

Interacting with virtual instructors: The effect of gender and years of study on the perception of in-game instructors

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Abstract

Previous research has shown that student-instructor interaction is vital to motivating students to learn a second language. However, it is unclear whether learners' demographics affect in-game immersion and interactions with virtual instructors. This study's purpose is to investigate whether the number of years learning Japanese (foreign language familiarity) influences students' immersion levels in serious games and their interactions with virtual instructors. We developed a 3D animated Japanese roleplaying game with a virtual in-game instructor. Eighty-four college students enrolled in 200- and 300-level Japanese language courses voluntarily participated in the study. Participants played the game and then answered a questionnaire concerning virtual character appearance, attentiveness to the instructor, and immersion in the game. The findings indicated that gender and the number of years studying Japanese significantly impact multiple measurements.

KEYWORDS

game immersion, gender differences, language learning, serious games, virtual character interaction, virtual instructors

1 | INTRODUCTION

In recent years, a growing number of people have chosen to learn Japanese as a foreign language.^{1,2} For this reason, institutes have developed various teaching methods that use either traditional textbooks or online learning software.³ By understanding how people with different backgrounds perceive virtual instructors, we can teach developers to create more efficient interactions between students and virtual instructors. Developers can then take students' backgrounds into consideration and customize their interactions with instructors.

It is always important for game developers to consider immersion when developing serious games for language learning.^{4,6} Serious games have proven to be more educational when users feel immersed in the games.⁷ Previous studies on serious games have focused on the use of visual and tactile cues to achieve immersion⁸ and how adjusting content, such as learning materials, can affect immersion.⁹ Prior research has also illustrated that the implementation of conversation systems and facial expressions can improve students' motivation to learn¹⁰ and that there are various benefits to using distinct virtual characters in an interactive virtual learning environment.¹¹ Although game-based learning has been found to provide an immersive experience,^{12,13} it remains unknown how learners perceive virtual instructors or how their perceptions are associated with their gender or previous learning experiences.

Assuming that the effort, motivation, and performance of participants may vary depending on their individual backgrounds and circumstances, this study is designed to investigate whether students' genders and Japanese language learning backgrounds (foreign language familiarity) influence their perceptions of virtual in-game instructors, their levels of immersion in the game, and their attentiveness to virtual instructors. The application we developed allows participants to freely explore and interact with gaming environments and virtual characters and to receive instant feedback based on their actions and input. The application and study are intended to answer the following research questions:

- **RQ1:** Does a history of studying Japanese affect participants' in-game immersion, perceptions of virtual instructors, and attentiveness to the instructors?
- **RQ2:** Are there gender differences in game immersion, perceptions of virtual instructors, and attentiveness to the instructors?

This paper is organized into the following sections. Section 2 presents related works, and Section 3 covers the study's methodology. Section 4 shows the results, and Section 5 contains the discussion. Finally, Section 6 presents the study's conclusions, limitations, and implications for future research.

2 | RELATED WORKS

There are a few serious games for learning Japanese. *Crystalize*, the Japanese massively multiplayer online role-playing game (MMORPG) from Cornell University, is one of them. Another one is the language-learning game *Influent*,¹ a third-person game for Japanese vocabulary. Froschauer et al.¹⁴ developed ICURA, a 3D adventure game that has shown significant learning potential in its goal to help people learn more about Japanese culture and language. Woo¹⁵ suggested that the increased interaction that video games provide can highly motivate students to learn. It is for this reason that serious games have proven effective in education. According to Tomlinson,¹⁶ teaching materials, such as textbooks, are shifting away from simple or cliché conversations by focusing on social culture. It is believed that more realistic content can motivate students to become more interested in learning.

We considered a number of previously published papers that observed that virtual instructors are key to maximizing the positive impacts of education. Davis and Bobick¹⁷ developed a virtual instructor for aerobics training as an innovation that expanded upon videotapes and TV-based training. LaFortune and Macuga¹⁸ created a virtual instructor for dance practice. Jiman's¹⁹ collaborative virtual reality (VR) learning environment focused on a natural, human-like instructor using an intelligent tutoring system. In addition to teaching students, virtual instructors have also been created to assist in training workers. Lugin et al.²⁰ successfully implemented a low-cost, collaborative, and immersive VR training program with both a virtual trainee and instructor, and Podmore et al.²¹ implemented a virtual instructor in a program called Emergency Operations with PowerSimulator (EOPS).

Lassitter's²² virtual instructor who is able to establish a relationship with the student is better at helping students in a virtual classroom than traditional self-learning software. The virtual instructor in Podmore et al.²¹ EOPS has successfully trained more than 500 operators in 50 companies. Furthermore, Doswell²³ asserted that virtual instructors have the ability to provide autonomous instructions. Using such systems on a mobile platform can help facilitate lifelong learning. In the area of language learning, there have also been many attempts to use virtual instructors in virtual environments. Shih and Yang²⁴ created a collaborative virtual environment for situated language learning and promoted students' positive attitudes and learning experiences. Zheng et al.²⁵ developed an avatar-embodied virtual environment for native and non-native English speakers in English language learning, which many participants found useful for practicing the language. Berns et al.²⁶ developed a 3D virtual world for foreign language learning and found that students' motivation and learning efficiency were positively impacted by the virtual world.

This paper evaluates the effect of gender and years of study on the perception of in-game virtual instructors (characters). To the best of our knowledge, no prior study has explored how virtual instructors affect in-game language learning. Therefore, we chose to develop a serious 3D game to answer our research questions. Our study primarily contributes to research in serious language-learning games and provides ideas about student-virtual instructor interactions based on students' backgrounds.

¹<https://store.steampowered.com/app/274980/Influent/>

3 | METHODS

3.1 | Participants

We conducted an a priori power analysis to determine the sample size of four groups (less than one year, one to two years, two to three years, and more than three years of Japanese language learning) using G*Power3.10 software. The calculation was based on 75% power, a medium to large effect size of .35, and an $\alpha = .05$. The analysis resulted in a recommended sample size of 84 participants.

In this between-group study, participants were recruited through in-class announcements and e-mails. In total, 84 individuals aged 18 to 35 from intermediate-level Japanese courses participated in our experiment. There were 19 male ($M = 20.68$, $SD = 1.62$) and 65 female ($M = 21.54$, $SD = 1.81$) students. Half of the students ($N = 42$) had studied Japanese for more than one year, and the other half of the students had studied Japanese for less than one year. Most of the students were not familiar with serious games but had previous experiences with PC games. Participants gave written consent before participating, which was dictated by the institutional review board of our university. Participants were not compensated in our study.

3.2 | The Daigaku Life game

We developed a 3D Japanese role-playing game called *Daigaku Life*. In the game, the user is embodied by Takeru, our main virtual character. Takeru is attempting to create a documentary and needs footage for his video. To obtain this footage, he must communicate with other in-game virtual characters (see Figure 1). These characters are used as the virtual instructors for the game and ask permission from the user to conduct interviews. There are a total of five scenes in the game. Each scene contains a virtual character with a different social background. Two virtual characters are Takeru's peers. The other three include two professors and a senior. Throughout their conversations, Takeru asks them questions regarding their study abroad experiences. In between each interview, Takeru must move around the campus to find the next interviewee. The game concludes after Takeru collects all the interview information.

The teaching content our game covers includes different Japanese conversational forms. By having the participants interact with all five key virtual characters (see Figure 2), they are able to read through the entire story and practice virtual conversations to improve their understanding of polite conversation forms. In Japan, it is important for people



FIGURE 1 Screenshots of gameplay with the main virtual character exploring different locations

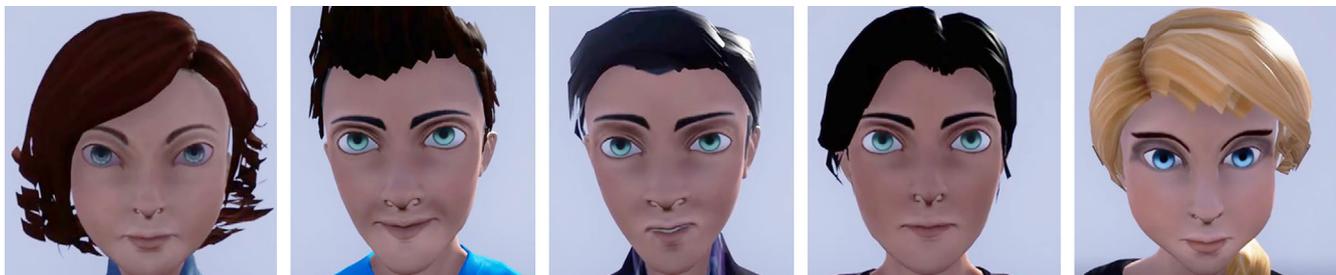


FIGURE 2 All five virtual characters (virtual instructors) from the game. Each virtual character has a different social background. This setup is ideal for helping students practice their use of polite forms



FIGURE 3 An example of conversation in the game. Players must select the correct response. If they answer incorrectly, the virtual characters change their facial expressions. The users then press “Continue” to proceed

to use different forms depending on the circumstances. In order for people to be polite, they must use either casual or polite forms according to the status of their conversational partners. The polite form is a sophisticated language system for expressing honorific emotions to people of a higher status. Incorrect usage of the polite form can result in unpleasant interactions during daily life. Therefore, it is important for students to master this knowledge.

Because most of our participants were expected to be first-year or second-year Japanese language learners, we designed the game conversations according to content from a 200-level Japanese language course. All the written in-game scenarios were approved by 200-level instructors and professors of Japanese from our university’s Japanese department. In addition, an in-game vocabulary list function was provided to enable students to check the meanings of words. This allowed participants to clear the game during the experiment.

The gaming environment is composed of one large outdoor and three indoor levels. All 3D models (virtual environment and virtual characters) were imported into Unreal Engine, which was used to develop our game. Players control the virtual character to walk around the campus. They can make conversation with the virtual instructors by walking close to them and pressing the conversation key. During gameplay, the participants must select the correct responses in a conversation to practice polite and casual forms of Japanese depending on the virtual instructors’ social backgrounds (see Figure 3). If the selected response is false, the virtual characters’ facial expressions will change accordingly.

3.3 | Measurement

In this study, the questionnaire was developed according to an immersion questionnaire by Jenette et al.²⁷ and a virtual character realism questionnaire by Wilson et al.²⁸ Our questionnaire was divided into five sections: realism of virtual character reactions, realism of virtual character appearances, game immersion, attentiveness to in-game virtual characters, and interaction with virtual characters. Participants answered all questions using a rating from 1 to 7, with 1 representing strongly disagree and 7 representing strongly agree. The questionnaire we developed is presented in Table 1.

3.4 | Procedure

This section summarizes all the results our study obtained. All analyses were performed using IBM SPSS v.23.0 statistical analysis software. A one-way analysis of variance (ANOVA) was used to analyze the data using the number of years

TABLE 1 The questionnaire used in this study. Participants answered using the Likert scale from 1 to 7, with 1 being strongly disagree and 7 being strongly agree

No.	Questions	Concept
1	I felt focused on the game.	Game immersion
2	I felt the game was something I was experiencing rather than something I was just doing.	
3	At any point, I found myself so involved that I wanted to speak to the game directly.	
4	I paid close attention to the virtual characters' animations.	Attentiveness to in-game characters
5	I paid close attention to the virtual characters' appearances.	
6	Reactions from the virtual characters were appropriate.	Realism of character reactions
7	Responses from the virtual characters were realistic.	
8	The appearance of the virtual characters was realistic.	Realism of character appearance
9	The appearance of the virtual characters was appropriate.	
10	I had fun interacting with the in-game virtual characters.	Interaction with characters
11	I felt connected to the virtual characters.	

learning Japanese as the independent variable and immersion as the dependent variable. We also conducted an independent samples *t*-test to explore the influence of gender on game immersion. The normality assumption of the measurements was evaluated graphically using Q-Q plots of the residuals. The Q-Q plots indicated that the obtained data fulfilled the normality assumption. Individual differences were assessed using a post-hoc Bonferroni correction if the ANOVA was significant. For all statistical tests, a *p*-value below .05 was deemed statistically significant.

4 | RESULTS

All results obtained from our study are summarized in this section. All analyses were performed using IBM SPSS v.23.0 statistical analysis software. One-way analysis of variance (ANOVA) was used to analyze the data using the number of years of Japanese study as independent variables and immersion as dependent variables. We also conducted an independent samples *t*-test to explore the influence of gender on game immersion. The normality assumption of the measurements was evaluated graphically using Q-Q plots of the residuals. The Q-Q plots indicated that the data obtained fulfilled the normality assumption. Individual differences were assessed using a post-hoc Bonferroni correction if the ANOVA was significant. For all statistical tests, a *p*-value below .05 was deemed statistically significant.

4.1 | Years of Japanese study

Our statistical analysis showed that the number of years spent learning Japanese had a significant effect on the perceived realism of the virtual characters' appearances ($F_{3,80} = 3.271, p = .025$). Post-hoc comparisons showed a significant difference between students who had studied Japanese for less than one year ($M = 5.73, SD = 1.24$) and those who had studied it for one to two years ($M = 4.76, SD = 1.17$). Additionally, the number of years learning Japanese was significant to game immersion ($F_{3,80} = 3.077, p = .032$). Post-hoc comparisons showed a significant difference between participants who had studied Japanese for less than one year ($M = 5.64, SD = 1.21$) and those who had studied it for more than three years ($M = 4.06, SD = 1.88$). Finally, we found significant effects from studying Japanese on interactions with virtual characters ($F_{3,80} = 2.922, p = .039$). Post-hoc comparisons showed significant differences between participants who had studied Japanese for more than three years ($M = 3.33, SD = 1.81$), less than one year ($M = 5.27, SD = 1.39$), and one to two years ($M = 4.83, SD = 1.31$). No significance was found for realism in the virtual characters' reactions ($F_{3,80} = 2.615, p = .057$) and attentiveness to the in-game virtual characters ($F_{3,80} = 2.694, p = .052$). Figure 4 summarizes the abovementioned results.

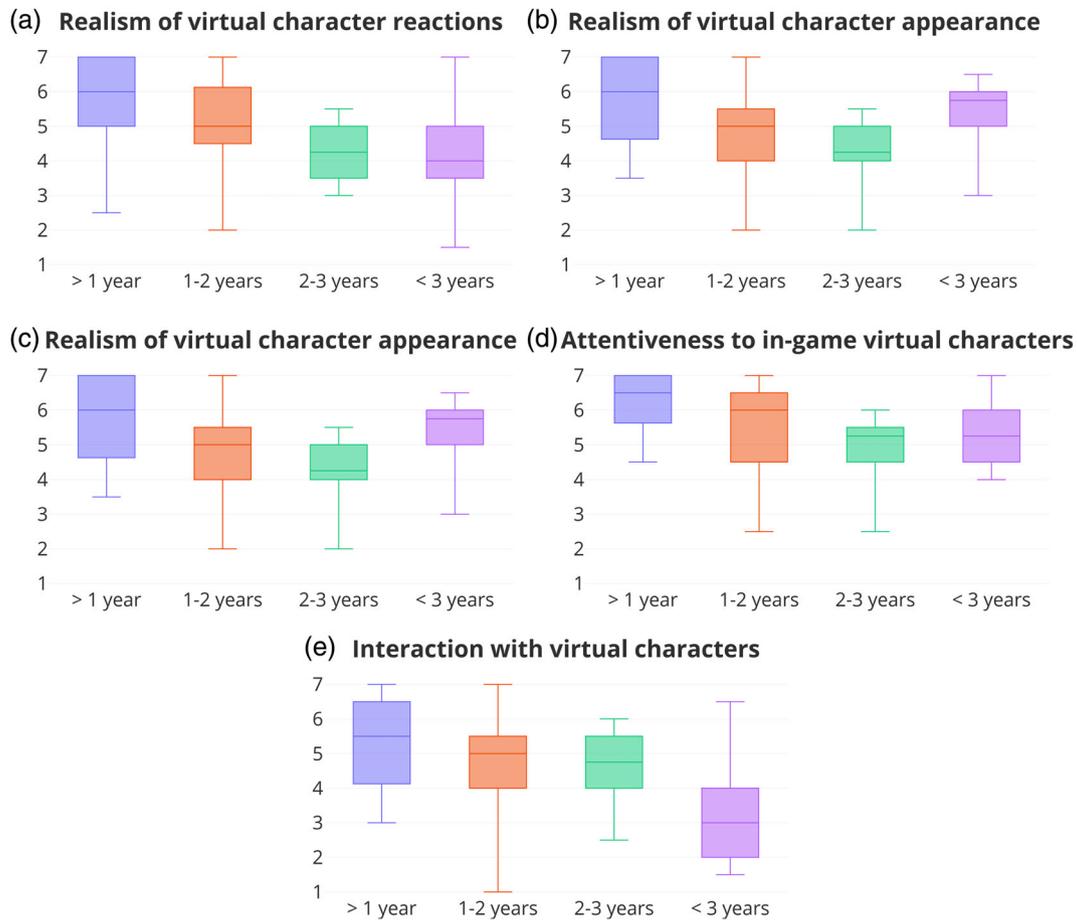


FIGURE 4 Boxplots of our results regarding the effects of years learning Japanese. Boxes enclose the middle 50% of the data. The median is denoted by a thick horizontal line

4.2 | Gender differences

Independent samples *t*-tests were conducted to compare self-reported data between male and female students (see also Figure 5). Significant results were found for realism in the virtual characters' appearances ($t_{82} = -2.021, p = .047$). Female participants ($M = 5.10, SD = 1.23$) rated the realism of the virtual instructors higher than male participants ($M = 4.47, SD = 1.05$). The results suggest that females perceived the game to be more realistic than males did. There was also a significant difference in game immersion ($t_{82} = -3.002, p = .004$) according to the self-reported information from females ($M = 5.22, SD = 1.17$) and males ($M = 4.30, SD = 1.19$). These results suggest that females felt more immersed in the game than males did. There was a significant difference between females ($M = 5.68, SD = 1.07$) and males ($M = 4.89, SD = 1.37$) in their attentiveness to the in-game virtual characters ($t_{82} = -2.657, p = .009$). These results suggest that females paid more attention to the game than males did. Finally, no significant differences were found in the interactions with the virtual characters ($t_{82} = -1.522, p = .132$) or the realism of the virtual characters' reactions ($t_{82} = -1.698, p = .093$).

5 | DISCUSSION

This study sought to examine whether the number of years participants spent learning Japanese (foreign language familiarity) influences game immersion (RQ1). The study's researchers developed a 3D animated Japanese role-playing game. Participants were asked to play the game and complete a post-questionnaire.

In terms of game immersion, participants who had studied Japanese for less than one year were significantly more immersed in the game than those who had studied it for more than three years. According to previous research, there is a relationship between optimal challenge and positive engagement. The results of Shernoff's²⁹ research indicated that

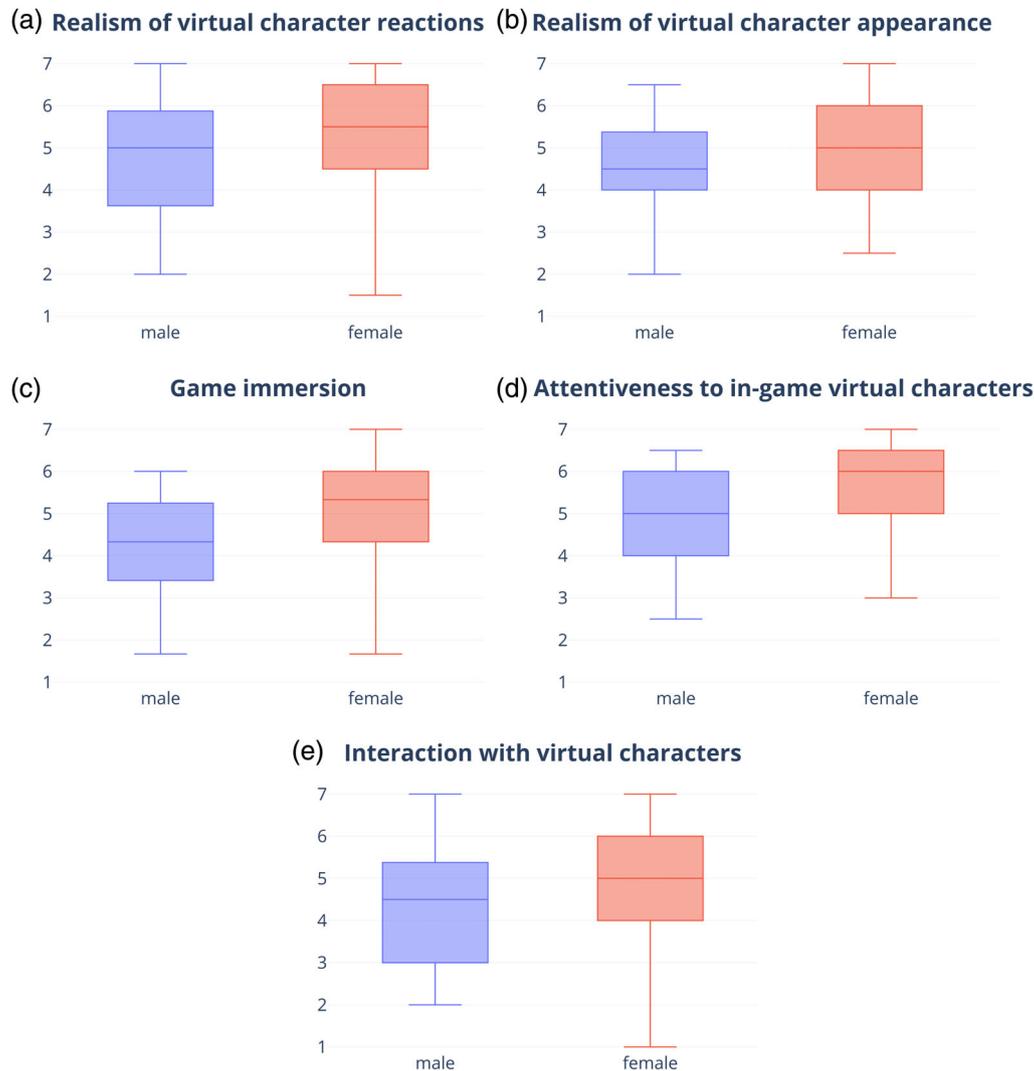


FIGURE 5 Boxplots of our results regarding gender differences. Boxes enclose the middle 50% of the data. The median is denoted by a thick horizontal line

players are more likely to enter into a flow state when a game is more challenging. Because the game proved more challenging for the group that had studied Japanese for less than one year than the group that had studied the language for more than three years, this is a reasonable explanation for why participants who had studied Japanese for less than one year were significantly more immersed in the game than those who had studied Japanese for more than three years. Indeed, according to discussions with Japanese professors from our university, the Japanese content in the game was more difficult for the former group than the latter one. Therefore, beginner students who faced greater challenges were more engaged in the gameplay than their more advanced counterparts.

Regarding realism in the virtual characters' appearances, participants who had studied Japanese for less than one year perceived the virtual characters to be significantly more realistic than those who had studied Japanese for one to two years. Unsurprisingly, the first group had less experience with real Japanese culture than the second group, and they found the game more challenging and were thus more easily drawn into the game. As a result, it was easier for them to accept the appearances of the virtual characters. Cheng and Cairns²⁹ illustrated that an immersive experience can help to negate other usability issues once that experience has been achieved. As long as there are no inconsistencies within the environment, players are more likely to become immersed and notice less of the surrounding environment, suggesting that immersion and realism are partially interwoven. Kokkinara and McDonnell's³⁰ research revealed that the level of realism in animation affects the virtual characters' perceived appeal. Users provide more positive feedback for more realistic assets. Their study concluded that the level of realism in the appearance and animation of virtual characters in games, movies, and other VR applications affects audiences' acceptance of and engagement with those virtual characters.

The results about virtual character interaction indicate that participants who had studied Japanese for more than three years felt they had significantly less interaction with the virtual characters than those who had studied Japanese for less than two years. According to the questionnaire, it was likely that because the first group's participants had more experience with Japanese culture and people, they had higher expectations for their interactions with virtual characters than participants who studied the language for less than one year or for one to two years. It can be inferred that the more advanced students expected to see something more than basic content. Failing to meet their expectations caused a decrease in tension and thus resulted in less interaction between them and the in-game virtual characters. Although a few significant results were found, further studies are needed before any conclusions can be drawn about the relationship between language experience and virtual character interaction.

We found significant differences between the groups in terms of gender differences (RQ2). For instance, females felt significantly more immersed in the game than males. During the study, female participants spent most of their time passively watching *Daigaku Life*, only occasionally clicking the mouse to keep the game going. In Nicovich's³¹ research on computer-mediated communications, it was found that women tend to be more engaged in watching than in doing, providing a reasonable explanation for this study's varied results on game immersion.

During the experimental process, females paid significantly more attention to the in-game virtual characters than males. Desai et al.¹¹ found that females were better at identifying anger and were more appreciative of virtual characters' behaviors. Because our study used angry facial expressions assigned to the virtual instructor, our results were highly similar. Based on Nicovich's³¹ theory, it is also likely that females became more engaged in playing the game and were thus more attuned to the in-game virtual characters.

For the findings about realism in the virtual characters' appearances, females perceived the virtual characters to be significantly more realistic than males did. Baylor and Kim³² identified a major difference between females and males in their perceptions of realism in media stories, with females perceiving the stories to be more realistic than males. These findings support our varied results about realism in the virtual characters' appearances. Because *Daigaku Life* resembled a media story, females perceived the game's virtual characters to be more realistic than males.

6 | CONCLUSIONS, LIMITATIONS, AND FUTURE RESEARCH DIRECTIONS

This research's primary findings show that the number of years participants spend learning the Japanese language significantly impacts the variables of realism in virtual characters' appearances, game immersion, and virtual character interactions. The findings also indicate that participants' experiences with language learning can affect their awareness of the realism in virtual characters, their levels of game immersion, and their interactions with virtual characters. This research's secondary findings indicate that gender significantly influences self-reported ratings of realism for virtual characters' appearances, game immersion, and attentiveness to in-game virtual characters. Females felt more immersed in the game because they thought the virtual characters were more realistic, and they paid more attention to them as a result.

We believe that when designing serious games, the potential audience and game types should be adjusted based on target users' gender and age to increase their level of immersion. According to our findings, story-based games such as *Daigaku Life* are better suited for female learners. However, further experimentation with other game types is required in order to identify learning games that are more appropriate for male learners.

In spite of the promising findings covered above, this study contained a few limitations that require additional attention. First, other in-game elements, including the in-game environment, game story, virtual character animation, and game interactivity, may have influenced the study's results. Second, although the questionnaire measured participants' attentiveness to virtual characters, an eye-tracking device could tell us whether the participants' self-reported attentiveness was accurate. Third, the vast majority of the sample was female. Given Nicovich et al.'s³¹ research that found that males are more interested in interactive media, the present study's sample may have affected the results of the other examined variables since it is known that the lack of equal representation for both genders more accurately reflect the perceptions of one gender group over the other.

Apart from these limitations, we hope to expand our work to different domains related to virtual instruction. Our research has shown value in Japanese language learning, and this type of research should be applied to other language areas to validate the study's findings and applicability. To build stronger evidence, additional studies in different subject domains and settings should be conducted. Based on this study's significant findings, more research by serious game developers should investigate elements related to game immersion. Furthermore, subsequent research should aim to adopt a simplified game design. Elements that may influence the experiment's outcome, such as complex game environments, background music, and difficult game controls, can be eliminated at the development stage. Finally, in

order to verify participants' attentional allocation and to collect precise data, we strongly recommend using eye-tracking devices when asking participants to interact with gaming environments.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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