The Teaching Efficacy of the Protégé Effect in Gamified Education

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Abstract—Researchers and designers have considered how gamification can make education more effective. In this paper, the role of player-character relationships is considered. Designers can use various factors to get users attached to their character, including the feeling of responsibility. In this paper, we investigate whether feeling responsible for one's in-game character improved the efficacy of a gamified educational experience. An educational, gamified story called *Humanatees* was designed to incite the protégé effect to see if participants learned more when they felt responsible for their character. The results suggest that participants in the experimental condition achieved significantly higher learning gains, providing evidence for the protégé effect. However, how this effect is established is more complex than feeling responsible. Future work should shed more light on the dynamics behind the protégé effect.

Index Terms—responsibility, protégé effect, player-character relationship, gamification, education

I. INTRODUCTION

Gamifying education has long been considered as having considerable potential for making education more effective [1]–[3]. While significant progress has been made, it is still unclear how to design such gamified educational experiences beyond the now commonly well-known best practices such as working with subject-matter experts and integrating content, (frequent) playtesting, and balancing gameplay. Recent work suggests that we should look deeper into the role of specific game mechanics [4] or game attributes [5]. In this light, the present paper considers and evaluates the role of player-character relationships on the efficacy of gamified educational experiences.

Depending on the purpose of the experience, some developers will address players directly ("players playing as themselves") while some will put players into different kinds of roles and relationships with the game character that they control (or avatar).[1] The feelings players have about their characters and the kinds of relationships players form with their characters can influence their experience. In their study

[1]While we acknowledge that a player-character and avatar are different (see [6], [7]), we use them interchangeably as the research is relevant for both.

of avatars, Bowman et al. [8] found that players who reported on pleasurable or exciting video games tended to feel a greater sense of control over their online avatars. They also noted that players who "reported on meaningful video games...were players who tended to feel stronger senses of responsibility over their avatars" [8, p. 2]. When discussing meaningful experiences participants had during gameplay, Banks and Bowman [9] were specifically referring to experiences that "fostered a sense of appreciation, introspection, and self-reflection of the game experience" (p. 2). Banks and Bowman's research suggests that there is a connection between a player's sense of responsibility for the avatar and the game's meaningful aspects affecting the player more than it would otherwise. This can include a player's responsibility for game characters as well. The aforementioned suggests that encouraging players to feel responsible for their character will help the experience be more successful at achieving its purpose.

Following this, the purpose of this paper was to study if the teaching efficacy of a gamified educational experience will improve when players feel responsible for their in-game character. More specifically, we hypothesized if the *protégé effect* would occur. This effect suggests that one learns better when intending to teach others than they would when learning for their own benefit. To examine this effect, we created a gamified experience for this study, *Humanatees*, which aims to teach players about the West Indian manatee. In *Humanatees*, participants receive either a self-selected character that they were told they control, or this self-selected character turns out to be someone that asks for their help in learning about manatees, making participants feel a sense of responsibility for that character. Through our study with *Humanatees*, we contribute to understanding how specific design aspects, here how players relate to their character, can influence the teaching efficacy of gamified educational experiences.

II. RELATED WORK

A. Gamified Education

Deterding et al. [10] defined the broad topic of gamification as the use of game design elements in non-gaming contexts. The practice has been used in multiple fields, such as fitness

and health [11], advertising [12], and particularly education [13], [14]. Numerous researchers have incorporated game design elements in educational settings such as classrooms and online courses, with many reporting improved learner motivation, engagement, and enjoyment [15], [16]. In an empirical review [17] results indicate that the majority of gamified systems in education lean toward a positive effect on the engagement of students; however, the amount of mixed results is considerable. For gamification to enhance learning outcomes, it must be carefully designed and implemented to align with the specific learning objectives of the course or curriculum [18]. Moreover, it is important to use gamification in meaningful ways to enhance engagement, motivation, and learning outcomes in education [16], which goes beyond simply adding game-like elements to non-game contexts. Instead, it should focus on designing experiences that align with the goals, interests, and values of the users. One way to foster meaningful gamification is the consideration of narrative, and storylines as a gamification mechanic have been demonstrated to keep learners engaged [19]. In our work, we focus on the efficacy of a particular narrative element: How players relate to characters in gamified educational scenarios.

B. Player-Character Relationships

Player-character relationships are an essential facet of game design. Erb et al. [20] suggest that the player-character relationship is a crucial factor in players' overall satisfaction with narrative-driven video games. The authors further argue that games that allow players to control multiple characters and develop emotional connections with them can enhance players' engagement and enjoyment of the game's narrative.

Banks [21] argues that the relationship between players and avatars is based on three factors, each one on a spectrum from high and low: self-differentiation (the extent to which the player and avatar are experienced as distinct social agents), emotional intimacy (the degree of sentimentality players felt for their avatar), and agency (between the player and the avatar being perceived as "in-charge"). From these factors, Banks listed four different types of relationships that players and avatars can have: avatar-as-object (the avatar is how the player interacts with the game and nothing more), avatar-as-Me (the avatar is Me in the game), avatar-as-symbiote (the avatar is a new persona), and avatar-as-other (the avatar is its own being).

The design of the avatar and level of resemblance could influence the player-character relationship. For example, Nizam et al. [22] examined three types of avatar design: realistic, cartoonish, and abstract, and found that participants who played the game with a realistic avatar design reported higher levels of engagement and enjoyment compared to those who played with a cartoonish or abstract avatar design. Moreover, Birk et al. [23] articulate that participants who played with an avatar that resembled them reported higher levels of intrinsic motivation to play the game than those who played with an avatar that did not resemble them.

Game characters are different from avatars in that avatars represent the player in online spaces. The player sees other players in the form of their avatars, and other players perceive the player as their avatar [7]. Characters, on the other hand, allow the game player to immerse themselves into the game world by becoming attached to the character that is defined and scripted by the designers. Character attachment is the "internalization and psychological merging of a player's and a character's mind" [6, p. 515]. The mechanisms that result in character attachment were defined as "an individual's feelings of (a) friendship and (b) identification with a video game character when an individual (c) is willing to suspend disbelief, (d) feels responsible for the game character, and (e) feels in control of the game character's actions" [6, p. 516].

Studies suggest that players typically identify more strongly with characters that they pick for themselves. This might involve players using or making characters that look like themselves, but that does not apply to every type of player. Yang et al. [24] ran a study to see if the effects of violent video games on player aggression are moderated by the genders of the players and the genders of their characters. The results indicate that players more strongly identified with similarly gendered characters. This would suggest that players should ideally be given characters that match their gender to strengthen the player-character relationship, but some players may prefer dissimilar characters. Soutter and Hitchens [25] discussed two factors that influence character identification, a concept similar to character attachment. These factors were (1) the similarities between the character and player and (2) life satisfaction and the game's requirements. The former can refer to demographic information such as race or gender, as well as personality and past experiences. For the latter, "players identify with similar characters only if their life satisfaction is high and the game requires or allows for a similar character; however, if one's life satisfaction is low or the game requires a dissimilar character, players will identify with a dissimilar character" [25, p. 1033]. The more dissatisfied players are with their own circumstances, or the more the game requires a dissimilar character, the more likely players are to adopt the identity of a character dissimilar from themselves. This suggests that players should be allowed to choose their character for themselves to form a strong relationship. This can be done through character-customization tools. Studies such as Birk et al. [23] suggest that players typically identify more strongly with characters they create themselves using such tools. Based on this prior work, we considered that choosing a character should be a basic aspect of our work.

C. Player-Character Emotional Attachment

Character attachment is an essential element for creating engaging and emotionally rich gaming experiences. In this paper, we use character attachment as an umbrella to explain various emotional feelings between player-character such as empathy, loyalty, and responsibility. Accordingly, in character attachment literature several concepts are relevant to character attachment in games, especially identification. According to Cohen [26] identification is the act of imagining oneself as the character, considering both the character and oneself as a

single entity. In particular, similarity identification pertains to the phenomenon where individuals identify with a character who shares similarities with them.

To elaborate on emotional attachment, Banks and Bowman [27] propose that players may form emotional bonds with their avatars in a similar way that individuals form attachments to other people. In their study, they examined participants' attachment style, relationship with their avatars, and levels of agency and intimacy. The results showed that attachment style was related to the level of intimacy and agency that participants reported feeling toward their avatars. Additionally, the study found that players who reported feeling a higher level of intimacy with their avatars also reported greater enjoyment of the game. Szolin et al. [28] found that players developed strong emotional connections with their avatars and viewed them as extensions of themselves. Players described feeling a sense of ownership over their avatars and experiencing emotions such as pride, frustration, and empathy in response to their avatar's actions and experiences.

Many factors influence emotional attachment in games. The study by Bopp et al. [29] found that players can form emotional attachments to game characters and these attachments are influenced by a variety of factors, including the character's appearance, personality, backstory, and behavior. Moreover, players may perceive characters differently. Isbister [30] explains how players experience characters differently based on their social roles. She examines the role of emotion, empathy, personality, and social interaction in creating effective game characters, and provides practical advice for developers on how to use these insights to improve their character design [30]. In another study, Emmerichet al. [31] found that players evaluated companion characters more positively when they were perceived as offering a "meaningful emotional relationship" [31, p. 149].

There are several outcomes when players feel an emotional attachment to characters, for example, Szolin et al. [32] argue that emotional attachment can create a sense of escapism, where players feel a sense of belonging and control within the game world that they may not experience in their real lives. The authors suggest that emotional attachment may lead to increased gaming time, social isolation, and neglect of real-life responsibilities. However, they acknowledge that emotional attachment can have positive effects on players, such as increased motivation and enjoyment. The results of the study by Banks and Bowman [27] show that attachment and intimacy are positively associated with enjoyment and appreciation of the game, while agency is negatively associated. This suggests that players who feel emotionally invested in their avatar and experience a sense of closeness are more likely to enjoy and appreciate the game. On the other hand, players who feel a high degree of control over their avatar may not experience the same level of emotional investment.

Moreover, Bopp et al. [29] also found that emotional attachment to game characters can lead to positive outcomes, such as increased enjoyment of the game, and negative outcomes, such as frustration when the character is killed or when the game ends. The results of the study showed that emotional attachment to game characters can be measured and is positively associated with character likability, perceived similarity to the player, and the degree to which the character is perceived as a partner or friend. Additionally, the authors found that attachment to game characters is positively related to the player's enjoyment of the game and the player's willingness to continue playing the game. Bopp et al. also explain how different forms of attachment are defined based on emotional qualities, such as players' excitement, admiration of role models, or feeling concerned or responsible about their protégé. Research done by Bowman et al. [8] suggests that players who feel a sense of responsibility or care for their avatar found their game experiences more meaningful. They had players report on both their most enjoyable video game experience and their most meaningful video game experience. Players who reported on enjoyable games tended to feel a great sense of control over their avatars. Players who reported on "meaningful video games—games that fostered a sense of appreciation, introspection, and self-reflection of the game experience—were players who tended to feel strong senses of responsibility over their avatars" [27, p. 2].

Thus, character attachment is multifaceted but can have important positive effects. Importantly, prior work suggests that *feeling responsible* can be an important contributor, which gives rise to the possibility of the protégé effect.

D. Protégé effect

The protégé effect is the phenomenon where one learns better when intending to teach others than they would have when learning for their own benefit. This can include teaching artificial learners, such as robots [33]. Suttie et al. [34] and Arnab et al. [4] sought to map game mechanics to learning mechanics to aid the development of serious games. Both sets of researchers found that the protégé effect, when used as a game mechanic in serious games, taught and encouraged players to take responsibility. "The protégé effect is not a learning goal but is the [Serious Game Mechanic] through which the goal can be achieved" [4, p. 401]. In another study [35], scholars developed teachable agents (i.e., computer-based characters) to interact with students and provide personalized feedback to study the protégé effect. They found that teachable agents can serve as a form of protégé, allowing students to teach the agent and in turn improve their own learning outcomes. The authors suggest that teachable agents can increase student motivation and effort toward learning, as students are more willing to invest time and energy into teaching the agent. The protégé effect is a tool through which responsibility is inoculated, and this responsibility can improve the efficacy of an experience in terms of its learning outcomes. Thus, *Humanatees* implemented the protégé effect to incite responsibility in users, and it did this by giving users a character who needed their help. With this in mind, our hypotheses are as follows:

1) *The protégé effect*: Participants will learn more in *Humanatees* when they are helping their game character (H1).

2) *Role of responsibility*: Increased feelings of responsibility will affect learning outcomes (H2).

The first hypothesis establishes whether we find evidence for the protégé effect; whereas the second hypothesis seeks to explain why this effect occurs, which we hypothesize is a logical result of increased feelings of responsibility.

III. METHODS

A. Participants

Participants were recruited from a University Campus and through various online outlets (e.g., Twitter). Through these recruitment methods, 113 users participated, with 92 of those completing the game and submitting their results. Two participants were removed from the collected data, as they were considered outliers, resulting in a total of 90 participants. Participation was fully anonymous and voluntary.

B. Experimental Design

The main manipulation in this study was to give a character the participants need to help (instead of being themselves) to incite the protégé effect (Figure 1). In the experimental condition ($n = 45$), participants were introduced to a character who asked them for help in learning about manatees ("avatar-as-other" [21]). This was meant to create a feeling of responsibility. In the control condition ($n = 45$), participants were told they would need to learn about manatees using a character to interact with the game world ("avatar-as-Me" [21]).

C. Materials and Measures[2]

1) Humanatees: Humanatees is an interactive 2D story where players choose a character and attend a lecture about manatees. The player clicks to read the utterances of an omniscient narrator, their player-character, and the teacher. At times the player is presented with response options or an open response prompt, which are all meant to engage them in the narrative. *Humanatees* was created with *StudyCrafter*, a free program that allows users to easily create gamified projects and share them online [36], [37].[3]

2) Manatees Pre/Post Knowledge Test and In-Game Lecture: West Indian manatees were primarily chosen as the subject of the game to lower the likelihood of participants having prior knowledge. Additionally, we believed participants would be enticed to learn about manatees because they are intriguing and, unfortunately, endangered species. To measure the effectiveness of each study condition, we evaluated how much participants learned about manatees by comparing what they knew before and after the in-game lecture with a "Manatees Pre/Post Knowledge Test," similar to Papastergiou [15].

Both the pre- and post-test include six questions with four choices, including an "I don't know" option. The post-test questions were different because paying attention to the pre-test may have influenced post-test results rather than paying attention during the lecture due to increased feelings of responsibility caused by the protégé effect. The right answers

on the post-test can be given based on the information given during the in-game lecture by a (teacher) character in the game. Examples of questions are: "Which of these is *not* a risk of quasi-extinction for the West Indian Manatee?" and "The scientific name for the Florida manatee subspecies is..."

The Pre/Post-Test and the in-game lecture were developed from a number of different sources [38]–[42] and were all directly integrated into the *Humanatees* game. For both tests, each correctly answered question resulted in 1 point; therefore, the highest score that can be obtained on either test was 6 points and the lowest possible score was 0 points.

3) The Character Relationship Survey: The Character Relationship survey is based on two validated survey instruments. The first 17 items are from the character attachment survey created by Lewis et al. [6]. These 7-point Likert items measure factors in character attachment, specifically identification/friendship, suspension of disbelief, control, and responsibility. We excluded the item "I daydream about my character," because participants would not spend enough time with their character.

Items 18 to 24 were added from Banks and Bowman's [9] player-avatar interaction scale, specifically the emotional investment (having deep, positive affect for the avatar or relationship) and anthropomorphic autonomy (seeing the avatar as having a human-like agency) subscales, which are additional factors to be considered for examining character relationships. For consistency, we changed this scale from a 10-point to a 7-point Likert scale.

4) Engagement: Engagement can be a contributing factor in interactive experiences [43], [44] such as ours: less engaged players may be obtaining less learning outcomes as they may be paying less attention to the lecture. To consider engagement in our study, we opted for the Game Engagement Questionnaire (GEQ; $\alpha = .85$) [45], a short, validated instrument where players state how they felt while playing the game by responding "yes," "maybe," or "no" on 19 statements (e.g., "The game feels real" or "I lose track of where I am"). Because of the short experience, however, we removed the "maybe" option from the questionnaire to force participants to make a clear choice on how they felt. The highest score that can be obtained on the GEQ is 19. In addition, we considered *playtime*, which is an often-used proxy for engagement in the game industry [46], with the assumption that longer play times would reflect more engagement as these players took time and effort to comprehend the content.

D. Procedure

The application starts with a briefing explaining that participants will be learning about and taking a test on manatees, specifically West Indian manatees. The total experience takes approximately 11 minutes. After consenting to participate, participants were presented with the pre-test. In the next scene, participants are asked to choose a character from a set of eight: four men, four women, each with different skin-tones. This character selection feature was included based on the findings from Yang et al. [24] and Soutter and Hitchens [25], both

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[2]All materials are accessible here: http://hdl.handle.net/2047/D20508750
[3]https://studycrafter.com

Fig. 1. Screenshots from the scene where the participant is introduced to the character they control (left image, control condition) or help (right image, experimental condition).

Fig. 2. Screenshots of the lecture on manatees.

of which suggest that players should be able to choose the character that is most similar or dissimilar to themselves to form a strong relationship with that character.

Participants are then randomly placed into one of the two conditions (see Figure 1). In the control condition, they are shown their chosen character and told by an omniscient narrator that this is the character they control. In the experimental condition, participants are also shown their chosen character but are then introduced that they are called "Rasa." Rasa asks the player for their name, to which the player has the option to give it to Rasa through an open response. Rasa tells players that they have been attending a class to learn about manatees, but have trouble paying attention due to the lecturer's dry way of speaking. Rasa asks the player to attend the lecture to help them. This exchange is meant to incite the protégé effect. Overall, participants in both conditions did not have any interaction differences. The main difference between the conditions was the narrative aspect (whether the character is presented as themselves or Rasa).

In the next scene, participants in both conditions read through a lecture being given by a teacher. The lecture starts by explaining some of the causes behind the endangerment of the West Indian manatee before listing some trivia facts about the species. Players read what the teacher has to say, then click for the next utterance, and continue with this interaction loop until the lecture ends. Following the lecture, they have a conversation with either the omniscient narrator for those in the control condition or Rasa in the experimental condition. This scene contains similar text and choices between the two conditions, and was primarily designed to give time between the lecture and the post-test to prevent a ceiling effect on the post-test scores. This transitioning scene also allowed participants in the experimental condition to get to know Rasa a bit more, and feel more responsible for them. After the transition scene, participants are presented with the post-test. In the control condition, they directly answer with the character they control; with the experimental condition, they give the answers to Rasa. After the post-test, participants were given a survey to evaluate their relationship with their player-character and their engagement with the game and were debriefed about the true purpose of *Humanatees*.

E. Data Analysis

All measures were considered for normality, and because they all violated this assumption, non-parametric statistics

TABLE I
SUMMARY STATISTICS ON MEASURES FOR THE CONTROL AND
EXPERIMENTAL CONDITION, IN M (SD).

	Control	Experimental
Pre-test	1.02 (1.08)	0.93 (1.03)
Post-Test*	4.76 (0.91)	5.18 (0.83)
Identification/Friendship	0.43 (0.26)	0.47 (0.20)
Suspension of Disbelief*	0.42 (0.24)	0.56 (0.25)
Control**	0.71 (0.19)	0.57 (0.26)
Responsibility*	0.46 (0.18)	0.57 (0.23)
Emotional Investment	0.36 (0.20)	0.38 (0.21)
Anthropomorphic Autonomy***	0.34 (0.24)	0.55 (0.24)
Playtime (in s)	641.12 (239.32)	692.98 (209.59)
GEQ	8.00 (4.45)	6.69 (4.28)

* $p < .05$; ** $p < .01$; *** $p < .001$

were chosen (e.g., Spearman correlations).

IV. RESULTS

A. Manatees Pre/Post Knowledge Test Outcomes

The most common pre-test score was 0 out of 6 correct answers, and the most common post-test score was 5 out of 6. This is true for both conditions, suggesting that participants indeed had little prior knowledge about the subject matter and that in either condition the application achieved its educational purpose of teaching about manatees. However, the post-test scores were significantly different between conditions (see Table I), with participants in the experimental condition scoring higher, $U = 1287$, $p = .02$, $r = .25$. Inspection of the individual questions on the post-test shows that more than half of the experimental condition got all six post-test questions right, while the majority in the control condition answered the first question, "The scientific name for the Florida manatee subspecies is...," wrong and the other five right. Therefore, we found evidence supporting H1 or the protégé effect: participants who had Rasa as their character performed better on the post-knowledge test.

B. Character Relationship Survey Outcomes

Table I shows the results of the normalized survey scores for each of the six character relationship factors. Overall, the results show that players across both conditions felt only

moderately affected by the character, which is not surprising given the relatively short experience. There are no significant differences between conditions for the feelings of friendship or identification toward the character, $U = 1017$, $p = .97$, $r < .01$, or participants' emotional investment for their character, $U = 1108$, $p = .44$, $r = .08$. However, participants in the experimental condition suspended their disbelief significantly more, $U = 1324$, $p = .01$, $r = .27$; felt that the character had significantly more autonomy, $U = 1461$, $p < .001$, $r = .38$; and—important for this study—felt significantly more responsible for their character, $U = 1310$, $p = .02$, $r = .26$. On the other hand, participants in the control condition felt significantly more control over their character, $U = 679$, $p < .01$, $r = .29$. Therefore, the manipulation had an impact on various measures of a player-character relationship.

Spearman correlations were performed on the factor scores across both conditions. These correlations suggest that identification/friendship correlates with emotional investment, $r = .54$, $p < .001$; with control over the character, $r = .43$, $p < .001$; and with responsibility for the character, $r = .21$, $p < .05$. Similarly, emotional investment correlates with control, $r = .34$, $p < .01$; and with responsibility, $r = .46$, $p < .001$; but also with anthropomorphic autonomy, $r = .33$, $p < .01$. Therefore, emotional investment, which is in part related to the feelings of friendship or identification toward a character, was strongly associated to feelings of responsibility.

The correlations between the factor and the post-knowledge test scores were also analyzed. The only relationship was that control had a significant negative correlation with the post-knowledge test scores, $r = -.21$, $p = .05$, suggesting that the feeling of control over the character diminished post-test scores. None of the other factors, including responsibility, had a significant correlation with post-knowledge test scores. Thus, we did not find support for H2.

C. Engagement Outcomes

There was a significant negative correlation between play-time across both conditions ($M = 667.15$, $SD = 225.18$) and GEQ ($M = 7.34$, $SD = 4.39$), $r = -0.21$, $p = .04$. This suggests that—contrary to our expectations—participants who took less time to complete the project were more engaged. This engagement, however, had no impact on the manipulation: the time participants took in the experimental condition ($M = 692.98$, $SD = 209.59$) was not significantly different from those in the control condition ($M = 641.12$, $SD = 239.32$), $U = 1216$, $p = 0.1$, $r = 0.17$. Likewise, participants in the experimental condition ($M = 6.69$, $SD = 4.28$) did not significantly differ on the GEQ scores than those in the control condition ($M = 8.0$, $SD = 4.45$), $U = 836$, $p = 0.15$, $r = 0.15$.

V. DISCUSSION

A. Humanatees Is Effective

Humanatees was successful at teaching participants about manatees. The average pre-test scores for each condition were lower than 1 (out of 6), with most participants getting none of the answers right. The post-test scores, on the other hand, were higher than the pre-test scores for both the experimental and control conditions. On the other hand, the GEQ scores were relatively low. While there are no clear benchmarks for the GEQ available and it is unlikely that players would answer positively on some items (e.g., "I feel scared" or "I feel different"), the scores are indicative that the experience may not have been very engaging. Similarly, when it comes to establishing a character relationship, we observe only moderate scores in both conditions. This might be due to the rather short experience, which might have failed to build a sufficient relationship between the player and the character. Several improvements are imaginable, both in what *Humanatees* offers as an experience and how it facilitates player-character relationships. For example, as a gamified learning experience, it could be improved by changing the content delivery from a traditional lecture integrated into a narrative to experience the content in a game-like experience, e.g., by representing a filmmaker who is making a documentary of manatees. In fact, in a way, the current version does not follow many of the very established serious game design principles such as "integrating content and gameplay" [1]; however, for the sake of this exploratory design study, we purposely kept it as simple as possible and avoided including game mechanisms that would make it more game-like and fun but also more complex as an experience. Importantly, while simple, the experience demonstrated evidence of learning.

B. Evidence for The Protégé Effect

This study shows that those in the experimental condition scored higher on the post-test, thereby providing evidence for the protégé effect and support for H1. Our design was relatively simple: instead of letting players play as themselves, we introduced participants to the character Rasa and told them that Rasa needed help learning about manatees. There was no difference in engagement between the conditions so the difference in post-test scores can be attributed to this manipulation. Therefore, our work suggests that the design of player-character relationships can be of influence in the teaching efficacy of gamified experiences, a finding that is supported in other work that has looked into the role of avatar identification in serious games [47]. However, it is important to acknowledge that we only found a small effect ($r = .25$) and the performance difference can be attributed to a single question (Question 1). Future work can consider other implementations of the protégé effect. For example, in the current version, the player answers for Rasa; we can think of a version where the player gives hints or teaches Rasa strategies to learn instead of answering for them. It can be hypothesized that this variation of the protégé effect may give a greater sense of helping the player-character.

C. Player-Character Relationships Are Complex

For the role of responsibility on efficacy, we did not find evidence (H2). However, we did find that the experimental condition differed in how players relate to their character compared to the control condition, specifically on factors

related to the suspension of disbelief, responsibility, control, and anthropomorphic autonomy, with small to medium effects. The suspension of disbelief was stronger in the experimental condition perhaps because social feedback (in this case talking/speech) actively drew participants in; responsibility was intended to be stronger in the experimental condition through the protégé effect, and these results suggest that it succeeded in that regard; feeling of control over the character was higher in the control condition likely because players were repeatedly told and shown that they control the character's actions; and, lastly, because Rasa was a character with dialogue in the experimental condition, that seemed to cause participants to think of Rasa as an autonomous agent. The feelings of identification/friendship and emotional investment for the character, however, were not different between conditions. These latter two factors were also strongly correlated. Both involve the player growing to care about or identify with their character.

These results strengthen the evidence that our manipulation had an impact on the player-character relationship. In fact, it impacted 4 out of 6 unique factors that we found from the literature that determine a character relationship. But, as we showed, we are unable to clearly explain what aspect of the manipulation would cause the change in learning outcomes. We hypothesized that increased feelings of responsibility would be important. However, our results show that the impact cannot be reduced to feelings of responsibility; it is more complex because of the aforementioned correlations.

In addition, our correlational analysis suggested that another factor may be more important: increased feelings of control negatively impacts the learning outcomes, albeit weakly ($r = -.21$). The lecture that taught participants about West Indian manatees never required the players to control their character, so it is possible that participants who were expecting to control their character during the lecture were less attentive to the lecture, as they were waiting for a chance to control the character directly. These results may also be tied to player motivations, which may have been more negatively impacted due to the limited agency and autonomy that the experience provides in the control condition. As such, in future work, it can be beneficial to consider motivation.

D. Limitations and Future Work

Our work was inherently limited due to its scope and can be further expanded in ways described above (e.g., more interactive experience, actually teaching the character) but which can also include other types of relationships [21]). However, the relatively simple setup presented in this paper provides a stepping stone to such research. We should highlight that to generate character attachment by default we allowed the player to choose a character in *both* conditions. In future studies, such customization can be studied itself, including the use of a character-customization tool [23]. Moreover, we collected additional data beyond the measures for responsibility and learning that were necessary to test our main hypotheses to explore if these other variables (e.g., engagement, emotional investment) may play a role in the results, which then ought

to be confirmed/tested in future work. With this in mind, we did not hypothesize specifically about these other variables, or collected enough data to build and test more complex models, which, based on these results, seems to be necessary. This does mean that the results outside of our main hypotheses should be considered as *exploratory results*. Demographic variables may play a role too and should be considered in future studies. Additionally, as an initial attempt, our application was short (approx. 11 minutes). Despite the short interaction, we found some evidence for the protégé effect. However, participants can be given more opportunities to bond with the character before delivering the content, which might consequently increase the seen effect. As a future direction, it will also be interesting to study how a long-term relationship between players and their characters (over the course of several play sessions) may affect learning. Finally, while we leveraged several existing, validated instruments, we made minor changes for the purposes of this work. In terms of practical implementations, we suggest incorporating mechanisms that create responsibility in players for teaching others, which potentially will lead to improved learning outcomes. Moreover, our findings show that engagement through interactive gameplay mechanics can help create more meaningful connections between users and virtual characters, potentially leading to better learning outcomes.

VI. CONCLUSION

The central research question in this paper was whether gamified education that makes players feel responsible for their character would be more effective in teaching content. To answer this question, *Humanatees*, an educational gamified narrative that taught players about West Indian manatees, was created. This game put players into one of the two conditions. One condition had players using a character that they were told they control. The second condition, the experimental condition, used the protégé effect to make players feel responsible for an autonomous character by having that character ask for help from the player. Our results show that participants in the experimental condition felt more responsible for their character and scored higher on the post-test. However, responsibility was not correlated with post-test scores. While this study showed that the protégé effect resulted in better knowledge gains, from this study it is unclear how exactly this effect contributes to better learning outcomes. A more complex consideration of the player-character relationship, one that goes beyond responsibility, will have to be explored in future research. The key implication is that changes in the design of a narrative, such as framing how players relate to characters, can potentially have a significant impact on the learning outcomes.

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