# Research on Perceptual Dimensions of Anthropomorphism in Virtual Avatar Applications in Online Education

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**Abstract.** With the advancement of AI technology, the application of virtual avatars in online education has entered a new era. This paper investigates the perceptual importance of respondents based on the anthropomorphic dimensions of virtual avatars in four aspects: linguistic features, physical appearance, body movements, and interactive abilities. It finds that the perceived importance level of interactive ability is the highest, followed by body movements. Moreover, the more anthropomorphic the linguistic features, physical appearance, body movements, and interactive abilities, the better the perceived effectiveness of online learning. The paper suggests that in the development of virtual avatars, particular attention should be paid to interaction and feedback in online education platforms, such as designing emotionally engaging interaction interfaces, implementing multimodal interactive experiences, and enhancing cognitive interactions, to provide more possibilities for the application of virtual avatars in online learning platforms.

**Keywords:** virtual avatars, online learning, anthropomorphism, perceptual dimensions.

## 1 Introduction

With the development of technologies such as artificial intelligence, big data, virtual simulation, as well as breakthroughs in holographic sensing technology and generative AI algorithms, virtual avatars have begun to enter the education industry. Virtual teachers like " Kaikai He " designed by Henan Open University and " Jianrong Yao " from Zhejiang University of Finance and Economics have ushered in a new era of teaching. In the current research, much attention has been paid to the application scenarios of virtual avatars in education to improve educational intelligence and informatization. Scholars have focused on virtual avatars in education, such as teacher anchors or classroom assistants. According to relevant research, the closer virtual avatars are to real humans, the higher the acceptance of them will be. However, fewer scholars have approached the anthropomorphic perceptual dimensions of virtual ava-


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tars from the perspective of online learning users. This paper will focus on the anthropomorphic perceptual dimensions of virtual avatars in online education applications and provide constructive suggestions for enhancing the anthropomorphic level of avatars based on the perceptions of online learners through surveys.

## 2 Literature Review

Many scholars have focused on research into the effectiveness of using digital avatars in online course learning, reaching positive conclusions. For instance, they argue that virtual intelligent classrooms supported by avatar technology provide richer and more interactive learning experiences, aiming to improve teaching effectiveness, encourage student participation, and enhance learning interest[1]. Virtual intelligent classrooms with robots, such as those constructed by Vando Gusti Al Haki[2], allow students to interact with physical robots and avatars, creating an open, flexible, autonomous, and immersive classroom learning environment, providing students with meaningful, multimodal, and enjoyable experiences. Loveys Kate and other scholars found that emotional expressions of digital avatars can significantly reduce feelings of loneliness and stress among various groups of people, compensate for the lack of emotional interaction in traditional classrooms, establish emotional connections with learners, make interactions in the virtual world more active, and improve the learning experience of learners who feel unfamiliar, alienated, and resistant to new technologies[3].

Virtual digital avatars are essentially artificial symbols lacking genuine human perception and emotion. According to Agata and others' research[4], it was found that when the virtual nature of digital avatars was not disclosed to users, there was no difference in users' perception of digital avatars compared to humans. However, when users were explicitly made aware of the virtual nature of digital avatars, an avoidance effect occurred, where users viewed interaction with digital avatars as a means to avoid interacting with human companions[5]. Domestic scholars, in their research on the fidelity of virtual news anchors, summarized measures of simulation for linguistic and non-pre-scripted features, where linguistic features include timbre, tone quality, speech rate, and language rhythm, while non-verbal features include appearance and behavioral characteristics.

Considering the above research, particularly regarding students studying at vocational colleges in China, who lack self-management skills and require stronger autonomy and strict supervision in the online learning process, the degree of anthropomorphism in digital avatar applications is crucial.

## 3 Methodology

### 3.1 Virtual Avatars and Hypothesis

The scope of research on virtual avatars in online education in this paper refers to virtual avatars created and used by computer graphics, rendering, motion capture, deep learning, speech synthesis, and other computer techniques, with multiple human

characteristics. They can be virtual avatars created based on real human voices, facial expressions, and body movements, or completely fictional virtual beings. The anthropomorphic degree is defined as the degree of similarity in external characteristics to real humans. Based on the perceptual physiological factors of learners[6], the following hypotheses are proposed:

H1: Linguistic anthropomorphic perceptual features have a positive impact on online learning effectiveness.

H2: Appearance anthropomorphic perceptual features have a positive impact on online learning effectiveness.

H3: Expressive anthropomorphic perceptual features have a positive impact on online learning effectiveness.

H4: Anthropomorphic perceptual features of interactive ability have a positive impact on online learning effectiveness.

### 3.2 Participants

Participants were randomly selected from 468 college students in a vocational and technical college who had experience with online platform courses and could provide objective feedback based on actual perceptions. After excluding invalid questionnaires with missing or consistent answers, a total of 462 valid questionnaires were collected. The demographic information of the responses is summarized in Table 1.

**Table 1.** The demographic information of participants

| | | number | percentage |
|---|---|---|---|
| gender | male | 252 | 54.55 |
| | female | 210 | 45.45 |
| age | <19 | 105 | 22.73 |
| | 19-20 | 346 | 74.89 |
| | >20 | 11 | 2.38 |
| experience with online platform courses(per week) | <1.5h | 136 | 29.44 |
| | 1.5-3h | 286 | 61.90 |
| | >3h | 40 | 8.66 |

### 3.3 Research Design

In addition to basic information surveys such as respondents' gender and online learning experience, the questionnaire invited 15 users of the Chaoxing FanYa Learning Platform for open-ended interviews. Based on these interviews, four major items were identified: linguistic features, appearance features, body language, and interactive abilities of virtual avatars. Questions were designed based on these four dimensions of perception importance in online education, and respondents were asked to answer each question using a Likert scale ranging from "strongly disagree" to "strongly agree." Finally, respondents rated the impact of these aspects on online

education platforms on a five-point scale. The questionnaire underwent pre-survey before distribution, with a total of 23 participants. During the survey, ambiguous or significantly leading wording expressions were corrected (Table 2).

**Table 2.** Questionnaire Design

| Constructs | Item | Questions of the virtual digital avatar |
|---|---|---|
| Linguistic features | L1 | The pronunciation enables me to accurately understand the lecture content. |
| | L2 | The speech rate can vary according to the context, attracting my attention. |
| | L3 | The voice is clear, allowing me to recognize gender characteristics. |
| Physical appearance | P1 | The facial features have lip movements matching pronunciation. |
| | P2 | The hairstyle should conform to the teacher's persona. |
| | P3 | The proportions of body should be naturally coordinated. |
| | P4 | It should have obvious gender characteristics in appearance. |
| Body movements | B1 | The facial expressions are natural, allowing me to distinguish expressions. |
| | B2 | The posture is natural, with flexible movements and timely gestures. |
| Interactive abilities | I1 | The virtual digital avatar can interact and communicate with me. |
| | I2 | It can provide timely responses based on my actual questions. |
| | I3 | The replies from digital avatar should be closely related to my questions. |
| Effectiveness | L | Linguistic features have a significant impact on my learning effectiveness online. |
| | P | Appearance features have a significant impact on my learning effectiveness online. |
| | B | Body language has a significant impact on my learning effectiveness online. |
| | I | Interactivity capability has a significant impact on my learning effectiveness online. |

## 4 Results

Descriptive statistical analysis of the anthropomorphic perception of virtual avatars in online learning was conducted using SPSS software, revealing minimal differences among the dimensions. Perception of interactive ability was the highest, reaching 4.97, indicating that interaction between virtual avatars and learners is crucial during online

learning. Respondents also perceived significant impacts of all dimensions on learning effectiveness, with an average perception score of 4.56(in Table 3). Furthermore, analysis using AMOS software showed significant path influences of all dimensions on learning effectiveness, with significance levels below 0.05, validating the hypotheses (in Table 4).

**Table 3.** The descriptive statistical analysis of anthropomorphism perception dimensions

| Constructs | Mean | SD | Item | Min | Max | Mean | SD |
|---|---|---|---|---|---|---|---|
| Linguistic features | 4.01 | 0.52 | L1 | 3 | 5 | 4.16 | 0.59 |
| | | | L2 | 2 | 5 | 4.08 | 0.75 |
| | | | L3 | 1 | 5 | 3.90 | 0.61 |
| Physical appearance | 4.26 | 0.56 | P1 | 4 | 5 | 4.31 | 0.54 |
| | | | P2 | 3 | 5 | 4.59 | 0.85 |
| | | | P3 | 2 | 5 | 4.66 | 0.66 |
| | | | P4 | 2 | 5 | 4.01 | 0.93 |
| Body move-ments | 4.89 | 0.51 | B1 | 4 | 5 | 4.96 | 0.46 |
| | | | B2 | 4 | 5 | 4.65 | 0.53 |
| Interactive abilities | 4.97 | 0.61 | I1 | 4 | 5 | 4.96 | 0.54 |
| | | | I2 | 4 | 5 | 4.89 | 0.67 |
| | | | I3 | 4 | 5 | 4.99 | 0.74 |
| Effectiveness of online learning | 4.56 | 0.67 | L | 3 | 5 | 4.55 | 0.56 |
| | | | P | 3 | 5 | 4.35 | 0.73 |
| | | | B | 4 | 5 | 4.68 | 0.68 |
| | | | I | 4 | 5 | 4.89 | 0.69 |

**Table 4.** The results of hypothesis testing

| Hypotheses | Hypothesized path | β | S.E. | p | Support |
|---|---|---|---|---|---|
| H1 | Linguistic features→L | 0.497 | 0.178 | * | Yes |
| H2 | Physical appearance→P | 0.505 | 0.129 | ** | Yes |
| H3 | Body movements→B | 0.516 | 0.069 | ** | Yes |
| H4 | Interactive abilities→I | 0.702 | 0.046 | * | Yes |

**p<0.01, *p<0.05

## 5 Discussion

Based on the data results, it is recommended to focus on technical improvements in linguistic features, appearance features, body movements, and interactive abilities.

Regarding linguistic features, natural and fluent language expressions should be used to enhance students' affinity, avoiding excessive stiffness or too many professional terms. Introducing emotional colors and personalized language styles can make virtual avatars more charismatic and attractive[7]. Cultural and regional factors should

be considered to ensure that language expressions are easy to understand and cover learners from different backgrounds.

For appearance features, designs should incorporate human-like characteristics such as facial expressions and body postures to increase emotional resonance and identification with students. Personalized appearance designs should be introduced, allowing students to customize appearances based on their preferences or needs to increase affinity and participation. Combining virtual reality technology can achieve more realistic and immersive appearance presentations, enhancing students' immersion and engagement.

Concerning body movements, avatars should have diverse and flexible actions, adapting to different teaching scenarios and content presentations. Natural and vivid body movements can enrich interaction experiences and increase the authenticity of online learning. Incorporating emotion recognition and synthesis technologies can enable avatars to express more subtle emotions, enhancing communication effectiveness and emotional connections with learners.

Regarding interactive abilities, virtual avatars should possess rich interactive features, enabling real-time feedback, personalized guidance, and adaptive learning. Emphasis should be placed on enhancing dialogue interactivity, response speed, and conversation continuity to create more dynamic and responsive interaction experiences. Implementing AI-driven technologies can enable avatars to analyze learning behaviors and preferences, providing targeted recommendations and assistance to learners, thereby improving learning efficiency and effectiveness.

## 6 Conclusion

This paper explores the perceptual importance of respondents on the anthropomorphic dimensions of virtual avatars in online education applications, focusing on linguistic features, appearance features, body movements, and interactive abilities. The research findings indicate that the perceived importance level of interactive ability is the highest, followed by body movements, and all dimensions have significant positive impacts on learning effectiveness. Based on these findings, suggestions are provided for enhancing the anthropomorphic level of virtual avatars, including technical improvements in linguistic features, appearance features, body movements, and interactive abilities. These recommendations aim to optimize online learning experiences, improve learning effectiveness, and promote the application of virtual avatars in online education platforms.

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