International Journal of Research Studies in Education
2026 Volume 15 Number 7, 121-132

Affective versus static pedagogical agents: Which are more effective in optimizing multimedia instruction?

Siew, Pei Hwa ✉
Universiti Tunku Abdul Rahman, Sungai Long, Malaysia (siewph@utar.edu.my)
Tjew, Erwin
Asia Pacific University of Technology & Innovation, Malaysia (erwin_tjew@yahoo.com)

ISSN: 2243-7703
Online ISSN: 2243-7711

OPEN ACCESS

Received: 31 January 2026 **Revised**: 20 February 2026 **Accepted**: 5 March 2026
Available Online: 9 March 2026 **DOI**: 10.5861/ijrse.2026.26825

Abstract

The advancement of information and communication technologies (ICTs) is progressively redefining the educational landscape. The effective infusion of ICTs to support teaching-learning process has paved the way for innovative teaching methods to engage students in meaningful learning experiences. Utilizing ICTs in education, also known as Technology Enhanced Learning (TEL) or simply educational technology (EdTech) has revealed a pedagogical shift from teacher-led instruction to student-centered learning. The embedment of pedagogical agents (PAs) into digital learning environments are popular EdTech to scaffold learning. Previous studies found that PAs had shown a positive impact on student learning outcomes. In current study, two interactive multimedia modules (IMMs) for teaching an Introductory Psychology course to non-majors were developed, comprising two different designs of PAs—affective PAs (APA) with animated and emotive responses and static PAs (SPA). The study aimed to examine the effectiveness of APA and SPA on students' learning achievement in an Introductory Psychology course through a two-group post-test only experimental design. 32 university students from a Malaysian university who studied a communication program were recruited via purposive sampling, and equally allocated to APA and SPA groups. The research findings corroborate with the hypothesis that the APA embedded in IMM module is more effective in promoting students' learning compared to SPA during the acquisition of Introductory Psychology knowledge. Research findings also reveal that the combination of animated visuals (APA) and narration with recorded human voice play a pivotal role in enhancing comprehension and knowledge retention compared to static with text-only presentations through SPA.

Keywords: affective pedagogical agents, static pedagogical agents, multimedia instruction, introductory psychology course, learning achievement

Affective versus static pedagogical agents: Which are more effective in optimizing multimedia instruction?

1. Introduction

In the era of 21st century, rapid technological advancement has undeniably transformed all facets of our lives, and the education sector is no exception. The Covid-19 global pandemic acted as a massive catalyst for rapid digital transformation, leading to substantial changes in education systems worldwide. This global crisis has spurred significant innovation in educational technology (EdTech), and has further revolutionised instructional methods, causing a rapid shift from traditional in-person instruction in brick-and-mortar classrooms to "bricks-to-click" models, including remote learning (distance-based), online learning (fully digital), and blended learning (hybrid mix).

EdTech has evolved from computer-assisted instruction (CAI) programmes, to the current cutting-edge technologies such as Artificial Intelligence (AI)-driven tools, has profound impact on the teaching and learning practices at all levels. The proliferation of EdTech is reshaping classrooms by moving away from the conventional "one-size-fits-all" model towards more innovative, personalised, and interactive learning experiences, significantly enhancing student engagement and learning outcomes. Embedding pedagogical agents (PAs)—virtual characters that guide learners in digital learning environments are well-known EdTech to guide the learning process and support instruction.

The advent of PAs has ushered in a novel paradigm for digital interactive learning. The evolution of PAs can be traced back to the 1970s with the emergence of early Intelligent Tutoring Systems (ITSs) that featured text-based interfaces, relying on natural language through Socratic dialogue (i.e., a form of question-and-answer discussion) in educational settings (Apoki, et al., 2022; Gulz et al., 2011; Lane, 2016). The disembodied conversational agents built into those basic ITSs laid the groundwork for modern embodied agents. The development of PAs closely aligned with advancements in computer animation, image processing technology, artificial intelligence (AI), and immersive technologies such as virtual reality (VR) and augmented reality (AR). Over the decades, the PAs in ITSs and computer-assisted instruction (CAI) systems evolved from text-based to the simple cartoon-like two-dimensional (2D) and characters in the 1990s, then progressed to more sophisticated, emotive, and lifelike AI-powered three-dimensional (3D) characters in recent years.

Over the past decades, numerous studies (e.g., Grivokostopoulou et al., 2020; Li et al., 2019; Schneider et al., 2022; Wang et al., 2022) found that PAs could arouse online learners' interest of learning by providing instant feedback which led to enhancing their learning experiences and performance. Previous studies (e.g., Arguedas et al., 2025; Lang et al., 2022; Tang, et al., 2025; Wang et al., 2023) also discovered that PAs could create emotionally supportive learning environments to increase student motivation and engagement.

The remainder of this paper is structured as follows: Section 2 describes the design of affective and static pedagogical agents in the interactive multimedia modules. Section 3 presents the Introductory Psychology as instructional content in the interactive multimedia modules. Section 4 discusses the findings on the effectiveness of affective and static pedagogical agents for Introductory Psychology instruction, and finally, Section 5 wraps up the discussion and propose directions for future research.

2. The design of affective and static pedagogical agents in the interactive multimedia modules

A pedagogical agent (PA) is also referred to as an embodiment, teachable, and conversational agent (Mohammad Yusoff et al., 2024). PA is not a newcomer to teaching and learning; it is an interdisciplinary concept that emerged from the integration of knowledge-based learning environments (originated from early

Intelligent Tutoring Systems—ITSs in the 1970s) and animated agents (which had started from the 1990s) that has been a subject of research and implementation for over 30 years (AL-KAİSİ et al., 2019; Mohammad Yusoff et al., 2024).

Throughout the years, instructional designers have developed different forms of vivid onscreen PAs with different roles in multimedia learning environments using a wide array of technologies (Dai et al, 2022; Wang et al., 2022). Schroeder et al. (2025) defined PAs as "virtual characters that instructional designers include in learning environments to help students learn" (p. 2127). Zhang and Mo (2025) explained PAs as "digital characters designed to support instruction in online or blended learning environments" (p. 37). According to Clarebout and Heidig (2012 as cited in Dai et al., 2022), PAs are "lifelike characters that guide users in multimedia learning environments". Citing numerous past studies, Wang et al. (2022) revealed that PA is "a character that is presented on a screen to deliver instruction through verbal and non-verbal communication".

Based on a systematic review of literature, Martha and Santoso (2019) concluded that the design of PAs encompasses various forms, including text-based, voice, 2D characters, 3D characters, and human. With the relentless acceleration of technological advancement, particularly in artificial intelligence (AI), virtual reality (VR), and other emerging technologies, the PAs appear in both 2D and 3D forms, and the degree of anthropomorphism is increasingly improving and becoming more sophisticated (Tao et al., 2022; Wang et al., 2022). Dai et al. (2022) affirmed that the design of PAs differs from 2D cartoonish talking heads to 3D humanoid embodied agents capable of exhibiting vast set of facial expressions and body gestures. According to Yusuf et al. (2025), the agents in pedagogical settings vary widely, spanning embodied (virtual/ physical avatars) and disembodied (text-based/ voice) forms, offering personalised support through emotional intelligence and sensory input. Li et al. (2025) pointed out that the appearance of PAs can be classified into three types, namely cartoon, anthropomorphic, and real.

Tao et al. (2022) highlighted that PAs support students in online learning by providing personalised learning experiences since it is difficult for instructors to provide in-person instruction. Although many past studies have proved the benefits of PAs in facilitating learning and promote student learning, however, poorly designed PAs would exacerbate learners' extraneous cognitive load, and have a negative impact on learning experience and performance (Mohammad Yusoff et al., 2024; Schroeder, 2017; Tao et al., 2022). Thus, PAs should be carefully designed in ways that add pedagogical value to the digital learning environments, rather than simply acting as an aesthetic "add-on" feature.

Over the years, PAs have evolved from simply being the directive information-conveying tools (act as guiding agents) into social learning companions that facilitate, motivate, and scaffold the learners (Kim & Baylor, 2016 as cited in Sikström et al. 2022). Scholars and researchers have identified diverse roles of PAs in which they served distinct instructional purposes, for examples teaching assistants/ tutors, mentors, experts, learning companion/ peer learners, and motivators that were presented on a screen to deliver instruction online through verbal and non-verbal communication (Li et al., 2025; Mohammad Yusoff et al., 2024; Ralegaonkar et al., 2019; Tao et al., 2022; Zhang & Mo, 2025). PAs can simulate teacher-like guidance, mentorship, and tutoring, as well as to encourage and support online learners, regardless of their specific assigned roles (Zhang & Mo, 2025). Through a series of literature reviews, it is evidence that PAs span a wide design spectrum, from static and minimalist representations to highly anthropomorphic avatars design (Sikström et al. 2022; Tao et al., 2022; Tatli & Karoğlu, 2025; Wang et al., 2022; Zhang & Mo, 2025):

- **Static and minimalist design –** These PAs are often simple 2D images (humanoid agents or non-humanoid agents such as animals) that appear on the screen, which have a less "rich" or distracting interface to provide cues or feedback without movement or complex expressions.
- **Anthropomorphic/Avatar design –** These PAs are 2D or 3D characters, sometimes designed as cartoonish, or "human-like" avatars that capable of lifelike behaviours such as gestures, gaze, facial expressions, and movements, as well as auditory cues through narration or speech.

This study focused on two different types of simple 2D cartoon-like PAs designs—Affective and Static, embedded in two interactive multimedia modules (IMMs) to deliver an Introductory Psychology (IP) course content for non-majors who studied a communication programme at a Malaysian university. 2D agents are generally found to be more effective at minimising cognitive load compared to 3D counterparts with increased visual complexity (Li et al., 2025; Tao et al., 2022). Mayer et al. (2008 as cited in Dai et al., 2022) also suggested that the PAs should be designed in accordance with "less is more" principle, coupled with necessary functions that are related to instructional content to reduce extraneous cognitive load and provide focused guidance.

This paper describes two PAs called Karen (female PA) and Joe (male PA) that were designed as learning companion to the targeted users, i.e., second-year university students to work with multimedia-based instructional materials for an IP course. Both PAs in the IMMs represented their typical peers' characteristics. Karen plays the character of a high academic-achiever who generally show traits like self-discipline and a strong sense of responsibility, while Joe is portrayed as otherwise. However, both Karen and Joe shared the same roles as learning companion in guiding learners to understand the IP lessons (see Table 3) integrated in two interactive multimedia modules (IMMs). Karen and Joe implemented key pedagogical functions: Presentation of IP course content as well as probing questions, hints, and explanations. Adobe Animate CC was used to design and develop these two IMMs with two different types of PAs as depicted in Table 1 and Table 2.

Table 1

Features of affective PAs in an IMM for the instruction of lessons in an Introductory Psychology course

Type of PAs	Description
Affective PAs (APAs) with animated and emotive responses  **Text flow is provided as subtitle at the bottom of the panel**	Karen (female PA) and Joe (male PA) with an animated persona and emotive responses were built into the first IMM to guide the learning and support instruction. Affective PAs were designed to provoke affective experiences in learners through multiple modalities such as facial expressions eye gaze, body gestures, human-like movements, and voice. Schneider et al. (2022) discovered that a PA who exhibited gestures and facial expressions led to better knowledge retention. Karen and Joe were designed to equip with recorded human voices to deliver dialogues while conveying instructional content. Atkinson et al. (2005 as cited in Dai et al., 2022) asserted that PAs with a human voice were performed significantly better than PAs with a synthesized/ machine voice in retention. Subtitles that transcribed spoken dialogue into written text on the screen, enhancing clarity and accessibility during the conversations flows. Subtitles assist learners to better understand audio while they consume the multimedia content.

Apart from the differences of PA designs between the two IMMs (i.e., IMMAPA and IMMSPA), both IMMs present IP lessons with identical content while incorporating same interactive elements, ensuring consistent learning objectives are met while catering to diverse PAs. Both IMMs serve as primary research instruments in the study, mainly to evaluate how the IMMs with different PAs could enhance students' achievement in learning the fundamental of psychology.

Table 2

Features of static PAs in an IMM for the instruction of lessons in an Introductory Psychology course

Type of PAs	Description
Static PAs (SPA) **Display the dialogue between PAs about a lesson in a transparent dialogue box**  	Karen (female PA) and Joe (male PA) were designed and embedded in the second IMM in the form of static characters with minimal/ low embodiment. When delivering lessons, they constantly facing users all the time, showing limited facial expressions and body gestures without speech. They deliver text-based instructional content without audio. A series of text flow adhering to the lessons are presented on top of the panel in a transparent dialogue box, rather than conversation between the two PAs.

3. Introductory psychology as instructional content in the interactive multimedia modules

The Introductory Psychology (IP) course (often referred to as Psychology 101) has appeal to a broad variety of programmes across the college or university curriculum due to its nature of study. IP is an interdisciplinary course that explores the concepts and principles from both the social sciences (e.g., personality, society) and natural sciences (e.g., brain function, human mind and behaviour) perspectives (King, 2023; Warne et al., 2018). Thus, the IP course is one of the most common taught courses in higher education for students of the psychology majors, and the vast majority of non-majors (Bernstein & Frantz; Gurung et al., 2016; Lewis, 2024; Warne et al., 2018) such as medicine, education, communications, business, com science, engineering, computer science, law and so forth.

According to Sparkman et al. (2023), the IP course provides students opportunity to connect concepts and findings from psychology with social problems such as climate change, educate students regarding ways to address social issues, prepare students for the real-world problems and challenges, as well as empowers them to become critical thinkers and problem solvers. Totton and Sanderson (2026) pointed out that the IP course provides a foundation in psychological theories, core psychological principles, and research, equipping students with the critical skills for success in the future workplace that prepare them for a wide range of career pathways. As such, Gurung et al. (2016) and Norcross et al. (2016) asserted that the IP course has been a general education requirement for many undergraduate programmes of study. Spencer et al. (2020) also stated that the psychology course offers a chance for students in majors and non-majors to learn psychological concepts and skills, and apply them in real-world settings. Totton and Sanderson (2026) proclaimed that one of the significant challenges instructors facing is to select the most relevant content to cover in the IP course for both psychology majors and non-majors, as well as aptly incorporate strategies that could boost student learning, and encourage them to make effective connections between course topics and relate course content to everyday life.

Citing past research work, Gurung and Hackathorn (2018) noted that the IP course is taught face-to-face, online, and in a hybrid or blended mode. In current attempt, blended learning was used in the teaching of IP course among non-major students who studying a communication programme at a Malaysian university. To enhance student engagement in learning, and ensure that complex psychological concepts are clearly understood, instructors integrate interactive multimedia content as well as provide instant feedback and virtual discussions to

create a dynamic learning environment. Instructors also use digital tools to support teaching-learning process, and foster interaction for effective learning.

This study aimed to design and develop two interactive multimedia modules (IMMs) with identical instructional content but two different types of PAs—affective and static, guiding students in learning 14 topics of IP as revealed in Table 3.

Table 3

14 topics of Introductory Psychology integrated in both IMMs

1.	Definition, and Etymology of Psychology
2.	Branches (Types) of Psychology
3.	Developmental Psychology (Term and Definition)
4.	Clinical Psychology (Term and Definition)
5.	Mental Illness (Definition)
6.	Abnormal Psychology
7.	Nature and Nurture in Psychology
8.	Hereditary and Psychology
9.	Psychologist versus Psychiatrist
10.	Psycho-Analysis – Hypnotherapy
11.	Introversion and Extraversion
12.	Ambiversion
13.	Anti-Social Behaviour
14.	Darwin's Theory of Evolution and Hereditary

4. The effectiveness of affective and static pedagogical agents for introductory psychology instruction

This study also aimed to examine the effectiveness of different types of PAs by comparing the learning achievement of students after using IMMs with APAs and SPAs in learning an IP course.

Research design - A two-group post-test only experimental design was conducted to evaluate the effectiveness of using IMMs with different types of PAs—Affective (APA) versus Static (SPA) in the teaching and learning of an IP course. There was no pre-test given to either APA or SPA group to avoid testing effects bias. By removing the pre-test entirely eliminates the possibility of the pre-test priming the participants, which mitigates testing effects and pre-exposure effects (Mitschke & Slater, 2020). A participant taking a similar test for the second time may be more prepared to the type of questions asked (Choueiry, 2022). Choueiry added, with the absence of pre-test before the intervention isolates the effect of pre-test results. The participants' post-test scores or learning outcomes reflect the true impact of an intervention. The post-test scores obtained from both APA and SPA groups were then being compared to determine if there was a statistically significant difference in students' learning achievement to examine the effectiveness of affective and static PAs in multimedia lessons.

Research instruments - The research instruments in this study encompassed: 1) two IMMs with different types of PAs (i.e. IMMAPA and IMMSPA) for the teaching and learning of an IP course as have been discussed in section 2; and 2) a 20-question achievement test for measuring student knowledge in the IP course. Cizek (2004) defined the achievement test as "A procedure designed to measure an examinee's attainment of knowledge or skills" (p. 41). In this study, a set of achievement test consisting of 20 multiple-choice items was developed. The test covered selected topics in the IP course as depicted in Table 3, which was modified from several past year quiz questions that were created by experienced psychology lecturers (i.e., lecturers with teaching experience in psychology for more than 5 years). The test attempted to measure student learning at the end of the instruction. Numerous past studies (Hakim & Irhamsyah, 2020; Kinyua & Okunya, 2014; Sugianto, 2017) revealed that teacher-made tests were generally acceptable and valid. The findings of Kinyua and Okunya (2014) also indicated a positive correlation exists between the experiences of teachers with the validity of the tests they constructed. The participants' scores obtained from the achievement tests were used to evaluate the effectiveness of two different types of PAs—Affective versus Static on students' learning achievement in the IP course.

Research participants - All the research participants were the second-year university students from a

Malaysian university. 32 participants were recruited via purposive sampling from a class of a communication programme who have not taken any psychology courses previously. A comparative study was conducted to examine the effects of different types of PAs (i.e., APAs and SPAs) on students' learning achievement in the IP course. Participants were then equally allocated into the following two groups:

1) **APA group –** 16 students participated in APA group learned the IP course with the guidance of two affective with animated and emotive responses characters, which equipped with multiple modalities such as facial expressions, eye gaze, body gestures, human-like movements, as well as recorded human voice features, and

2) **SPA group –** 16 students participated in SPA group learned the IP course with an aid of two static characters, which equipped with minimal/ low embodiment, and text-based instructional content where audio feature was absent.

Scholars (Creswell & Guetterman, 2019; Fraenkelet al., 2018) recommended that carrying out experimental studies with at least 30 participants in a group is necessary, otherwise there will be low statistical power, which may cause unreliable research findings. However, Basavarajaiah and Narasimha (2020) indicated that "The more heterogeneous a population is, the larger the sample size required to obtain a given level of precision. The less variable (more homogeneous) a population is, smaller the sample size is." (p. 241). This means that if the population that is to be sampled is homogeneous (i.e. the relevant characteristics are evenly distributed), a smaller sample can be relied on if the population is less highly variable.

Due to the small sample size in this study (i.e., 16 in each group), all the participants All participants from both the APA and SPA groups were selected on similar traits basis to keep the homogeneity of variance, which included: 1) they were second-year university students who studied a communication programme, and 2) they have never taken an IP course. Since these requirements are easily met, it is possible to show that sample characteristics such as age, learning experience are fairly homogeneous in any sample of students. Hence, a small number of participants are assumed to be adequate.

Data analysis and research findings - Total score of each student in the achievement test were calculated by summing up the score for each correct answer to measure students' achievement in the knowledge acquisition and retention of IP after the intervention (i.e. learning the IP course using IMMs with different types of PAs). The IMM group with higher score was assumed to successfully retain the instructional content more effectively in this study. The evaluation of the effects of IMMs with two different types of PAs on students' learning achievement in the IP course was measured through hypothesis testing. The data were then analysed using SPSS (Statistical Package for Social Science). Independent-samples t-test was used to test the following null hypothesis:

H_0: There is no significant difference between the learning of Introductory Psychology using IMMAPA and IMMSPA on students' learning achievement.

An independent-samples t-test was used to determine whether there is a statistically significant difference between the means in two unrelated samples (Usman, 2016). Even though this study involved a small sample size (i.e., N=16 for each group), the parametric test (independent t-test) was used instead of performing a non-parametric test since the sample characteristics such as age and learning experience are fairly homogeneous in any sample of students. Usman (2016) pointed out that the non-parametric tests are usually less powerful. de Winter (2013) had also affirmed that some prior studies found that applying the t-test on small samples is feasible. The independent samples t-test was conducted to determine whether there was a significant difference between the mean scores of students' achievements under two different conditions (i.e., learning IP using IMMAPA and IMMSPA) among respondents. The results are shown in Table 4.

Table 4

Comparison of APA and SPA groups on post-test

Group	N	M	SD	*t*-value	p
APA (Learning through the use of IMMSPA)	16	18.06	1.61	3.19	0.003**
SPA (Learning through the use of IMMSPA)	16	916.13	1.82		

** Significant at 0.01 level (2-tailed)

As can be perceived through Table 4, the p-value was 0.003 ($p < 0.01$) indicating that the data provides enough evidence to reject H_0 at a 0.01 significance level ($t=3.19$, $p=0.003$). The results explain that there is a significant difference between the achievements of the APA and SPA groups on post-test. The results also corroborate the assumption that "there is a significant difference between the learning of IP using IMMAPA and IMMSPA on students' learning achievement" with a significant difference in mean scores between the two groups ($M_{IMMAPA}=18.06$, $SD_{IMMAPA}=1.61$; $M_{IMMSPA}=16.13$, $SD_{IMMSPA}=1.82$) as shown in Table 4. The difference between the learning achievements of both APA and SPA groups in the post-test is clearly shown in Figure 1.

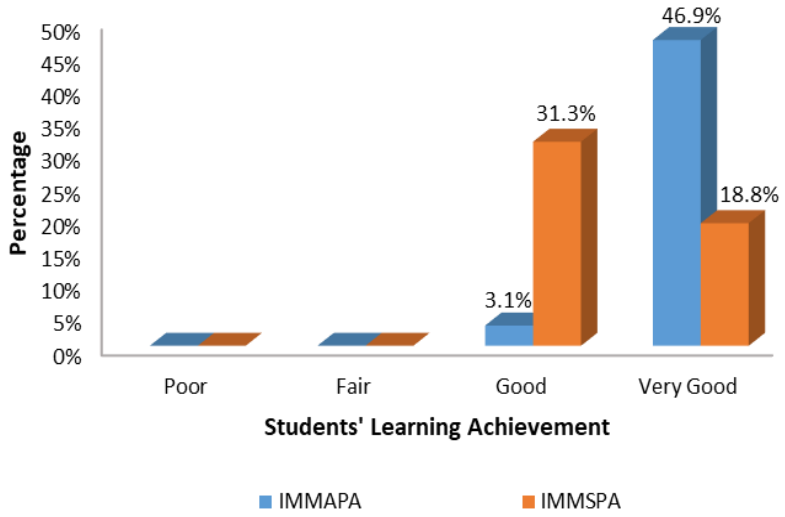

Figure 1. Students' learning achievement on achievement test to measure their knowledge in Introductory Psychology

The research findings proved that the IMMs with PAs had a positive impact on students' learning achievement, in which both IMMAPA and IMMSPA groups scored well, i.e. 11 points and above in the total score of the achievement test. Figure 1 shows that none of the respondents in either group fell into "Poor" and "Fair" categories, i.e., scored less than 11 points in the total score of the achievement test.

Figure 1 also shows that students who learned IP course using IMMAPA had better performance compared to students who learned the course using IMMSPA with the following results:

- **"Very Good" (scored 16-20 points in total in the achievement test)** – The percentage of students in the IMMAPA group was higher (46.9%) than the students in IMMSPA group (18.8%), and
- **"Good" (scored 11-15 points in total in the achievement test)** – 31.3% of students in the IMMSPA group's rating fell in this category whereas the students in the IMMAPA group was only 3.1%.

The research findings proved that different types of PAs in the IMMs had a significant effect on students' performance in the learning of IP course. The study found that students performed better in the achievement test

when the high embodied PAs showed gesturing, facial expressions, eye gaze, and human-like movements in multimedia instruction compared with a low embodied PAs. The findings from the present study coincide with the past studies, for instances Li et al. (2021), Li et al. (2019), Park (2015) and Wang et al. (2022). These studies share a common finding where affective PAs gesturing in multimedia instruction resulted in more effective learning as well as significantly enhance the learning outcomes and retention compared to static PAs.

5. Conclusion

The research findings reveal that students who learned using IMMAPA embedded with human-like affective PAs that leverages human-like gestures, facial expressions, and human voice resulting in better learning outcomes compared to students who learned using IMMAPA embedded with static PAs and text-based delivery of content without audio feature. The findings of this small-scale research also found that affective PAs combining different multimedia elements (text, graphics, animation, and audio) significantly optimise the instruction of IP course by leveraging multiple senses, fostering deeper understanding, and increasing retention rates, compared to static PAs with text-only instruction. Large-scale of studies are needed in future to establish broad and generalizable findings. While these findings lay the groundwork for future research, further studies are needed to fully identify the factors enhancing human-like PA communication.

6. References:

AL-KAİSİ, A., Arkhangelskaya, A., Rudenko-Morgun, O., & Lopanova, E. (2019). Pedagogical agents in teaching language: Types and implementation opportunities. *International E-Journal of Advances in Education*, *5*, 275-285. https://doi.org/10.18768/ijaedu.593875

Apoki, U.C., Hussein, A.A., Al-Chalabi, H.K.M., Badica, C., & Mocanu, M.L. (2022). The role of pedagogical agents in personalised adaptive learning: A review. *Sustainability*, *14*(11), 6442. https://doi.org/10.3390/su14116442

Arguedas, M., Daradoumis, T., Caballe, S., Conesa, J., & Ortega-Ochoa, E. (2025). Exploring the impact of affective pedagogical agents: Enhancing emotional engagement in higher education. *Computers*, *14*(12), 542. https://doi.org/10.3390/computers14120542

Basavarajaiah, D.M. & Narasimha, M.B. (2020). *Design of experiments and advanced statistical techniques in clinical research*. Springer Nature.

Bernstein, D. & Frantz, S. (2025). Teaching an introductory psychology course that matters. *American Psychologist*. https://doi.org/10.1037/amp0001597

Choueiry, G. (2022). *Posttest-only control group design: An introduction*. Quantifying Health. https://quantifyinghealth.com/posttestonly-control-group-design/

Cizek, G.J. (2004). Achievement tests. In C.D. Spielberger (Ed.), *Encyclopedia of Applied Psychology* (pp. 41-46). Elsevier. https://doi.org/10.1016/B0-12-657410-3/00226-9

Creswell, J.W. & Guetterman, T.C. (2019). *Educational research: Planning, conducting, and evaluating quantitative* (6th Ed.). Pearson Education.

Dai, L., Jung, M.M., Postma, M., & Louwerse, M.M. (2022). A systematic review of pedagogical agent research: Similarities, differences and unexplored aspects. *Computers & Education*, 190, 104607. https://doi.org/10.1016/j.compedu.2022.104607

de Winter, J.C.F. (2013). Using the student's t-test with extremely small sample sizes. *Practical Assessment, Research & Evaluation*, *18*(10), 1-12. http://pareonline.net/getvn.asp?v=18&n=10

Fraenkel, J.R., Wallen, N.E., & Hyun, H.H. (2018). *How to design and evaluate research in education* (10th Ed.). McGraw-Hill.

Grivokostopoulou, F., & Kovas, K., & Perikos, I. (2020). The effectiveness of embodied pedagogical agents and their impact on students learning in virtual worlds. *Applied Sciences. 10*(5), 1739. https://doi.org/0.3390/app10051739

Gulz, A., Haake, M., Silvervarg, A., Sjödén, B., & Veletsianos, G. (2011). Building a social conversational

pedagogical agent: Design challenges and methodological approaches. In D. Perez-, & I. Pascual-Nieto (Eds). *Conversational agents and natural language interaction: Techniques and effective practices* (pp. 128-155). IGI Global. https://doi.org/10.4018/978-1-60960-617-6.ch006

Gurung, R., Hackathorn, J., Enns, C., & Frantz, S., Cacioppo, J., Loop, T., & Freeman, J. (2016). Strengthening introductory psychology: A new model for teaching the introductory course. *American Psychologist, 71*. 112-124. https://doi.org/10.1037/a0040012

Gurung, R.A.R. & Hackathorn, J. (2018). Ramp it up: A call for more research in introductory psychology. *Teaching of Psychology, 45*, 302-311. https://doi.org/10.1177/0098628318796413

Hakim, L. & Irhamsyah. (2020). The analysis of the teacher-made test for senior high school at State Senior High School 1 Kutacane, Aceh Tenggara. *Jurnal Ilmiah DIDAKTIKA*, *21*(1), 10-20. https://doi.org/10.22373/jid.v21i1.4120

Imran, M., Almusharraf, N., & Abbasova, M.Y. (2025). Digital learning transformation: A study of teachers' post-Covid-19 experiences. *Social Sciences & Humanities Open*, *11*, 101228. https://doi.org/10.1016/j.ssaho.2024.101228

King, C. (2023, April 11). Is psychology a social science or natural science? *POSTGRAD.com* https://www.postgrad.com/blog/is-psychology-a-social-science/

Kinyua, K. & Okunya, L.O. (2014). Validity and reliability of teacher-made tests: Case study of year 11 physics in Nyahururu District of Kenya. *African Educational Research Journal*, *2*(2), 61-71. http://www.netjournals.org/pdf/AERJ/2014/2/14-015.pdf

Lane, H.C. (2016). Chapter 3 - Pedagogical agents and affect. In S.Y. Tettegah, & M. Gartmeier (Eds). *Emotions, technology, design, and learning* (pp. 47-62). Academic Press. https://doi.org/10.1016/C2014-0-01127-6

Lang, Y., Xie, K., Gong, S., Wang, Y., & Cao, Y. (2022). The impact of emotional feedback and elaborated feedback of a pedagogical agent on multimedia learning. *Frontiers in Psychology, 13*, 810194. https://doi.org/10.3389/fpsyg.2022.810194

Lewis, L. (2024, September 1). *Using the APA guidelines 3.0 to inform the teaching of introduction to psychology*. American Psychological Association. https://www.apa.org/ed/precollege/psychology-teacher-network/introductory-psychology/using-guidelines

Li, H., Wang, Z., Din, L., Zhang, J., & Wang, G. (2025). The facts about the effects of pedagogical agents on learners' cognitive load: A meta-analysis based on 24 studies. *Frontiers in Psychology, 16*, 1635465. https://doi.org/10.3389/fpsyg.2025.1635465

Li, W., Wang, F., Mayer, R.E. & Liu, H. (2019). Getting the point: Which kinds of gestures by pedagogical agents improve multimedia learning? *Journal of Educational Psychology*, *111*(8), 1382–1395. https://doi.org/10.1037/edu0000352

Li, W., Wang, F., Mayer, R.E. & Liu, T. (2021). Animated pedagogical agents enhance learning outcomes and brain activity during learning. *Journal of Computer Assisted Learning*. https://doi.org/10.1111/jcal.12634

Martha, A.S.D., & Santoso, H.B. (2019). The design and impact of the pedagogical agent: A systematic literature review. *The Journal of Educators Online*, *16*(1). https://doi.org/10.9743/JEO.2019.16.1.8

Mitschke, D. & Slater, H. (2020). 8.1 Experimental design: What is it and when should it be used? In R.L. Mauldin (Ed.), *Foundations of Social Work Research* (pp. 249-256). Mavs Open Press.

Mohammad Yusoff, M.D., Mohd Yusof, A., Mohd Anuar, A.A., Jamaludin, N.S.A., & Ruzzaman, M.S.K. (2024). Effects of pedagogical agent on learner's cognitive load and intrinsic motivation: A systematic literature review. *Pakistan Journal of Life and Social Sciences*, *22*(2), 7316-7327. https://doi.org/10.57239/PJLSS-2024-22.2.00552

Norcross, J.C., Hailstorks, R., Aiken, L.S., & Pfund, R.A. (2016). Undergraduate study in psychology: Curriculum and assessment," *American Psychologist, 71*(2), 89-101. https://doi.org/10.1037/a0040095

Park, S. (2015). The effects of social cue principles on cognitive load, situational interest, motivation, and achievement in pedagogical agent multimedia learning. *Educational Technology & Society*, *18*(4), 211-229.

Ralegaonkar, A.A., Thorat, S.B., Patil, P.R., & Tamseka, P.B. (2019). The role of pedagogical agents in designing KITWEB. *IOSR Journal of Engineering (IOSRJEN)*, *19*, 53-58 https://iosrjen.org/Papers/Conf.ICIREST-2019/Volume-19/9.%2053-58.pdf

Schneider, S., Krieglstein, F., Beege, M., & Rey, G.D. (2022). The impact of video lecturers' nonverbal communication on learning – an experiment on gestures and facial expressions of pedagogical agents. *Computers & Education*, *176*, 104350. https://doi.org/10.1016/j.compedu.2021.104350

Schroeder, N. L. (2017). The influence of a pedagogical agent on learners' cognitive load. *Journal of Educational Technology & Society*, *20*(4), 138–147. http://www.jstor.org/stable/26229212

Schroeder, N.L., Davis, R.O., & Yang, E. (2025). Designing and learning with pedagogical agents: an umbrella review. *Journal of Educational Computing Research*, *62*(8), 2127-2156. https://doi.org/07356331241288476

Sikström, P., Valentini, C., Sivunen, A., & Kärkkäinen, T. (2022). How pedagogical agents communicate with students: A two-phase systematic review. *Computers & Education*, *188*, 104564. https://doi.org/10.1016/j.compedu.2022.104564

Sparkman, G., Hackel, L.M., Crosby, J.R., Gross, J.J., & Hard, B.M. (2023). Connecting introductory psychology to climate change can empower students. *Teaching of Psychology*, *52*(1). . https://doi.org/10.1177/0098628323117794

Spencer, S.M., Oliveira, J.M., Ruben, M.A., Blais, C., & Nugent, L.A. (2020, February 4). Interdisciplinary education as a route to promoting psychology across occupations. *Society for the Teaching of Psychology*. https://teachpsych.org/E-xcellence-in-Teaching-Blog/8727857

Sugianto, A. (2017). Validity and reliability of English summative test for senior high school. *Indonesian EFL Journal: Journal of ELT, Linguistics, and Literature*, *3*(2), 22-38.

Tang X., Jiang L., Liu G., & Li, H. (2025). The interaction effect of pedagogical agent and emotional feedback on effective learning: A 2 × 2 factorial experiment in online formative assessment. *Frontier in Psychology*, *16*, 1610550. https://doi.org/10.3389/fpsyg.2025.1610550

Tao, Y., Zhang, G., Zhang, D., Wang, F., Zhou, Y., & Xu, T. (2022). Exploring persona characteristics in learning: A review study of pedagogical agents. *Procedia Computer Science 201*, 87-94. https://doi.org/10.1016/j.procs.2022.03.014

Tatli, A. & Karoğlu, A.K. (2025). Comparing design features of educational agents: Student perspectives. *International Journal on Studies in Education*, *7*(3), 699-731 https://doi.org/10.46328/ijonse.5086

Totton, R.R. & Sanderson, C.A. (2026). Introduction to teaching introduction to psychology. In R.R. Totton & C.A. Sanderson (Eds.), *Teaching Introduction to Psychology* (pp. xi). Edward Elgar Publishing.

Usman, M. (2016). On consistency and limitation of independent t-test Kolmogorov Smirnov Test and Mann Whitney U test. *IOSR Journal of Mathematics*, *12*(4), 22-27. http://www.iosrjournals.org/iosr-jm/papers/Vol12-issue4/Version-5/E1204052227.pdf

Wang, Y., Feng, X., Guo, J., Gong, S., Wu, Y., & Wang, J. (2022). Benefits of affective pedagogical agents in multimedia instruction. *Frontiers in Psychology*, *12*, 797236. https://doi.org/10.3389/fpsyg.2021.797236

Wang, Y., Gong, S., Cao Y., & Fan W. (2023). The power of affective pedagogical agent and self-explanation in computer-based learning. *Computer Education*, *195*, 104723. https://doi.org/10.1016/j.compedu.2022.104723

Warne, R.T., Astle, M.C., & Hill, J.C. (2018). What do undergraduates learn about human intelligence? An analysis of introductory psychology textbooks. *Archives of Scientific Psychology, 6*(1), 32-50. https://doi.org/10.1037/arc000008

Yusuf, H., Money, A., & Daylamani-Zad, D. (2025). Pedagogical AI conversational agents in higher education: A conceptual framework and survey of the state of the art. *Educational Technology Research and Development, 73*. https://doi.org/10.1007/s11423-025-10447-4

Zhang, C. & Mo, L. (2025). The effectiveness of virtual digital human pedagogical agents in virtual reality learning environments: A meta-analysis of 36 empirical studies. *Journal of Visual and Performing Arts Research, 1*(1), 37-61. https://doi.org/10.71204/6p1ny979

Zhang, S., Jaldi, C.D., Schroeder, N.L., López, A.A., Gladstone, J.R., & Heidig, S. (2024). Pedagogical agent design for K-12 education: A systematic review. *Computers & Education*, *223*, 105165. https://doi.org/10.1016/j.compedu.2024.105165

Zou, Y., Kuek, F., Feng, W., & Cheng, X. (2025). Digital learning in the 21st century: trends, challenges, and innovations in technology integration. *Frontiers in Education*, *10.* 1562391. https://doi.org/10.3389/feduc.2025.1562391