*

Katelyn M. Grasse[1]*, *Max Kreminski*[2], *Noah Wardrip-Fruin*[2], *Michael Mateas*[2] and *Edward F. Melcer*[1]

[1]Alternative Learning Technologies and Games Lab, Computational Media Department, University of California, Santa Cruz, Santa Cruz, CA, United States, [2]Expressive Intelligence Studio, Computational Media Department, University of California, Santa Cruz, Santa Cruz, CA, United States

Choice-based interactive storytelling games such as *Academical*, our responsible conduct of research training game, show great promise as a novel way of providing efficacious ethics training. However, much work remains to determine what factors of such games contribute to their advantages over traditional text-based training tools, especially if we hope to further improve their enjoyment, engagement and efficacy. In this article, we present a case study exploring how the motivational factors of Self-Determination Theory (SDT) underlie players' perceived most and least enjoyable experiences arising from the design of *Academical*. Specifically, we discuss how certain elements of *Academical*'s design influence different SDT factors and subsequently player experience, as well as how such elements can be changed to further improve the game. Furthermore, our work highlights potential limitations of existing conceptualizations for the relatedness factor of SDT—discussing ways that it can be extended to properly understand player enjoyment within single-player educational interactive narrative games.

Keywords: interactive narrative, game-based learning, enjoyment, self-determination theory, case study

OPEN ACCESS

Edited by:
Hartmut Koenitz,
University of Amsterdam, Netherlands

Reviewed by:
Deborah Richards,
Macquarie University, Australia
Katja Zibrek,
Inria Rennes - Bretagne Atlantique Research Centre, France

***Correspondence:**
Katelyn M. Grasse
katy@ucsc.edu

Specialty section:
This article was submitted to Virtual Reality and Human Behaviour, a section of the journal Frontiers in Virtual Reality

Received: *01 January 2022*
Accepted: *24 May 2022*
Published: *16 June 2022*

Citation:
Grasse KM, Kreminski M, Wardrip-Fruin N, Mateas M and Melcer EF (2022) Using Self-Determination Theory to Explore Enjoyment of Educational Interactive Narrative Games: A Case Study of Academical. Front. Virtual Real. 3:847120. doi: 10.3389/frvir.2022.847120

1 INTRODUCTION

Choice-based interactive storytelling games are enjoyed by many groups and show great promise as a novel way of providing efficacious ethics training. For example, we created a choice-based interactive narrative game, titled *Academical*, that was designed to teach responsible conduct of research (RCR). We previously demonstrated that Academical is an effective web-based tool for training the three key learning outcomes that are thought to drive ethical behavior—conceptual knowledge, moral reasoning skills, and positive attitudes Grasse et al. (2022). Critically, we showed that our game can train both cognitive and socio-affective learning outcomes simultaneously, which is a rare accomplishment for traditional ethics pedagogy Powell et al. (2007), Antes et al. (2010), Plemmons and Kalichman (2013), Kalichman, (2016). However, much work remains to determine what factors contribute to the game's advantages, especially if we hope to further improve its engagement and efficacy. Enjoyment is an important experiential concept to evaluate because it can strongly predict a player's feelings of engagement with an educational game Busselle and Bilandzic, (2009), Ainley and Ainley, (2011), which has been shown to contribute to learning and academic performance in turn Hamari et al. (2016).

In this article, we present a case study exploring how the motivational factors of Self-Determination Theory (SDT) underlie players' perceived most and least enjoyable experiences arising from the design of *Academical*. According to SDT, players can be intrinsically motivated to enjoy and engage with a game via three basic psychological needs: autonomy, relatedness, and/or competence (ARC). Since Ryan, Rigby and Przybylski's seminal paper describing how SDT can be used to explain the motivational pull of video games Ryan et al. (2006), much research has demonstrated that each of the ARC factors can impact players' enjoyment and/or engagement of a game experience Tamborini et al. (2010), Peng et al. (2012), Azadvar and Canossa, (2018). However, Tyack and Mekler's recent review of SDT literature from premier game conferences (i.e., CHI and CHI Play) emphasizes that "certain core concepts (e.g., relatedness) have received little to no attention" and that "few papers engage with SDT beyond merely descriptive accounts" Tyack and Mekler, (2020). Notably, our work brings to light potential limitations of existing conceptualizations for the relatedness factor of SDT—discussing ways that it can be extended to properly understand player enjoyment within single player educational interactive narrative games. Furthermore, we highlight how this new conceptualization and overall analysis approach could be beneficial to the design and evaluation of educational interactive narrative games more broadly.

2 BACKGROUND

2.1 Interactive Storytelling and Learning

Prior work has argued for interactive storytelling's power in terms of providing therapeutic benefits Starks et al. (2016), Dias et al. (2018) and enabling learning experiences through educational games Weiß and Müller, (2008), Danilicheva et al. (2009), Melcer et al. (2015), Nguyen et al. (2018), Camingue et al. (2020). Specifically, narrative/storytelling is an important element that can be incorporated into educational games in order to maintain and increase students' motivation Dickey, (2006), Rowe et al. (2011), Padilla-Zea et al. (2014), with some suggesting that integration of a good story into an educational game will determine its success or failure Göbel et al. (2009). Interactive storytelling has been incorporated into a number of educational games focusing on topics such as history Christopoulos et al. (2011), Song et al. (2012), STEM Danilicheva et al. (2009), Rowe et al. (2011), Weng et al. (2011), Zhang et al. (2019), and bullying Aylett et al. (2005), Watson et al. (2007). However, the majority of research on educational interactive storytelling games has focused on adaptivity Göbel and Mehm, (2013), Kickmeier-Rust et al. (2008), interactivity Song et al. (2012), Zhang et al. (2019), emergent narrative Aylett et al. (2005), player and knowledge modeling Magerko, (2007), Rowe and Lester, (2010), narrative planning and generation Riedl et al. (2008), Hodhod et al. (2011), Wang et al. (2016), Zook et al. (2012), and the game creation process itself Spierling, (2008), Christopoulos et al. (2011), Diez and Melcer (2020). As a result, there is comparatively little work evaluating the impact of an interactive storytelling approach on learning outcomes. This is especially the case for topics such as RCR with ethically complex concepts that require a variety of perspectives, which our previous work sought to address Grasse et al. (2022).

To better understand how interactive narrative game design relates to teaching efficacy, this paper extends our previous work by using SDT to explore players' motivations for enjoying our RCR training game, *Academical*, as well as educational interactive narrative games more broadly. Our attempt to explicate this relationship ultimately serves to demonstrate the complexity of tensions between various intrinsic motivations (i.e., ARC factors) and educational interactive narrative game design choices that we intended to facilitate acquisition of learning outcomes. Based on the success of our prior research demonstrating the efficacy of *Academical* for training RCR learning outcomes Grasse et al. (2022), we posit that our insights from this work can be generalized beyond the scope of research ethics to more broadly inform the design of motivation within interactive digital narratives representing complexity.

2.2 Self-Determination Theory

Intrinsic motivations, such as those described by Self-Determination Theory, are thought to satisfy basic psychological needs and have been demonstrated to be potent drivers of enjoyment and engagement Tamborini et al. (2010), Peng et al. (2012), Oliver et al. (2016). The following descriptions broadly summarize each factor's definition (Ryan and Deci, 2017, pgs. 513–17):

1) **Autonomy:** a sense of control or volition. The very nature of virtual environments removes some real-world constraints and opens up choices that are often unavailable in everyday realities (e.g., through customization); allows players to choose activities and roles from an increasingly large menu; and provides opportunities for action.
2) **Relatedness:** a sense of social connectedness. Relatedness needs are satisfied when others recognize and support one's self and when the person feels able to connect with, feel significant with, and be helpful to others; when there is a rich and textured social world—one in which players actually have things to do together; and relatedness, being in part a function of contingent responsiveness, can be experienced toward animated virtual characters who demonstrate this attribute.
3) **Competence:** a sense of mastery or effectiveness. Feelings of competence come about when people have opportunities to apply skills and effort; when there is clarity of goals; when there is rich, multilevel, effectance-relevant, positive feedback; and when there is smoothness of the interface through which players' actions in a game are mediated.

SDT also highlights a fourth motivational construct—**presence** or **immersion**—that is distinct from the above ARC factors because it is not a source of psychological need satisfaction. Ryan and Deci summarize presence/immersion as "people's sense that they are, psychologically speaking, *within* the game world, as opposed to experiencing themselves as agents

outside the game, manipulating controls or characters" and clarify that "people perceive and respond to events within a medium as if the medium were not there" (Ryan and Deci, 2017, p.520). Additionally, they state that the capacity for presence/immersion involves "the flow of psychological satisfactions that keep players fluidly and fully engaged within the game world" Ryan et al. (2006). Presence/immersion can certainly arise from conditions such as the realism of a story's setting and/or characters Smith, (1994), Green and Jenkins, (2014), but these feelings of engagement (i.e., *narrative*, *emotional* and *physical* presence) can be enhanced and better predicted by "ongoing opportunities for meaningful, need-satisfying activities" Ryan et al. (2006).

According to Ryan and Deci, "different types or genres of video games afford distinct profiles of the psychological needs that they can satisfy" Ryan and Deci, (2017). Thus, it is firmly understood that the ARC definitions described by SDT are not relevant to every game. For instance, SDT (and its affiliated Player Experience of Need Satisfaction survey, i.e., PENS) does not officially define how relatedness can contribute to intrinsic motivations to enjoy and/or feel engaged with single-player games (e.g., interactive narratives like *Academical*). The authors of SDT specifically describe single-player role-playing games (RPGs) as satisfying autonomy and competence, whereas similar games with multiplayer options (e.g., massively multiplayer online RPGs, or MMORPGs) further satisfy the need for relatedness through supportive interactions with other players (Ryan and Deci, 2017, p. 518). However, the theory's designers admit (and some studies indicate) that players can experience relatedness through interactions with non-playable characters (NPCs; i.e., interactive characters that are not controlled by humans), particularly via "contingent responsiveness" Rigby and Ryan, (2011), Ryan and Deci, (2017), Dechering and Bakkes, (2018). For example, an NPC could foster a sense of relatedness with the player by providing them with aid in the form of an action or advice. Further bolstering this claim, the Ubisoft Perceived Experience Questionnaire (UPEQ), a similar validated game-specific survey based on SDT, amends the concepts covered by the PENS survey to explicitly include assessment of relatedness to NPCs via 3 of its 9 relatedness questions Azadvar and Canossa, (2018). Thus, it is possible for a single-player game (particularly one with a strong narrative and developed characters) to support enjoyment and/or engagement via each of the ARC factors described by SDT, including relatedness.

While the UPEQ survey is able to assess relatedness within single-player narrative game content, other game and media researchers have suggested that the definition of relatedness within this context (i.e., contingent responsiveness) can be further refined and extended Smith, (1994), Tyack and Wyeth, (2017), Adachi et al. (2018), Dechering and Bakkes, (2018). More specifically, this body of work suggests that, under certain conditions, it is possible for players to feel relatedness with the main character of a story (playable or not) in addition to supporting characters or NPCs. Drawing from this body of work, the following section describes the relatedness criteria we included in the final version of the rubric we used to code players' qualitative answers for the presence of ARC factors.

2.3 Relatedness in Single-Player Games

Relatedness in games is typically interpreted in terms of the player's relatedness to *other players*, particularly in a multiplayer context Ryan and Deci, (2017). Here, however, we interpret relatedness primarily in terms of the player's relatedness to *fictional characters* in general, including both the player characters that they control and the non-player characters with whom they interact. In this regard we follow both Tyack and Wyeth, (2017), who extend relatedness to include parasocial relationships Rubin and Perse, (1987), Schramm and Hartmann, (2008), Kavli, (2012) with non-player characters, and Bopp et al. (2019), who address player feelings of attachment to both player and non-player characters.

The idea that spectators of fiction understand fictional characters by modeling them as other people is well-supported by the modern cognitive-narratological understanding of character (Schneider, 2001, p. 608), as is the idea that readers can therefore experience a sense of relatedness to fictional characters. Smith, (1994) proposes a *structure of sympathy* consisting of three distinct levels of "imaginative engagement" with fictional characters: *recognition*, in which spectators are presented with "legible and consistent" information about characters that lead them to model these characters as internally coherent others; *alignment*, in which spectators are given access to a character's subjectivity to facilitate perspective-taking; and *allegiance*, in which spectators are led to "root for" (or against) characters on the basis of moral evaluation. The first of these three levels is largely connected to the spectator's sense that the characters are believable, while the latter two levels increasingly address *affective* relationships with characters of the sorts that we usually discuss under the label of "identification". However, all three levels involve the application to fictional characters of cognitive functions (such as perspective-taking) that are normally applied to *other people*.

Because relatedness centers on affective relationships, we code for relatedness any player response that contains evidence of the presence (or conspicuous absence) of either of the following constructs drawn from Smith's "structure of sympathy":

1) **Alignment:** Players being given privileged access to a character's subjectivity, including their emotions and inner thoughts, and consequently taking the character's perspective to some extent.
2) **Allegiance:** Players emotionally responding to characters, either as "sympathetic or antipathetic" Smith, (1994).

However, we do not code for relatedness (and instead code for presence/immersion) when only *recognition* is present. This is because players can recognize characters without identifying or sympathizing with them further.

3) **Recognition:** Players suggesting that characters are *psychologically believable*, that their actions seem to stem from a "legible and consistent" mental agency Smith, (1994).

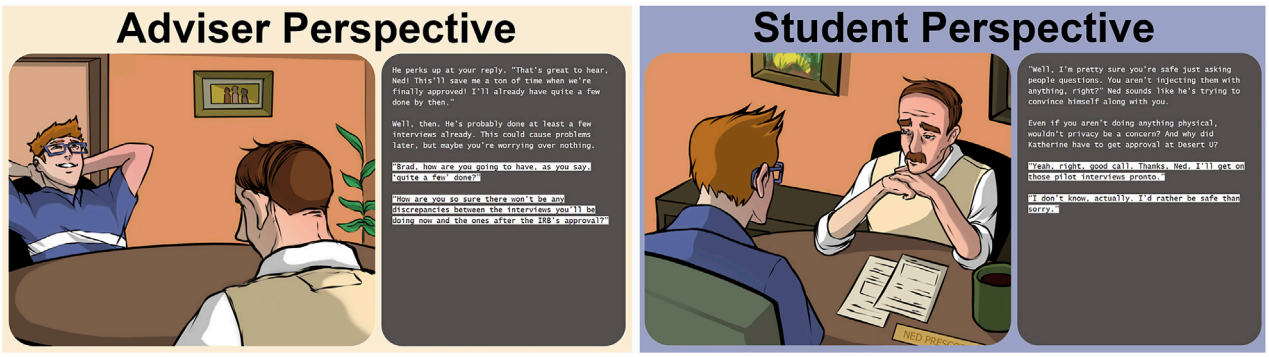

FIGURE 1 | Two perspectives and corresponding choice points from Academical's first scenario, "The Head Start." In this story, the player can role-play as an adviser or a graduate student struggling to navigate the human subjects research approval process. The two highlighted text blocks from each scene represent the player's dialogue options for their character.

2.4 *Academical*

Academical is a choice-based interactive narrative game that provides players the opportunity to role-play as various unique characters immersed within a collection of ethical dilemmas that are common in research. The game comprises fundamental ethical topics that inform all aspects of the research process and highlights how this process can be complicated by many factors such as power dynamics and marginalized identities. Each playable scenario in Academical centers on a conversation between two stakeholders in the RCR issue at hand, one of whom is controlled by the player—in the sense that they select dialogue options for that character (see **Figure 1**). By virtue of these choices, the player will ultimately reach one of several possible endings, a subset of which represent successful navigation of the situation. Upon reaching a good ending for the first character, the player then unlocks the other interlocutor and replays the scenario from that person's viewpoint. In turn, reaching a good ending for the second character in a given scenario unlocks the next scenario/RCR topic.

2.4.1 Prior Work

We have conducted two studies evaluating the efficacy of *Academical* for teaching RCR learning outcomes Grasse et al. (2022). Our first study was a randomized group comparison study (N = 14 for each group) that showed that our game is equal or better than traditional web-based training materials at teaching students RCR knowledge and moral reasoning skills Melcer et al. (2020a). Notably, this experiment also revealed that the game was significantly more engaging than the web-based training materials Melcer et al. (2020b). Our second experiment—a within-subjects comparison study (N = 60)—showed that the game can significantly improve attitudes about RCR for students who have never received RCR training Grasse et al. (2021). This quasi-experimental correlational study also revealed that the students' post-game scores and changes in pre-post scores were significantly correlated with their engagement. Together, these studies were the first to demonstrate the promising value for using choice-based interactive narrative games to train research ethics, including both cognitive and socio-affective RCR learning outcomes. Importantly, each study also highlighted that engagement may be an important factor driving learning outcome performance.

Clearly, merely using the interactive narrative medium does not guarantee that a story will feel immersive or engaging for all (or even any) readers. For instance, the results of our second study described above indicated that some players did not feel particularly engaged with the game. Furthermore, the most engaged participants were significantly more likely to report positive attitudes compared to their least engaged peers. Considering that the aim of the game is to train RCR learning outcomes (e.g., knowledge, skills and attitudes), it is crucial to understand how the design of our interactive narrative game can impact engagement since engagement seems to contribute to learning outcome performance.

3 METHODS

3.1 Participant Recruitment

This study was approved by the Institutional Review Board at the University of California, Santa Cruz (a Tier 1 research university). All participants were recruited as a convenience sample from an undergraduate course offered through UCSC's engineering department. Two weeks before the conclusion of the course, participants were informed of the study through email and offered extra credit toward their class grade in exchange for completing all parts of the study. Participants were told that the purpose of the study was to test the efficacy of a new RCR training program.

3.2 Procedure

This study was conducted entirely online. Participants accessed the game and post-game survey using the same methods as prior studies on this RCR training tool Grasse et al. (2022)—through their preferred web browser on their personal computers and without any supervision beyond automated data collection. Two of the nine possible scenarios were selected for students to play through (i.e., peer review and authorship). Participants were instructed to play through each character at least once in each scenario—equating a minimum of 4 total playthroughs (2 characters/playthroughs per module)—before completing the post-survey. After playing Academical, participants responded to short answer questions asking them to describe which aspects of the game they found most and least enjoyable.

TABLE 1 | Rubric used for scoring qualitative answers (left column) and corresponding "MOST enjoy" representative responses from study participants (right).

Autonomy	**Representative response**
Foster a sense of equifinality Przybylski et al. (2010)	"I liked being able to play two character perspectives of the story."
Varied opportunities for action Przybylski et al. (2010)	"The fact that you can choose what you want to say. The impact that the decision-making has can lead to different parts of the dialogue."
Agency to perform activities in preferred playstyle (i.e., "being able to" or "getting to" do something) Azadvar and Canossa, (2018)	"I liked being able to have options to choose what to say next or what could happen next."
Perceiving action as meaningful Dechering and Bakkes, (2018)	"I liked having a variety of decisions so I could choose the in game action that I was most likely to actually do."
Relatedness	**Representative Response**
The act of perspective-taking	"I liked being able to see a situation unfold from two different perspectives seeing how each character could respond to a given prompt."
Privileged understanding of the character's perspective Smith, (1994)	"I really liked how developed each character was given their extra bits of background text that I could click through."
Identification with or sympathy for (i.e., allegiance) the characters Dechering and Bakkes, (2018)	"I enjoyed the variety in the storylines, as well as the ability to switch between the perspectives of those in power and the students. Some of the student's experiences were relatable to me as a college student."
Competence	**Representative Response**
Challenges and goals to be mastered Przybylski et al. (2010)	"I really enjoyed unlocking new scenarios and characters. I felt a sense of accomplishment after getting the responsible ending. I replayed that one scenario 3 times trying out different dialog options in order to get that good ending."
Provide motivating performance feedback Przybylski et al. (2010)	"I liked how each decision I make can lead into different endings. This made me get motivated to try clicking other options to see other outcomes, to get a complete sense of all the consequences."
Opportunities to acquire new skills/abilities Ryan et al. (2006)	"I actually did learn quite a bit about the correct ways to respond or react to situations that even though I've never been in, I could see how this would be very useful."
Skill-graded challenges Przybylski et al. (2010)	"I enjoyed that I actually had to focus to make the right choices and couldn't just skim through it."
Presence/Immersion	**Representative Response**
Scenario feels relatable (Green and Jenkins (2014))	"It's educational and relevant, depicting real-world scenarios that are very relatable to students."
Scenario feels realistic Green and Jenkins (2014); Ryan et al. (2006)	"Being immersed in what could be a very real situations."
Characters feel realistic Smith, (1994)	"I liked the amount of detail put into the dialog between the two characters in each scenario. Each choice that was available seemed like a likely reaction anyone could give."

3.3 Post-game Survey

3.3.1 Short Answer Questions About Enjoyment

Participants answered two qualitative short answer questions assessing their reasons for enjoying the game. The questions were phrased in the following way: "What did you enjoy 1) MOST or 2) LEAST about your experience?" Other than the phrasing of the questions, no instruction was provided prompting participants about what to include in their answers.

3.3.2 Interest in Research Career

To help gauge participants interest in the game's subject matter, we included a question asking: "How likely are you to pursue a career in research?" Possible answers ranged along a 7-point Likert scale from Very Unlikely (1) to Very Likely (7).

3.4 Qualitative Coding

Three of the authors independently coded all of the qualitative answers (154 total, 77 answers for each enjoyment question) to determine whether their content described feelings of autonomy, relatedness and/or competence. Participants' answers could be categorized as including more than one factor (e.g., autonomy and competence). The initial rubric used for coding was based on definitions described in SDT-based game literature Ryan et al. (2006), Przybylski et al. (2010), Dechering and Bakkes, (2018), Azadvar and Canossa, (2018). After using this rubric, the ratings for autonomy and competence showed high agreement (percent agreement = 98.7 and 97.4%, respectively). However, there was still disagreement on what answers qualified as relatedness—particularly for responses that involved enjoyment of "perspective-taking" (a prominent feature of interactive narratives, especially *Academical*). Using both game- and media-based SDT literature Smith, (1994), Tyack and Wyeth, (2017), Dechering and Bakkes, (2018), the rubric was subsequently refined to clarify how perspective-taking could support feelings of relatedness with any of the game's characters. The coders then separately re-evaluated the responses for relatedness content, resulting in high agreement (percent agreement = 98.7%). Though presence/immersion is not categorized as an ARC factor, it is a substantial component of the PENS survey and indicated as an expression of a player being

TABLE 2 | Rubric used for scoring qualitative answers (left column) and corresponding "LEAST enjoy" representative responses from study participants (right).

Autonomy	**Representative response**
Limited/redundant/no preferred choice in options/paths	"I believe that would be playing the professor in the first scenario, you have little to no options and no way to change the path the story takes save for about two dialogue choices near the end."
Limited/no agency (i.e., "having to" or "not being able to" do something)	"Having to play the story from both angles, right after I just played it once."
Relatedness	**Representative Response**
Character is unrelatable	"The way I would handle the situation would be different from what that grad student complaining about his adviser would have done. I did not feel like I was able to actually do it the way I would do it. I eventually figured out the right choices, but they did not seem like the right choices to me. In real life, I would have eased into things and talked calmly about the situation."
Character is too relatable	"The male character not getting credit for writing a chapter."
Competence	**Representative Response**
Poorly scaled challenges	"Many of the dialog choices had rather predictable outcomes. I'm not sure if that is the intent or not, however, in a way it serves to make the overall storyline less compelling/enjoyable to play through."
Harsh or confusing performance feedback	"How confusing it was to understand the way to reach the ideal endings for the second character of each chapter."
Unclear premise/goals/context	"The premise of the game is not exactly obvious for someone who has never conducted this sort of research and does not have experience with understanding what is considered ethical or correct."
Presence/Immersion	**Representative Response**
Scenario feels unfamiliar or unrelatable	"I feel like I'm not immersed and interested with these character and choices since these stories never happened to me in a way, and I feel like these stories are other people's stories that I don't really care about."
Scenario feels too relatable	"What I enjoyed least was thinking about these scenarios and how often they occur in everyday student life."
Unrealistic characters	"It was not very engaging, I felt like some of the responses were unrealistic making overall experience less immersive."

TABLE 3 | Prevalence of SDT factors participants used to describe notable qualities of playing *Academical*.

SDT Motivational Factor	**Most enjoy (%)**	**Least enjoy (%)**	**Total N (% of 154)**
Autonomy	23 (30%)	21 (27%)	44 (29%)
Relatedness	11 (14%)	7 (9%)	18 (12%)
Competence	18 (23%)	27 (35%)	45 (29%)
Presence/Immersion	15 (19%)	7 (9%)	21 (14%)
Total N of responses with any factor (%)[a]	53 (69%)	45 (58%)	97 (64%)

[a]*The percentages in the first four rows do not add up to the values in this row because some responses contained more than one SDT factor (see* ***Table 4****).*

motivated to engage with game content. Therefore, we also report presence/immersion results (percent agreement = 100%) by showing the quantity of responses that described recognition of either the characters or setting as being familiar, real or believable Smith, (1994), Ryan et al. (2006); Green and Jenkins (2014). Since most literature discusses need satisfaction, the "most enjoy" rubric served as the reference point for coding the "least enjoy" answers (e.g., a lack of choice was regarded as low autonomy). A summary of coding themes and representative responses can be found in **Tables 1** and **2**. **Table 1** shows the final rubric used for coding SDT-based need satisfaction (most enjoy), while **Table 2** shows the final rubric used to identify SDT-based need frustration (least enjoy). Responses that received two or more coders' votes were included in the motivational factor tallies provided in **Table 3**, whereas responses with only one vote were excluded.

4 RESULTS

4.1 Participants

A total of 99 undergraduate students registered for this study through a participant recruitment website hosted by the university. Within this pool, 77 successfully participated by completing the study requirements. Nine of these participants reported that they had received prior RCR training. Altogether, we analyzed data from 51 males, 23 females and 3 non-binary individuals. The average participant age was 20.7 ± 2.2 years (median = 20, range = 18–29), which is a typical age for university students who are starting to engage in research and consider applying to graduate school. In response to the Likert survey question, participants on average indicated some interest in pursuing a research career (mean = 3.74, SD = 1.7, range = 1–7).

TABLE 4 | Examples of responses that contained more than one SDT factor (PI = presence/immersion).

SDT Motivational Factors	Representative response
Autonomy and Relatedness	"I like being able to play two character perspectives of the story."
Autonomy and Competence	"I did enjoy the fact that there were multiple endings to both stories depending on what actions you took. Unlocking the other sides of the story after each play through was nice too."
Relatedness and PI	"Learning about the various situations and the reality of the endings. It was also good to learn about both perspectives of the story."
Autonomy, Relatedness, and PI	"I enjoyed the variety in the storylines, as well as the ability to switch between the perspectives of those in power and the students. Some of the student's experiences were relatable to me as a college student."
Autonomy, Relatedness, and Competence	"I actually failed a lot more than I expected to, and sometimes felt like I wasn't given options that would reflect how I would have responded."

Participants reported pursuing the following undergraduate degrees: Arts and Design: Games and Playable Media (n = 29), Computer Science: Computer Game Design (16), Cognitive Science (16), Computer Science (9), Technology and Information Management (4), Psychology (2), Economics (1), Electrical Engineering (1), Film and Digital Media (1), Physics (1), Politics (1), and Sociology (1). Two participants reported that they had not yet declared a major, while seven reported pursuing two majors. Design-based (30) and engineering (30) degrees were the most common, followed by science (20) and economics/politics (2).

4.2 Participants' Reported Reasons for Enjoyment

In the following sections, we quantify and summarize the reasons participants gave for their most and least enjoyable aspects of the game. Notably, some participants provided multiple distinct reasons within a response, even for the same ARC factor. In **Table 3**, we simply tally the number of responses that contain each of the SDT motivational factors. However, the proceeding qualitative breakdown of these answers further delineates the presence of multiple distinct mentions of the same factor, which explains why the sum of these cases may exceed the total number of responses that contain that factor.

4.2.1 Self-Determination Theory Factors

Table 3 shows the quantity of responses that included the following SDT motivational factors: autonomy, relatedness, competence, and presence/immersion. Since a response could be coded to include more than one factor, the bottom row of **Table 3** indicates the quantity of responses that included at least one of the SDT factors. **Tables 1** and **2** provide representative responses for each of the SDT categories, while **Table 4** shows samples of responses that included codes for more than one category. At least one of the SDT factors (including presence/immersion) was identified in 64% (N = 98) of all 154 of the responses. These factors were more prevalent in the "most enjoy" responses (69%) compared to the "least enjoy" responses (58%). Overall, these results indicate that the majority of participants chose to use SDT-based intrinsic motivations to describe both their most and least enjoyable aspects of *Academical*.

4.2.1.1 Need Satisfaction

Autonomy was the most-cited reason that participants used to explain why they felt *Academical* was enjoyable to play (30% of responses). Participants were most often motivated by the game's provision of choice (N = 11). In general, these participants stated that they enjoyed the affordance and act of making decisions on behalf of the characters. The next most common autonomy-based cause for enjoyment involved the game's capacity to facilitate various abilities and playstyles (N = 9). For example, participants enjoyed how the game's design afforded them the ability to switch character perspectives for the same story, replay a scenario multiple times, read background information about the characters and setting, and choose to progress the story at their own pace. Thirdly, some responses involved equifinality (i.e., multiple routes to the same end, N = 4). These responses involved enjoyment of seeing the story from both perspectives (in contrast to simply enjoying "being able to" switch perspectives) and experiencing multiple "correct" endings with varying emotions between the characters. Finally, a few participants reported enjoying the game most when they perceived their actions as meaningful (N = 3). These participants specifically enjoyed how the decisions they made had causal impacts upon the direction of the story.

Competence was the next most prominent cause of participants' enjoyment while playing *Academical* (23% of responses). Participants particularly enjoyed the feeling of accomplishment they got from unlocking new characters and reaching the good story endings (N = 7). They also enjoyed that the game gave them the opportunity to learn and practice new skills and abilities (N = 5). This could involve practicing perspective-taking, good judgement, or decision-making skills as well as learning about how to have crucial conversations with important people (in research or in general). Some other participants enjoyed that the game provided them with an appropriate level of challenge (N = 5). More specifically, these participants enjoyed that the game was a kind of puzzle that they had to focus on and think about for a while in order to reach the desired ending, although one participant said that they simply enjoyed being given many additional chances to progress to a good story ending. Finally, a few participants appreciated that the game provided motivating feedback (N = 3). This was specifically because each scenario had multiple different endings that were identified as being either good or bad.

Of the three ARC factors and overall, **relatedness** was the least common reason participants used to describe their enjoyment of the game (14% of responses). Within this category of need satisfaction, participants overwhelmingly explicitly reported

enjoying the act of perspective-taking (N = 10). Most of these participants specifically liked how they could see the story unfold from multiple different perspectives. A few participants enjoyed feeling *alignment* or *allegiance* with the characters (N = 3). They either liked that they could know what was going on inside the characters' mind (alignment) or that the student characters provided a "relatable" perspective (allegiance).

Finally, **presence/immersion** was a slightly more common motivational factor for explaining participants' enjoyment than relatedness (19% of responses). Most of these participants enjoyed that the stories were immersive because they were relevant and/or relatable, either personally or conceivably to other students (N = 9). After saying that they liked how the story was relatable, one participant clarified that it felt so because they have not received credit for some group projects (a theme of the authorship story). Many of the participants stated that they felt immersed either because of how realistic the stories felt or because they "made sense" (N = 7). For some participants, this description coincided with their enjoyment of the relatability of the scenarios (N = 2), which is a similar but distinct concept. Lastly, a couple of participants most enjoyed that they could *recognize* the characters as being realistic (N = 2). They claimed that the characters seemed real either because each choice seemed like a likely reaction that anyone could give or because the characters showed varying emotions.

4.2.1.2 Need Frustration

Competence was cited as the most common reason for explaining the least enjoyable aspects of the game (35% of responses). This need frustration was expressed in many forms. More than half of the participants who struggled with feelings of competence essentially described poorly scaled challenges (N = 16). These participants didn't like how the decisions they had to make in the game felt either too easy or too hard, that the game's story or method of presentation was too difficult to understand or navigate, or that the dialogue of the two characters from the same scenario felt too redundant. Next, many participants felt like the game provided performance feedback that was either too harsh, vague or confusing (N = 8). Some of these participants said that they felt like the consequences of their decisions didn't make sense (e.g., some expected a different outcome to happen based on their choice), while others didn't enjoy being sent back to the beginning of the story after reaching a bad ending (i.e., they would have preferred to have save points in the middle of the story). Finally, a few participants least enjoyed the game because it did not provide clear enough objectives and/or means to reach them (N = 4). In particular, these participants felt like they were either unable to understand the game's goals, context, or ethical premise.

The next most common cause for participants' lack of enjoyment involved frustrated feelings of **autonomy** (27% of responses). These participants primarily had issues with the game either not facilitating preferred playstyles or requiring those that were not preferred (N = 13). For example, these participants did not enjoy the lack of agency when "having to do things" like read background information about the characters and/or situation, reach a good ending before unlocking new characters, play the story from the beginning for every attempt, or play both perspectives of the story. Alternatively, a number of these participants reported that they would have preferred having the ability to make decisions based on what they personally would have done (rather than being restricted to options based on the character's personality), while some others wished that they had been able to navigate around the game more easily (e.g., to go back to the main menu at any time). Similar to the need for agency, many participants would have preferred a different breadth of choice in navigating the stories than what was provided (N = 12). Lastly, one participant reported that they least enjoyed how they felt that the game did not provide them with any "real" decision-making power (which we interpreted as a lack of "meaningful choice").

Similar to the need satisfaction results, **relatedness** was the least common ARC factor that participants used to explain their least enjoyable aspect of playing the game (9% of responses). Notably, no participants reported disliking the act of perspective-taking—in contrast, perspective-taking was an overwhelmingly common relatedness reason for enjoying the game. Instead, these participants mainly had issues with feeling an inappropriate amount of *alignment* (N = 8) or *allegiance* (N = 1) with a character. We found that participants had issues aligning with characters because they did not like or were not able to understand the characters' dialogue options. More specifically, a failure of alignment happened when participants said that they would have preferred to have choices that aligned with their own personal logic rather than that of the character's personality. Interestingly, the one participant who felt frustrated via their allegiance with a character did so because they felt overly sympathetic with that character's unfair struggle (i.e., to receive authorship credit).

Finally, participants were also least likely to use **presence/immersion** to explain their least enjoyable aspect of the game (9% of responses). The majority of these participants took issue with the game's relatability (N = 6). Most of these participants did not like how the scenario content felt unfamiliar or unrelatable. Conversely, a couple of these participants did not enjoy the game content because it was too relatable (e.g., one participant did not like thinking about how common these issues are in real life). Just one participant described that they did not *recognize* the characters as believable (N = 1). Specifically, they stated that some of the responses seemed unrealistic.

4.2.2 Other Factors

The following sections summarize any non-SDT factors that participants used to describe their reasons for enjoying the game. Some of these factors were sourced from responses that also included descriptions of SDT factors.

4.2.2.1 Most Enjoy

A total of 25 participants (32%) described reasons for enjoying the game that did not involve SDT-based motivational factors. The most common reason these participants enjoyed the game was because they liked the art that accompanied the story text (N = 10). Some participants also stated that they liked the writing and story, either because of its quality, depth or setting (N = 4). A

couple of participants ($N = 2$) specifically liked the novelty of the game's content (i.e., its setting or characters). A handful of participants' explanations for enjoying the game ($N = 7$) were not able to be categorized with any of the above reasons (including the SDT factors) because the coders found the phrasing of the responses to be too vague (e.g., one participant simply liked "the end").

4.2.2.2 Least Enjoy

About a third of the participants ($N = 26$, 34%) described various non-SDT factors to explain their least enjoyable aspects of the game. Half of these participants simply did not enjoy how much reading was required to play the game ($N = 13$). Some other participants did not enjoy various aspects of the writing or story ($N = 5$). These participants either thought that the story was boring or just stated that they did not like the setting. Others did not like game's visuals ($N = 4$). Some did not like the quality or style of the art (e.g., one wished for a presentation style more like a comic book), while others found the visual format of the game to be jarring (e.g., they did not like the text color or the way the game transitioned between scenes). A couple of participants wished that there had been some form of audio ($N = 2$). Again, some participants provided reasons that were too vague to categorize ($N = 3$).

5 DISCUSSION

In this paper, we presented a case study aimed at qualitatively examining the primary reasons why a group of 77 undergraduates found our choice-based interactive narrative game, *Academical*, to provide an enjoyable play experience. This type of analysis was valuable for a few reasons. First, although validated surveys like the PENS or UPEQ are useful for assessing intrinsic motivations to enjoy or engage with a game, these types of quantitative evaluation are not able to represent players' experience in fine detail. Though substantially more time and effort was required to analyze our results, we believe that they are especially beneficial for informing specific improvements to future iterations of the game's design. Additionally, not only were we able to assess the extent to which participants' intrinsic needs were satisfied, our qualitative results provided us with just as much information about what aspects of the game frustrated these needs. Tyack and Mekler explicitly recognize the value of this analysis in their recent review when they observed that "fewer studies have investigated experiences of need frustration" Tyack and Mekler, (2020). Next, our results showed that about 2 in 3 participants felt that SDT-based intrinsic motivations accounted for their most salient causes of enjoyment. The other third of responses instead involved various commentary about the game's aesthetic design. These results provided a sense of scale for the salience of intrinsic need satisfaction for player enjoyment, showing that SDT-based factors were about twice as important compared to any other factors combined (e.g., less functional aspects of our game's design). This further validates the relative value of SDT and the use of its quantitative assessment tools for explaining the motivational pull of video games. Finally, the results from this study are valuable because there are relatively few studies that qualitatively explore the relevance and utility of SDT in games research—most SDT-based games research does not "engage with SDT beyond merely descriptive accounts" Tyack and Mekler, (2020).

5.1 Design Considerations for *Academical*

5.1.1 Autonomy

Autonomy was one of the most prominent factors that contributed to both need satisfaction and frustration (about a third of the responses for each). Participants especially enjoyed that the game's design provided them with a series of choices that allowed them to control the characters and drive the course of the story ($N = 11$). However, a comparable number of participants reported that they least enjoyed the game when it did not give them adequate control over the story ($N = 12$). Choice is a central design feature of interactive narrative games. For *Academical*, allowing the reader to control how the characters navigate through the story is the only educationally-relevant interactive component of the game—without it, the experience would become a passive reading exercise much like most traditional learning materials. Thus, it was not surprising that most people perceived the provision of choice to be such a salient component of their play experience. Only one participant reported that they felt like they were given too much choice. As a result, we predict that giving players a greater range of dialogue options would likely improve their enjoyment of the game.

The other major experiential factor participants most enjoyed was that the game afforded them certain abilities or playstyles ($N = 9$)—giving them the perception that they were "able/allowed to do" certain things in the game (e.g., perspective-taking). Conversely, participants especially disliked when they felt like the game's design either forced them to play a certain way or did not allow them to play in a way that they would have preferred ($N = 13$). This was the second most common single factor that negatively impacted participants' enjoyment of the game. The specific reasons that participants provided varied widely, so it is not immediately clear which design feature is the most crucial to address. Furthermore, some of the issues players cited are core features of the game that are key to the ethics learning process (e.g., playing through a scenario from both perspectives). However, we feel it is more reasonable to address some of the other design concerns, such as the fact that the game does not provide save states in the middle of the stories. As discussed in the next section, this particular change may help improve players' enjoyment of the game for multiple reasons.

5.1.2 Competence

Competence was another feeling that was critical for participants to enjoy playing *Academical* (about a third of all the responses), but it was noticeably more likely to frustrate participants' enjoyment (35%) than to satisfy it (23%). One common reason that participants said they enjoyed the game was because reaching milestones gave them a sense of accomplishment ($N = 7$). Additionally, it was encouraging to see that the game was successful at making the act of learning and practicing new skills particularly enjoyable ($N = 5$). However, many participants claimed issues with the game's perceived difficulty ($N = 16$), which was the most common reason of all

that players gave to explain their lack of enjoyment. This result is understandable considering that the participants were undergraduate students, the vast majority of which had never undergone RCR training (88%). As a result, our game gave most of the participants an in-depth introduction to research settings, professional roles and ethical dilemmas for the very first time. Though the stories and objectives in the game could have been made clearer to some participants, others stated various reasons for why the game seemed too easy or predictable. For instance, the requirement to play each scenario from both perspectives was clearly associated with the perception that the game's content was too easy or redundant. However, we addressed in the previous section how we believe that this feature is valuable (theoretically in the development of moral reasoning skills). Further work is required to clarify how the game can be improved to properly challenge players with a range of ethical experience and skill.

We also found that many participants did not enjoy the game when they perceived that the feedback they received about their choices was either hard to comprehend or inappropriately scaled (N = 8). Though we want to address the fact that some participants had trouble understanding the game's story-based feedback, the data we received is not detailed enough to be able to clarify *why* this was the case. We hypothesize, for example, that participants may have struggled with the feedback because they did not understand the ethicality of a decision, but it could have also been because the characters' dialogue options were too vague to allow meaningful predictions about the downstream effects of a choice. Considering that understanding the game's feedback is crucial to facilitating its learning goals, future playtesting studies should focus on acquiring more information about how to make these parts of the stories less confusing. Lastly, many participants agreed that they especially did not enjoy having to replay the stories from the very beginning every time. This feature of the game was perceived as too large a "punishment" for failure. As an example, one participant said, "It was really defeating to get a bad ending and being sent back to the beginning instead of just looping to a separate point or having a save state." Considering that this was also commonly perceived as an impediment to participants' autonomy, we believe that implementing a back button or save state feature in future iterations of the game would likely considerably improve enjoyment of the game—as is successfully employed in other genres such as platformers Cuerdo and Melcer (2020), Melcer and Cuerdo, (2020), Cuerdo et al. (2021). However, care should be taken in this implementation since it has been shown in other game-based learning contexts that players are more likely to think carefully about how to solve a problem when there are greater consequences for failure (e.g., the amount of time required to make more attempts) Mann et al. (2009), Melcer and Isbister (2018), Villareale et al. (2020).

5.1.3 Relatedness

In the context of our single-player interactive narrative game, relatedness occurred when the player engaged in perspective-taking or when they felt some form of *alignment* or *allegiance* with a character. Relatedness was considerably less common of a factor (12%) than autonomy or competence (29% each), which emphasizes the relatively greater impact that the latter two factors have on enjoyment of interactive narrative games. Alternatively, this result may be due to the fact that autonomy and competence had a greater breadth of coding definitions compared to relatedness. Descriptions of relatedness more often contributed to enjoyment (14%) compared to lack of enjoyment (9%). Nearly all of the relatedness-based enjoyment was because participants enjoyed taking the perspective of the characters (N = 10). Interestingly, no participants stated that they did not enjoy the act of perspective-taking. Although a couple mentioned that they did not like having to play the same story from both perspectives, many explicitly enjoyed the opportunity (which is a relatively rare feature of interactive narrative games). Importantly, the act of perspective-taking ended up being one of the single most prominent experiential factors driving players' enjoyment of the game—comparable to the game's provision of choice (autonomy) or its perceived difficulty (competence). The emphasis on perspective-taking is another core facet of the game's design, which may explain why so many participants found it to be so salient. However, what is clear from our results is that the game was very successful at making the act of perspective-taking enjoyable, at least for those participants who felt it an important enough part of the experience to mention in their responses. Therefore, we conclude that emphasizing the act of perspective-taking in an educational interactive narrative game is not only pedagogically relevant, but it can also be a major factor driving enjoyment of the learning experience.

The stories in *Academical* always involve a conversation between two characters with different levels of professional power (e.g., a student and an advisor). Amongst all the responses, participants were overwhelmingly more likely to describe their relationship to any of the characters in terms of *alignment* (N = 10) rather than *allegiance* (N = 2). It was rare for participants to mention either of these concepts with respect to their most enjoyable aspect of the game. In contrast, we interpreted that most participants' relatedness frustrations involved not feeling aligned with their character. More specifically, participants mainly wished that they had access to dialogue options that aligned better with their own preferred type of response. While the reasons for this based specifically on our game's design are unclear, interactive narrative research suggests that readers most often make decisions based on what they would actually do (rather than based on what the character would do), and that doing so exclusively fosters greater feelings of identification, perceived reality and attitude change Green and Jenkins, (2014). Furthermore, players are thought to experience relatedness—and thus "thrive" and experience well-being—when video games support the expression of their "true self" Przybylski et al. (2010), Tyack and Wyeth (2017), Tyack and Mekler (2020). *Academical* was designed to help the player practice seeing situations from multiple perspectives, and each character's unique personal struggles were purposefully constructed to amplify the reality that not all dilemmas are capable of being perfectly resolved. Importantly, there is a practical limit to both the number of choices that can be hand-authored into a branching storyline and the amount of time students can invest in a given activity, and so each of many possible endings were also purposefully selected to provide the player with the most valuable ethically-relevant learning opportunities. While we recognize the benefits of making the characters' behaviors more

relatable to the player to stimulate need satisfaction, we predict that redesigning the characters to be less defined has the potential to disrupt the intended learning process in a variety of ways. More research is required to understand the educational consequences of these design-based trade-offs.

5.1.4 Presence/Immersion

Presence/immersion was described in half as many responses compared to autonomy and competence. Participants were much more likely to cite presence/immersion factors to explain what they most enjoyed about the game (19%) compared to what they least enjoyed (9%). The majority of these participants most enjoyed that the game's stories felt relatable, relevant and/or realistic (N = 14). Conversely, just a handful of other participants did not enjoy how the stories did not feel familiar or relatable (N = 4). Interestingly, two participants did not like that the game was too relatable (N = 2). We would expect a lack of relatability to the game's content to negatively impact presence/immersion and thus learning Green, (2021). This could also apply to those who feel overly connected to the material because interacting with it may "hit too close to home" and therefore feel too threatening to properly facilitate learning Green and Jenkins, (2014). However, our results indicate that most people enjoyed being able to relate to the game because it provided a safe learning environment for practicing skills and behaviors that would be useful in the future. This result is encouraging considering that the game is expected to be used mainly for training students. However, since the game is also intended to train more senior research personnel, we remain curious to know how immersive the game feels for readers of all ages.

5.1.5 Non-Self-Determination Theory Factors

A number of aesthetic game design features stood out as worthy of discussion. First, the game's art was appreciated by a notable number of participants (N = 10). Only a couple of participants found the art to be the least enjoyable part of the game (N = 2). Visual resources can help stimulate immersion and reduce cognitive load Angeli and Valanides, (2004). Therefore, we conclude that the provision of art throughout the game was a valuable investment. Next, a comparable number of participants either did (N = 4) or did not (N = 5) enjoy various aesthetic qualities of the writing and/or story. These opinions did not appear nearly as influential to participants' enjoyment compared to many other factors. Thus, our impression is that the quality or style of the writing is adequate for satisfying most readers, and the most valuable improvements to the story should instead involve, for instance, increasing the variety of dialogue choices or adjusting the presentation of the characters to make them more universally relatable. Lastly, the second most common reason of all that participants used to explain their least enjoyable part of playing the game was simply that it required too much reading (N = 13). While the act of reading is an expected part of the learning process, it is possible that these participants did not feel that the mental investment matched the educational value of the experience. We are hopeful that the inclusion of save states would alleviate this burden. Additionally, reducing the depth of character descriptions to make them easier to identify with could also help decrease the amount of time players need to spend reading.

5.2 Experiencing Relatedness Through Role-Play

This paper has aimed to extend existing conceptualizations for the relatedness factor of SDT so that it can be better understood and applied within the context of single player educational interactive narrative games. Relatedness traditionally requires a minimum of a dyadic relationship characterized by "contingent responsiveness" that allows a person to psychologically thrive, experience well-being, and support the expression of their "true self." Indeed, Ryan et al. (2006) explicitly posit that "immersion players desire to … engage in role-play and 'be part of the story'," which implies that role-play is more closely associated with presence/immersion than relatedness. According to Tyack and Wyeth, (2017), "it remains improbable that relatedness needs can be fully satisfied without any form of direct human contact." However, various studies (theirs included) have suggested that relatedness can at least be partially satisfied within the context of media and story/character-based games Smith, (1994), Oliver et al. (2016), Tyack and Wyeth (2017), Dechering and Bakkes, (2018), Adachi et al. (2018). This can occur, for instance, when a person forms a parasocial relationship with a celebrity or movie character or when they form a more interactive supportive relationship with an artificial character in a game.

Role-play is an activity common to games that explicitly engages a person's capacity to experience the world from another's perspective as well as to experience *alignment* and *allegiance* with fictional characters. Many people feel very motivated to engage in these kinds of activities and feelings because it is enjoyable (e.g., reading choose your own adventure books). Ultimately, we determined that previous research supported the idea that: **People enjoy role-playing and connecting with fictional characters because it is intrinsically motivating (i.e., via relatedness).** This theory indicates that the act of role-playing and/or connecting with fictional characters is able to satisfy the psychological need to support genuine self-expression and feelings of well-being. Green and Jenkins, (2014) explain that role-play, specifically within the context of interactive narratives, induces identification with a character. They further state that "narrative can affect self-perceptions, … temporarily broaden the reader's perspective, … and expand the self or allow people to explore new possible selves." The authors then emphasize that the act of perspective-taking "may translate into motivation for real-world behavior change."[1] Interactive narratives are typically designed to support self-expression through the provision of choice on behalf of one or more characters (though our analysis indicates that *Academical* could be improved in this respect). Additionally, it is possible for educational interactive narratives to encourage feelings of

[1]Another body of research has shown that VR experiences that manipulate embodiment by spatially swapping perspectives can also be effective for promoting moral judgement and ethical decision making (Seinfeld et al. (2018); Herrera et al. (2018); Stavroulia and Lanitis (2019)). This type of experience is technologically more complex and currently not as accessible as playing an interactive narrative game, suggesting that it is less convenient as a means for mass education. Nonetheless, it emphasizes the value of perspective-taking for driving behavior change and may even be more effective than interactive narratives at facilitating presence/immersion (Herrera et al. (2018)). Our current methodology may be useful for evaluating how these two learning environments relate to each other in terms of enjoyment and efficacy.

well-being through attitude and behavioral change. Indeed, we previously found that our game is capable of significantly improving attitudes about RCR training Grasse et al. (2021), though we do not know if these changes in attitude were associated with the exploration of possible selves or increased feelings of well-being. Our current research evaluating the reasons why players felt that playing *Academical* was enjoyable provides some support to the theory that role-play induces feelings of relatedness. Of the 77 participants in our case study, many made a point to explain that they especially liked the perspective-taking (i.e., role-playing) experience that the game provided. That this experiential aspect was such a prominent explanation for the game's enjoyment, combined with the fact that the majority of the other responses involved other intrinsic motivations, suggests that the role-playing nature of the game may have contributed to SDT-based need satisfaction. However, more research is required to confirm this hypothesis.

5.3 Study Limitations and Future Work

This case study had a variety of limitations, especially in its ability to confirm the relationship between role-play and relatedness. This issue could have been addressed by asking the participants to complete a validated SDT-based survey such as the PENS or UPEQ. Furthermore, though our analysis is based on rubrics informed by popular psychological theory (i.e., SDT), other literature suggests that our assessment of presence/immersion may be oversimplified McMahon, (2003), Mestre et al. (2006), Roth and Koenitz (2016). Moving forward, future studies will account for the differences and relationship between presence and immersion using more nuanced assessment tools, such as the Game Experience Questionnaire (GEQ) Johnson et al. (2018) [2]or Roth's measurement toolbox for evaluating the user experience of interactive digital narratives Roth, (2016). Next, we recognize that the participant pool (i.e., undergraduates pursuing mainly design and engineering degrees) is not an ideal target population for this study. For example, the number of negative responses that mentioned feeling unrelatable to the content of the stories could be lower for graduate students and/or undergraduates intent on pursuing a career in science. Additionally, the results we discussed were most relevant in the assessment of our game and therefore may not hold true for other narrative-based games. In particular, educational interactive narrative games are by design more relatable than those for entertainment, and so some of our observations may only be applicable for the former sub-genre. Finally, our data collection methods were designed to only capture information about what made the game most or least enjoyable. Therefore, we were not able to report the prevalence or subjective importance of every SDT-based factor for each participant.

While this study constitutes a valuable starting point, in future studies we want to dive more deeply into determining explanations for why players perceive some game design features to assist enjoyment and engagement more than others (e.g., by conducting semi-structured interviews rather than online surveys). We can use these results to better predict how much impact certain changes will have on improving the quality of the game experience for a wide player audience. Ultimately, an interesting line of research would involve manipulating features of the game that we expect would directly impact specific need satisfactions Tamborini et al. (2010), Peng et al. (2012). In this way, we would be able to confirm whether the act of role-playing supports intrinsic need satisfaction via relatedness.

[2]Though see (Law et al. (2018)) for concerns regarding use of this particular assessment tool.

6 CONCLUSION

Using the lens of Self-Determination Theory, this case study extensively elaborated design considerations for our choice-based interactive narrative game, *Academical*. Our results bolster the importance of satisfying intrinsic motivations for making educational interactive narrative games in general enjoyable to play. Overall, we found that the most salient aspects of our game's design involved the need for autonomy and competence, and that these motivations were about twice as prevalent as relatedness and presence/immersion. Furthermore, all SDT-based factors combined were about twice as prevalent as non-SDT factors (e.g., game design aesthetics). Additionally, we evaluated the relevance of role-play for satisfying the need for relatedness. We concluded that our results provided some support for the idea that the act of role-playing and connecting with fictional characters is intrinsically motivating to players, but that further work is required to confirm this theory.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board of UCSC. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

KG designed and conducted the experiment, coded the qualitative data and authored the manuscript. MK coded the qualitative data and contributed to the manuscript. NW-F oversaw the development of the *Academical* game. MM provided contributions to the theories discussed in the manuscript. EM funded the experiment, coded the qualitative data and contributed to the manuscript.

ACKNOWLEDGMENTS

The authors would like to thank Jim Moore and the UCSC Division of Graduate Studies for sponsoring the development and evaluation of Academical. We would also like to thank the

many UCSC graduate and undergraduate students that assisted with various aspects of the game's development—particularly James Ryan, Nick Junius and Squinky, who led the development of successive versions of the game.

REFERENCES

Adachi, P. J. C., Ryan, R. M., Frye, J., McClurg, D., and Rigby, C. S. (2018). "I Can't Wait for the Next Episode!" Investigating the Motivational Pull of Television Dramas through the Lens of Self-Determination Theory. *Motivation Sci.* 4, 78–94. doi:10.1037/mot0000063

Ainley, M., and Ainley, J. (2011). Student Engagement with Science in Early Adolescence: The Contribution of Enjoyment to Students' Continuing Interest in Learning about Science. *Contemp. Educ. Psychol.* 36, 4–12. doi:10.1016/j.cedpsych.2010.08.001

Angeli, C., and Valanides, N. (2004). Examining the Effects of Text-Only and Text-And-Visual Instructional Materials on the Achievement of Field-dependent and Field-independent Learners during Problem-Solving with Modeling Software. *Educ. Technol. Res. Dev.* 52, 23–36. doi:10.1007/bf02504715

Antes, A. L., Wang, X., Mumford, M. D., Brown, R. P., Connelly, S., and Devenport, L. D. (2010). Evaluating the Effects that Existing Instruction on Responsible Conduct of Research Has on Ethical Decision Making. *Acad. Med.* 85, 519–526. doi:10.1097/acm.0b013e3181cd1cc5

Aylett, R. S., Louchart, S., Dias, J., Paiva, A., and Vala, M. (2005). "FearNot! - an Experiment in Emergent Narrative," in *International Workshop on Intelligent Virtual Agents* (Springer), 305–316. doi:10.1007/11550617_26

Azadvar, A., and Canossa, A. (2018). "UPEQ: Ubisoft Perceived Experience Qquestionnaire: A Self-Determination Evaluation Tool for Video Games," in Proceedings of the 13th International Conference on the Foundations of Digital Games.

Bopp, J. A., Müller, L. J., Aeschbach, L. F., Opwis, K., and Mekler, E. D. (2019). "Exploring Emotional Attachment to Game Characters," in Proceedings of the Annual Symposium on Computer-Human Interaction in Play, 313–324. doi:10.1145/3311350.3347169

Busselle, R., and Bilandzic, H. (2009). Measuring Narrative Engagement. *Media Psychol.* 12, 321–347. doi:10.1080/15213260903287259

Camingue, J., Melcer, E. F., and Carstensdottir, E. (2020). "A (Visual) Novel Route to Learning: A Taxonomy of Teaching Strategies in Visual Novels," in International Conference on the Foundations of Digital Games. FDG '20. doi:10.1145/3402942.3403004

Christopoulos, D., Mavridis, P., Andreadis, A., and Karigiannis, J. N. (2011). "Using Virtual Environments to Tell the Story: "The Battle of Thermopylae"," in 2011 Third International Conference on Games and Virtual Worlds for Serious Applications (IEEE), 84–91. doi:10.1109/vs-games.2011.18

Cuerdo, M. A. M., Mahajan, A., and Melcer, E. F. (2021). "Die-r Consequences: Player Experience and the Design of Failure through Respawning Mechanics," in 2021 IEEE Conference on Games (CoG) (IEEE), 01–08. doi:10.1109/cog52621.2021.9618894

Cuerdo, M. A. M., and Melcer, E. F. (2020). "I'll Be Back": A Taxonomy of Death and Rebirth in Platformer Video Games," in Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems, 1–13. doi:10.1145/3334480.3382863

Danilicheva, P., Klimenko, S., Baturin, Y., and Serebrov, A. (2009). "Education in Virtual Worlds: Virtual Storytelling," in 2009 International Conference on CyberWorlds (IEEE). doi:10.1109/cw.2009.57

Dechering, A., and Bakkes, S. (2018). "Moral Engagement in Interactive Narrative Games: an Exploratory Study on Ethical Agency in the Walking Dead and Life Is Strange," in Proceedings of the 13th International Conference on the Foundations of Digital Games, 1–10.

Dias, L. P. S., Barbosa, J. L. V., and Vianna, H. D. (2018). Gamification and Serious Games in Depression Care: A Systematic Mapping Study. *Telematics Inf.* 35, 213–224. doi:10.1016/j.tele.2017.11.002

Dickey, M. D. (2006). Game Design Narrative for Learning: Appropriating Adventure Game Design Narrative Devices and Techniques for the Design of Interactive Learning Environments. *Educ. Tech Res. Dev* 54, 245–263. doi:10.1007/s11423-006-8806-y

Diez, J. D. S., and Melcer, E. F. (2020). "Cookie Mania: A Serious Game for Teaching Internet Cookies to High School and College Students," in Joint International Conference on Serious Games (Springer), 69–77. doi:10.1007/978-3-030-61814-8_5

Göbel, S., de Carvalho Rodrigues, A., Mehm, F., and Steinmetz, R. (2009). Narrative Game-Based Learning Objects for Story-Based Digital Educational Games. *Narrative* 14, 16.

Göbel, S., and Mehm, F. (2013). "Personalized, Adaptive Digital Educational Games Using Narrative Game-Based Learning Objects," in Serious Games and Virtual Worlds in Education, Professional Development, and Healthcare (IGI Global), 74–84. doi:10.4018/978-1-4666-3673-6.ch005

Grasse, K. M., Melcer, E. F., Kreminski, M., Junius, N., Ryan, J., and Wardrip-Fruin, N. (2022). "Academical: A Choice-Based Interactive Storytelling Game for Enhancing Moral Reasoning, Knowledge, and Attitudes in Responsible Conduct of Research," in *Games and Narrative: Theory and Practice* (Springer), 173–189. doi:10.1007/978-3-030-81538-7_12

Grasse, K. M., Melcer, E. F., Kreminski, M., Junius, N., and Wardrip-Fruin, N. (2021). "Improving Undergraduate Attitudes towards Responsible Conduct of Research through an Interactive Storytelling Game," in Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems, 1–8. doi:10.1145/3411763.3451722

Green, M. C., and Jenkins, K. M. (2014). Interactive Narratives: Processes and Outcomes in User-Directed Stories. *J. Commun.* 64, 479–500. doi:10.1111/jcom.12093

Green, M. C. (2021). *Transportation into Narrative Worlds*, 87. London, United Kingdom: Entertainment-Education Behind the Scenes.

Hamari, J., Shernoff, D. J., Rowe, E., Coller, B., Asbell-Clarke, J., and Edwards, T. (2016). Challenging Games Help Students Learn: An Empirical Study on Engagement, Flow and Immersion in Game-Based Learning. *Comput. Hum. Behav.* 54, 170–179. doi:10.1016/j.chb.2015.07.045

Herrera, F., Bailenson, J., Weisz, E., Ogle, E., and Zaki, J. (2018). Building Long-Term Empathy: A Large-Scale Comparison of Traditional and Virtual Reality Perspective-Taking. *Plos One* 13, e0204494. doi:10.1371/journal.pone.0204494

Hodhod, R., Cairns, P., and Kudenko, D. (2011). "Innovative Integrated Architecture for Educational Games: Challenges and Merits," in *Transactions on Edutainment V* (Springer), 1–34. doi:10.1007/978-3-642-18452-9_1

Johnson, D., Gardner, M. J., and Perry, R. (2018). Validation of Two Game Experience Scales: The Player Experience of Need Satisfaction (PENS) and Game Experience Questionnaire (GEQ). *Int. J. Human-Computer Stud.* 118, 38–46. doi:10.1016/j.ijhcs.2018.05.003

Kalichman, M. (2016). Responsible Conduct of Research Education (What, Why, and Does it Work?). *Acad. Med.* 91, e10. doi:10.1097/acm.0000000000001442

Kavli, K. (2012). "The Player's Parasocial Interaction with Digital Entities," in Proceeding of the 16th International Academic MindTrek Conference, 83–89. doi:10.1145/2393132.2393150

Kickmeier-Rust, M. D., Göbel, S., and Albert, D. (2008). "80Days: Melding Adaptive Educational Technology and Adaptive and Interactive Storytelling in Digital Educational Games," in Proceedings of the First International Workshop on Story-Telling and Educational Games (STEG'08).

Law, E. L.-C., Brühlmann, F., and Mekler, E. D. (2018). "Systematic Review and Validation of the Game Experience Questionnaire (GEQ) – Implications for Citation and Reporting Practice," in Proceedings of the 2018 Annual Symposium on Computer-Human Interaction in Play, 257–270.

Magerko, B. (2007). Evaluating Preemptive Story Direction in the Interactive Drama Architecture. *J. Game Dev.* 2, 25–52.

Mann, K., Gordon, J., and MacLeod, A. (2009). Reflection and Reflective Practice in Health Professions Education: A Systematic Review. *Adv Health Sci Educ* 14, 595–621. doi:10.1007/s10459-007-9090-2

McMahon, A. (2003). "Immersion, Engagement, and Presence," in *The Video Game Theory Reader*. Editors M. P. Wolf and B. Perron (New York.

Melcer, E. F., and Cuerdo, M. A. M. (2020). "Death and Rebirth in Platformer Games," in *Game User Experience and Player-Centered Design* (Cham: Springer), 265–293. doi:10.1007/978-3-030-37643-7_12

Melcer, E. F., Grasse, K. M., Ryan, J., Junius, N., Kreminski, M., Squinkifer, D., et al. (2020a). "Getting Academical: A Choice-Based Interactive Storytelling Game for Teaching Responsible Conduct of Research," in roceedings of the 15th International Conference on the Foundations of Digital Games-FDG. doi:10.1145/3402942.3403005*P*

Melcer, E. F., Ryan, J., Junius, N., Kreminski, M., Squinkifer, D., Hill, B., et al. (2020b). "Teaching Responsible Conduct of Research Through an Interactive Storytelling Game," in Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems, 1–10. doi:10.1145/3334480.3382973

Melcer, E. F., and Isbister, K. (2018). "Bots & (Main) Frames: Exploring the Impact of Tangible Blocks and Collaborative Play in an Educational Programming Game," in Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, 1–14.

Melcer, E. F., Nguyen, T.-H. D., Chen, Z., Canossa, A., El-Nasr, M. S., and Isbister, K. (2015). "Games Research Today: Analyzing the Academic Landscape 2000-2014," in Proceedings of the 10th International Conference on the Foundations of Digital Games.

Mestre, D., Fuchs, P., Berthoz, A., and Vercher, J. (2006). *Immersion et présence*. Le traité de la réalité virtuelle. Paris: Ecole des Mines de Paris.

Nguyen, T.-H. D., Melcer, E., Canossa, A., Isbister, K., and Seif El-Nasr, M. (2018). Seagull: A Bird's-Eye View of the Evolution of Technical Games Research. *Entertain. Comput.* 26, 88–104. doi:10.1016/j.entcom.2018.02.002

Oliver, M. B., Bowman, N. D., Woolley, J. K., Rogers, R., Sherrick, B. I., and Chung, M.-Y. (2016). Video Games as Meaningful Entertainment Experiences. *Psychol. Popular Media Cult.* 5, 390–405. doi:10.1037/ppm0000066

Padilla-Zea, N., Gutiérrez, F. L., López-Arcos, J. R., Abad-Arranz, A., and Paderewski, P. (2014). Modeling Storytelling to Be Used in Educational Video Games. *Comput. Hum. Behav.* 31, 461–474. doi:10.1016/j.chb.2013.04.020

Peng, W., Lin, J.-H., Pfeiffer, K. A., and Winn, B. (2012). Need Satisfaction Supportive Game Features as Motivational Determinants: An Experimental Study of a Self-Determination Theory Guided Exergame. *Media Psychol.* 15, 175–196. doi:10.1080/15213269.2012.673850

Plemmons, D. K., and Kalichman, M. W. (2013). Reported Goals of Instructors of Responsible Conduct of Research for Teaching of Skills. *J. Empir. Res. Hum. Res. Ethics* 8, 95–103. doi:10.1525/jer.2013.8.2.95

Powell, S. T., Allison, M. A., and Kalichman, M. W. (2007). Effectiveness of a Responsible Conduct of Research Course: A Preliminary Study. *Sci. Eng. Ethics* 13, 249–264. doi:10.1007/s11948-007-9012-y

Przybylski, A. K., Rigby, C. S., and Ryan, R. M. (2010). A Motivational Model of Video Game Engagement. *Rev. general Psychol.* 14, 154–166. doi:10.1037/a0019440

Riedl, M. O., Stern, A., Dini, D., and Alderman, J. (2008). "Dynamic Experience Management in Virtual Worlds for Entertainment, Education, and Training," in International Transactions on Systems Science and Applications, Special Issue on Agent Based Systems for Human Learning, 23–42.4

Rigby, S., and Ryan, R. M. (2011). *Glued to Games: How Video Games Draw Us in and Hold Us Spellbound*. Santa Barbara, CA: AbC-CLIo.

Roth, C. (2016). *Experiencing Interactive Storytelling*. Ph.D. thesisVrije Universiteit Amsterdam.

Roth, C., and Koenitz, H. (2016). "Evaluating the User Experience of Interactive Digital Narrative," in Proceedings of the 1st International Workshop on Multimedia Alternate Realities, 31–36. doi:10.1145/2983298.2983302

Rowe, J. P., and Lester, J. C. (2010). "Modeling User Knowledge with Dynamic Bayesian Networks in Interactive Narrative Environments," in Sixth Artificial Intelligence and Interactive Digital Entertainment Conference.

Rowe, J. P., Shores, L. R., Mott, B. W., and Lester, J. C. (2011). Integrating Learning, Problem Solving, and Engagement in Narrative-Centered Learning Environments. *Int. J. Artif. Intell. Educ.* 21, 115–133.

Rubin, A. M., and Perse, E. M. (1987). Audience Activity and Soap Opera Involvement A Uses and Effects Investigation. *Hum. Comm. Res.* 14, 246–268. doi:10.1111/j.1468-2958.1987.tb00129.x

Ryan, R. M., and Deci, E. L. (2017). *Self-Determination Theory: Basic Psychological Needs in Motivation, Development, and Wellness*. New York, NY: Guilford Publications.

Ryan, R. M., Rigby, C. S., and Przybylski, A. (2006). The Motivational Pull of Video Games: A Self-Determination Theory Approach. *Motiv. Emot.* 30, 344–360. doi:10.1007/s11031-006-9051-8

Schneider, R. (2001). Toward a Cognitive Theory of Literary Character: The Dynamics of Mental-Model Construction. *Style* 35, 607–639.

Schramm, H., and Hartmann, T. (2008). *The PSI-Process Scales. A New Measure to Assess the Intensity and Breadth of Parasocial Processes*. Berlin, DE: Walter de Gruyter.

Seinfeld, S., Arroyo-Palacios, J., Iruretagoyena, G., Hortensius, R., Zapata, L. E., Borland, D., et al. (2018). Offenders Become the Victim in Virtual Reality: Impact of Changing Perspective in Domestic Violence. *Sci. Rep.* 8, 2692–2711. doi:10.1038/s41598-018-19987-7

Smith, M. (1994). Altered States: Character and Emotional Response in the Cinema. *Cine. J.* 33, 34–56. doi:10.2307/1225898

Song, Q., He, L., and Hu, X. (2012). To Improve the Interactivity of the History Educational Games with Digital Interactive Storytelling. *Phys. Procedia* 33, 1798–1802. doi:10.1016/j.phpro.2012.05.287

Spierling, U. (2008). "'Killer Phrases': Design Steps for a Game with Digital Role-Playing Agents," in *Transactions on Edutainment I* (Springer), 150–161. doi:10.1007/978-3-540-69744-2_13

Starks, K., Barker, D., and Cole, A. (2016). "Using Twine as a Therapeutic Writing Tool for Creating Serious Games," in Proc. Joint International Conference on Serious Games (Springer), 89–103. doi:10.1007/978-3-319-45841-0_8

Stavroulia, K. E., and Lanitis, A. (2019). Enhancing Reflection and Empathy Skills via Using a Virtual Reality Based Learning Framework. *Int. J. Emerg. Technol. Learn.* 14, 18–36. doi:10.3991/ijet.v14i07.9946

Tamborini, R., Bowman, N. D., Eden, A., Grizzard, M., and Organ, A. (2010). Defining Media Enjoyment as the Satisfaction of Intrinsic Needs. *J. Commun.* 60, 758–777. doi:10.1111/j.1460-2466.2010.01513.x

Tyack, A., and Mekler, E. D. (2020). "Self-Determination Theory in HCI Games Research: Current Uses and Open Questions," in Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems, 1–22. doi:10.1145/3313831.3376723

Tyack, A., and Wyeth, P. (2017). "Exploring Relatedness in Single-Player Video Game Play," in Proceedings of the 29th Australian conference on computer-human interaction, 422–427. doi:10.1145/3152771.3156149

Villareale, J., Biemer, F., Seif El-Nasr, M., and Zhu, J. (2020). "Reflection in Game-Based Learning: A Survey of Programming Games," in International Conference on the Foundations of Digital Games, 1–9. doi:10.1145/3402942.3403011

Wang, P., Rowe, J., Mott, B., and Lester, J. (2016). "Decomposing Drama Management in Educational Interactive Narrative: A Modular Reinforcement Learning Approach," in International Conference on Interactive Digital Storytelling (Springer), 270–282. doi:10.1007/978-3-319-48279-8_24

Watson, S., Vannini, N., Davis, M., Woods, S., Hall, M., Hall, L., et al. (2007). FearNot! an Anti-bullying Intervention: Evaluation of an Interactive Virtual Learning Environment. *Artif. Intell. Simul. Behav. (AISB)* 24, 446–452.

Weiß, S. A., and Müller, W. (2008). "The Potential of Interactive Digital Storytelling for the Creation of Educational Computer Games," in International Conference on Technologies for E-Learning and Digital Entertainment (Springer), 475–486. doi:10.1007/978-3-540-69736-7_51

Weng, J.-F., Kuo, H.-l., and Tseng, S.-S. (2011). *Interactive Storytelling for Elementary School Nature Science Education*. IEEE 11th International Conference on Advanced Learning Technologies IEEE, 336–338.

Zhang, L., Bowman, D. A., and Jones, C. N. (2019). "Exploring Effects of Interactivity on Learning with Interactive Storytelling in Immersive Virtual Reality," in 2019 11th International Conference on Virtual Worlds and Games for Serious Applications (VS-Games) (IEEE). doi:10.1109/vs-games.2019.8864531

Zook, A., Lee-Urban, S., Riedl, M. O., Holden, H. K., Sottilare, R. A., and Brawner, K. W. (2012). "Automated Scenario Generation: Toward Tailored and Optimized Military Training in Virtual Environments," in Proceedings of the International Conference on the Foundations of Digital Games, 164–171.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.