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Learner perception changes of ChatGPT over ten days: Focusing on psychological anthropomorphism, privacy concerns and trust

SUMMARY

Given the increasing popularity of generative artificial intelligence (GAI) among students, this study examined learners' experiences before and after a Python programming course using ChatGPT, conducted as part of a data-processing course. Using a pre-post study design, we gathered data from 23 participants to investigate the changes in learners' perceptions of ChatGPT, including perceived psychological anthropomorphism, privacy concerns, trust in ChatGPT, and continuance intentions. Our quantitative analysis revealed that perceived psychological anthropomorphism, privacy concerns, and trust increased significantly after participating in the course. The study also found that, despite being beginners in programming, learners showed a willingness to continue exploring related content after participating in the course. The participants also expressed that the use of ChatGPT lowered barriers to learning programming and text mining. These findings should be considered when planning or designing GAI-related literacy education programmes in the future.

Keywords: ChatGPT, Python programming course, privacy concern, psychological anthropomorphism, trust, learner awareness.

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INTRODUCTION

Generative artificial intelligence (GAI) is a subset of artificial intelligence (AI) dedicated to producing new and original content, such as images, texts, and music. GAIs are useful assistants in creative processes (Rios-Campos et al., 2023). Grand View Research (2022) forecasted an annual growth rate of 34.4% for the GAI market through 2030, highlighting its value across diverse sectors such as finance, healthcare, automotive, transportation, information technology, communications, media, and entertainment. The use of GAI has accelerated further since the emergence of ChatGPT 3.5 in November 2022. According to Fishbowl's 2023 survey, approximately 30% of 4,500 experts noted having experience using GAI, such as ChatGPT and Bard.

ChatGPT is a chatbot based on a large-scale language model and is increasingly being implemented in daily life. It enhances the interactions between humans and AI across various domains, including workplaces, educational and research sectors, and creative fields (Adiguzel et al., 2023; Kasneci et al., 2023; Lo, 2023). ChatGPT has become a pivotal tool for igniting creativity and expanding imagination; the outputs it generates are often indistinguishable from those created by humans (Guo et al., 2023; Herbold et al., 2023; Katib et al., 2023; Yeadon, 2023). Additionally, a humanoid robot powered by ChatGPT has been introduced. In February 2024, a video was released showcasing OpenAI's AI model integrated into Figure 01, a humanoid robot developed by Figure, an AI robotics start-up. Figure 01 demonstrated the ability to recognize and assess surrounding objects, exhibit human-like intonation, and perform actions. Figure AI attracted a substantial investment of $675 million from OpenAI, Microsoft, NVIDIA, Amazon, and Intel (Figure AI Inc., 2024). As robots combine with multimodal AI, such as ChatGPT, to embody not only appearance of humans, but also aspects considered unique to humans, such as situational awareness, judgment, and communication, the level of anthropomorphism is predicted to increase.

However, ChatGPT includes potential risks, such as the leakage of sensitive personal and organisational information. It is trained with a large amount of data obtained from various inputs, which often include sensitive personal information; even anonymised personal information can be used to identify a person by combining various types of data. It remains unclear how this data will be used. The biggest problem with ChatGPT is that in addition to the inadvertent disclosure of sensitive information, users and developers remain unaware of the privacy risks of the new technology (BCG AI Ethics Consulting Team, 2023).

ChatGPT's large language model (LLM) provides users with a familiar interface, that is akin to talking to a person. Additionally, as context-based prompting

progresses, users can obtain more accurate and adjusted answers. In this process, users' perceptions of anthropomorphism, privacy concerns, trust in ChatGPT, and continuance usage intention can change, because users may provide more contextual or personal information to obtain more precise answers.

Higher education institutions are developing and implementing guidelines for the use of GAI, in their educational programmes. Many universities have adopted an open but cautious approach toward GAI and have left it up to instructors to decide how to use GAI in each class (Wang et al., 2024). Therefore, it is necessary for educational policymakers and instructors to understand changes in their learners' perceptions or the influence of GAI during the learning process when planning and implementing education policies or curricula (Chan & Hu, 2023).

Studies on ChatGPT conducted in the context of higher education have mainly focused on factors that influence its continued use or adoption, such as ease of use, perceived usefulness, anthropomorphism, and others (Abdaljaleel et al., 2024; Chan & Zhou, 2023; Lai et al., 2023; Polyportis & Pahos, 2024). However, there is still a lack of research on how courses using ChatGPT in higher education affect learners' perceptions of ChatGPT (except for Sun et al., 2024). Thus, this study intends to answer the following research question:

> RQ: Do learners' perceptions of ChatGPT change after participating in programming activities using ChatGPT? Specifically, how do learners' perceptions shift regarding psychological anthropomorphism, privacy concerns, and trust?

To answer this question, this study examined changes in the perception of GAI among students in the humanities and social sciences, who are not computer science or AI majors. The study was conducted in a Python programming course using ChatGPT for humanities and social science majors, and pre- and post-surveys were analysed to investigate changes in students' perceptions.

RELATED WORK AND HYPOTHESIS DEVELOPMENT

Anthropomorphism refers to giving human characteristics (e.g., appearance, behaviour, and personality) to an inanimate object to make it appear like a human (Epley et al., 2007). Anthropomorphism can be performed in several ways, including giving names to objects (Eskine & Locander, 2014; Waytz et al., 2014) or designing their appearance to resemble that of a human, such as by adding limbs or eyes (Hur et al., 2015). Usually, people anthropomorphise inanimate objects and treat them as human beings (Freud, 2018; Hume, 2000). Because people have learned how to interact with humans, they feel uncertain when interacting with non-human objects,

which leads to cognitive and psychological discomfort. One strategy to resolve this discomfort is to anthropomorphise an object and view it as a human being, like oneself (Epley et al., 2007; MacInnis & Folkes, 2017). Anthropomorphism increases not only intimacy with the target (Epley et al., 2007), but also the sense of social presence toward it, which positively affects the effectiveness of the interaction (Duffy, 2003). The movie *Castaway* is a representative example where Wilson, a volleyball, is both a non-human object and a main character; Chuck thinks of Wilson as a human and interacts with it.

Anthropomorphism includes psychological features (i.e., emotions, personalities and gestures) as well as non-psychological features such as physical resemblance to human bodies (e.g., head, eyes, arms and legs) (Keeley, 2004). According to the CASA (Computers Are Social Actors) paradigm (Nass et al., 1994), individuals tend to treat computers as social actors rather than machines. The ways of thinking and behaving used when interacting with humans are also applied when interacting with computers. People adopt a polite attitude and tone of voice toward AI, as they do with other people, and they expect AI to reciprocate with similar politeness (Nass et al., 1999). This occurs because, in the process of interacting with AI, people come to believe that human attributes – such as emotions – are inherent in AI due to psychological anthropomorphism and physical characteristics (Duffy, 2003). Compared to when the CASA theory was proposed by Nass and colleagues (1994), current computer performance and services have advanced significantly. Luo et al. (2019) confirmed that the success rate of AI counsellors in inducing purchases for financial institution loan customers was no different from that of experienced counsellors. There is also a study showing that AI teaching assistants, which learn from students' questions posted in online lectures, can perform tasks better than human teaching assistants (Goel & Polepeddi, 2018). These results of extant studies further reinforce the position of AI as a social actor. This study focuses on psychological anthropomorphism in the case of AI software that does not have a physical appearance, such as ChatGPT, but interacts with people using human language.

In this study, individuals used ChatGPT to write codes in a course that processed and analysed data. During the course, participants explain the task to ChatGPT and execute the code provided by it. ChatGPT remembers requests and answers made in the same session, and responds to user requests in situations where it understands the prompt history. Through interaction with ChatGPT during the programming course, the degree to which users feel psychologically anthropomorphic toward ChatGPT increases. Therefore, the following hypothesis was proposed:

H1. Learner's perceived psychological anthropomorphism toward ChatGPT increases after participating in a programming course using ChatGPT.

Trust refers to a reliable belief in the accuracy of recommendations, that is, the quality or state of being correct or precise (Shin & Park, 2019). Trust denotes the reliability and credibility of a system. Many trust dimensions determine a user's decision to engage in technology; however, few studies have investigated this in the context of GAI services, particularly ChatGPT. In this study, trust denotes the degree to which ChatGPT recommendations or responses are considered reliable and credible. Kaplan et al.'s (2021) meta-analysis addressed the determinants of trust in AI. Among the three determinant categories, human-related significant factors were users' abilities: understanding and expertise. An individual's level of understanding of an AI system is a significant and positive predictor of trust, as is an individual's expertise in their task. The findings indicate that the more experienced the user, the higher their trust in the system. According to the results of prior research, we posit that participants in the programming course using ChatGPT will become knowledgeable about the virtual assistant, and will believe that its responses are reliable. Thus, we hypothesised the following:

H2. Trust in ChatGPT increases after participating in a programming course using ChatGPT.

Privacy concerns are among the most critical issues in the digital age. They refer to the degree of awareness and evaluation of the risks associated with privacy violations when using information services (Tan et al., 2012). Individuals can experience various benefits from personalised services by sharing personal information. However, sharing personal information can also lead to abuse or misuse of this information (Cram et al., 2019). A prominent privacy violation example is the Facebook-Cambridge Analytica data scandal (Confessore, 2018). Such examples illustrate how service organisations intentionally collect personal information without consent and misuse it. With the emergence of advanced technologies such as GAI, privacy concerns will only become more important and complex. Understanding information technology is believed to significantly impact privacy concerns. Knowledgeable individuals may be more concerned because they are more aware of the potential threats to privacy posed by information technology (e.g., Hoffman et al., 1999). However, previous studies on the relationship between IT knowledge and privacy concerns have produced mixed results (Hong et al., 2021).

In this study, privacy concerns denote the degree of awareness and assessment of the risks related to privacy violations using ChatGPT. As individuals understand ChatGPT, a relatively new technology, they become aware of its capabilities, benefits, and risks. Additionally, because ChatGPT retains context-based prompting information during a session, users can obtain more accurate and adjusted answers. Thus, we hypothesise that participants in a programming course using ChatGPT will

become knowledgeable about ChatGPT and become more concerned about their privacy. Thus, we posit:

H3. Privacy concerns increase after participating in a programming course using ChatGPT.

Dwivedi et al. (2019) highlighted that the relationship between facilitating conditions and behavioural intention is missing from Venkatesh et al.'s (2003) unified theory of acceptance and the use of technology model. In the context of technology adoption, facilitating conditions refer to technical infrastructure, ICT support, and sufficient knowledge to use the technology. Facilitating conditions help individuals perceive technological ease and positively influence effort expectancy (Patil et al., 2020; Polyportis & Pahos, 2024). Subsequently, the continuance intention of individuals to use certain technologies increases. In the context of the programming course, the participants learned how to use ChatGPT in programming and understood its benefits and functions. Thus, participants with the necessary knowledge or resources to use ChatGPT are likely to use ChatGPT continually. Thus,

H4. Continuance intention to use ChatGPT increases after participating in a programming course using ChatGPT.

METHOD

To answer our research questions, we used a mixed-methods approach (Olds et al., 2005; Teddlie & Tashakkori, 2003). The quantitative phase primarily used self-report ratings of Likert items with a pre- and post-test approach. In the qualitative phase, open-ended questions were asked and analysed to further understand the quantitative findings.

Participants

This study was conducted at a large public university in Seoul, South Korea in January 2024, where 31 undergraduate and graduate students not majoring in computer science were registered in the 'Data-processing using ChatGPT' course.

The course was a non-regular program consisting of Python programming and basic text mining for data processing. It was conducted over 10 days, with sessions lasting 2 hours each. Students registered and participated in the class to develop their data-processing abilities. The tuition fee was $30 (30,000 Korean won), and a refund was available for students who attended more than 70% of the course. The students were required to submit a programming assignment each day, which was admitted as attendance. When students uploaded their assignments to a learning management

system, they were required to use ChatGPT and were offered the opportunity to answer questions about their perceptions of and experiences with ChatGPT as part of the assignments. The open-ended question was: "Can I say that the results I requested from ChatGPT are the same as the results I programmed? If not, what are the differences between them? Please feel free to submit your comments." Table 1 presents the details of the course.

Our study drew on a popular approach, combining multiple AI-based programming assistants, and iteratively eliciting ChatGPT's power in Python programming (Yan, 2023). The steps were as follows: 1) taking basic programming lectures, 2) practising programming according to the directions in the lectures, 3) iteratively prompting with ChatGPT for the same directions, 4) comparing the outputs of ChatGPT with the participants' output, and 5) writing a reflection note focusing on comparison details.

Table 1. Course details

Day	Subjects	Contents
1	Understanding of conversation-based GAI	• Background of artificial intelligence, introduction to conversation-based generative artificial intelligence (GAI) technology • Pre-survey
2	Getting started with Python programming	• Programming environment, basic operations (input/output) and data
3	Turn tasks into procedures	• Conditional statements, types of actions: if, while, import
4	Repetitive structure and modularity	• Repetition structure: for, range
5	Breaking down complex problems	• Function handling (def), using turtle graphics, introduction to lists
6	Complex data handling and data pre-processing	• Lists, dictionaries, and Pandas modules
7	Data collection and pre-processing	• Reading file data (txt, csv), pre-processing process
8	Text Mining (1)	• Concept of text mining, word cloud
9	Text Mining (2)	• Text mining free practice, free problem practice
10	Final challenge event	• Off-line competition • Post-survey

Out of 31 participants, 23 responded to the pre-survey assessing their perceptions, and 17 of those also completed the post-survey. Since this study examines changes in participants' perceptions of ChatGPT before and after the training course, only those who completed both the pre- and post-surveys were included in the analysis.

All had heard of ChatGPT and most had attempted to use it to write their reports and course papers (see Table 2).

Table 2. Participant characteristics

Programming experience		Frequency	Percentage (%)
	No experience	18	60.00
	Python	11	36.67
	C, C++	2	6.67
Major		Frequency	Percentage (%)
	Humanities	18	60.00
	Social Science	7	23.33
	Arts	2	6.67
	Others	3	10.00
Educational Level		Frequency	Percentage (%)
	Doctoral Course	2	6.67
	Masters Course	6	20.00
	Undergraduate	22	73.33

Development of measures

The research model includes four variables: perceived psychological anthropomorphism, privacy concerns, trust in ChatGPT, and intention to continue using ChatGPT. The measures of perceived psychological anthropomorphism were adapted from Jang and Lee (2020). The operationalisation of each construct is presented in Table 3. All the constructs were measured using the multiple-item method. Each item was measured on a five-point Likert scale ranging from 'strongly disagree' to 'strongly agree' (see Table 4).

Table 3. Operationalisation of constructs

Constructs	Operationalisation	Adapted from
Perceived psychological anthropomorphism (PPA)	The degree of imbuing the imagined or real behaviour of ChatGPT with humanlike characteristics, motivations, intentions, and emotions	Epley et al. (2007)
Privacy concerns (PC)	The degree of awareness and assessment of risks related to privacy violations using ChatGPT	Tan et al. (2012)

Trust in ChatGPT (TR)	The degree of belief that ChatGPT's recommendations and responses are reliable and credible	Shin (2021)
Continuance intention of ChatGPT (CI)	Individual's willingness to use ChatGPT continuously	Alalwan (2020)

Table 4. Measure items

Constructs	**Items**		**Adapted from**
Perceived psychological anthropomorphism (PPA)	PPA1	I believe that AI device has its own personality.	Golossenko et al. (2020); Lu et al. (2019); Wang (2017)
	PPA2	I believe that AI device has consciousness.	
	PPA3	I believe that AI device has its own reasoning.	
	PPA4	I believe that AI is creative and has its own imagination.	
	PPA5	I believe that AI device can feel compassion.	
Privacy concerns (PC)	PC1	I am concerned that the information I submit to ChatGPT could be misused.	Mohamed & Ahmad (2012)
	PC2	I am concerned that others can find private information about me from ChatGPT.	
	PC3	I am concerned about providing personal information to ChatGPT because of what others might do with it.	
	PC4	I am concerned about providing personal information to ChatGPT because it could be used in a way I do not foresee.	
Trust in ChatGPT (TR)	TR1	ChatGPT is believable.	Baek & Kim (2023)
	TR2	ChatGPT is credible.	
	TR3	ChatGPT is trustworthy.	
Continuance intention of ChatGPT (CI)	CI1	I plan to keep using ChatGPT.	
	CI2	I want to continue using ChatGPT.	

ANALYSIS AND RESULTS

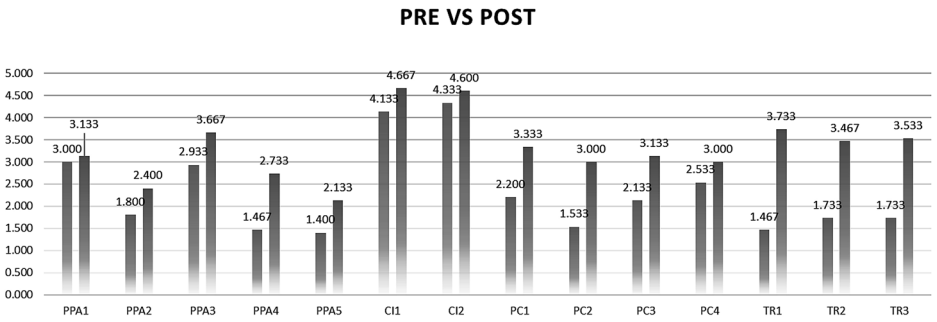
Paired t-test results

Perceived psychological anthropomorphism, privacy concerns, and trust increased significantly after participation in the course. Table 5 and Figure 1 present the results of paired t-tests.

Table 5. The result of paired t-tests

Concepts	Pre-Mean	Post-Mean	t-test Result
Perceived psychological anthropomorphism (PPA)	3.000	3.134	Not-significant but already high
	1.800	2.400	Significant
	2.934	3.667	
	1.467	2.734	
	1.400	2.134	
Privacy concerns (PC)	2.200	3.334	Significant
	1.534	3.000	
	2.134	3.134	
Trust in ChatGPT (TR)	1.467	3.734	Significant
	1.734	3.467	
	1.734	3.534	
Continuance intention of ChatGPT (CI)	4.134	4.667	Non-significant but already high
	4.334	4.600	

Figure 1. Comparison of the paired t-test results



In the qualitative phase, students completed programming assignments after each lecture and compared the code written in the class with the code provided by ChatGPT. The students were able to understand the programme codes and compare the results. They left comments about each lecture and assignment and responded to the overall evaluation of the course in the post-survey.

Measurement model

To assess convergent validity and reliability, we verified the following criteria: (1) all factor loadings exceeded 0.70 for their respective factors, (2) the average variance extracted (AVE) for each construct was greater than 0.50 and (3) both Cronbach's alpha and composite reliability exceeded 0.7 (MacKenzie et al., 2011). As shown in Table 6, all measurement item loadings and composite reliability were above the recommended values.

Table 6. Factor loadings

Items	PPA	CI	PC	TR	Type	SE	p-value
PPA1	**0.801**	0.327	0.055	-0.503	Reflective	0.271	0.005
PPA2	**0.776**	-0.285	0.249	0.497	Reflective	0.197	<0.001
PPA3	**0.759**	-0.103	-0.077	0.679	Reflective	0.309	0.013
PPA4	**0.76**	0.252	-0.136	-0.657	Reflective	0.167	<0.001
PPA5	**0.751**	0.044	-0.127	-0.081	Reflective	0.231	0.003
CI1	0.139	**0.948**	0.029	-0.183	Reflective	0.284	0.002
CI2	-0.139	**0.948**	-0.029	0.183	Reflective	0.204	<0.001
PC1	0.545	0.272	**0.775**	-0.578	Reflective	0.256	0.004
PC2	-0.487	0.14	**0.783**	0.168	Reflective	0.216	0.001
PC3	-0.389	-0.613	**0.906**	0.665	Reflective	0.186	<0.001
PC4	0.363	0.274	**0.856**	-0.334	Reflective	0.205	<0.001
TR1	-0.273	-0.411	-0.233	**0.902**	Reflective	0.266	0.002
TR2	0.045	0.193	0.077	**0.953**	Reflective	0.167	<0.001
TR3	0.21	0.193	0.141	**0.970**	Reflective	0.206	<0.001

Notes. PPA: Perceived psychological anthropomorphism; PC: Privacy concerns; TR: Trust in ChatGPT; CI: Continuance intention of ChatGPT.

Discriminant validity is assessed by examining the square roots of AVE. If the square root of each construct's AVE exceeds the inter-construct correlations, and the items load more strongly on their respective constructs than on other constructs, then the research model demonstrates distinct constructs and ensures discriminant validity. In Table 7, the square root of the AVE for each construct surpasses the cross-factors with all other constructs.

Table 7. Composite reliability, average variance extracted and correlations

Construct	Cronbach's Alpha	Composite Reliability (CR)	PPA	CI	PC	TR
PPA	0.878	0.906	***0.763***			
CI	0.686	0.864	0.189	***0.872***		
PC	0.815	0.880	0.134	0.073	***0.806***	
TR	0.899	0.937	0.601	0.363	0.462	***0.912***

Notes. PPA: Perceived psychological anthropomorphism; PC: Privacy concerns; TR: Trust in ChatGPT; CI: Continuance intention of ChatGPT; * Bold italic: Square root of AVE.

Examination of open-response questions

After every class, students submitted their programming assignments and responses to the question mentioned in the Methods section. Although most students were unfamiliar with programming, they could compare and evaluate the code they wrote and that presented by ChatGPT; accordingly, they left feedback on the parts that were different.

Interestingly, the students not only evaluated their level of understanding of the content in each class but also presented questions related to expansion This shows that ChatGPT can be a helpful assistant for students' learning experiences in new fields. In addition, students identified what ChatGPT can do (answer 1), what areas they would use it for (answers 2-3), and expressed their thoughts on how they would use ChatGPT in the future to strengthen their capabilities (answer 3). As shown in Table 2, the majority of the participants were in the humanities, social sciences, or arts fields. Although they were unfamiliar with programming or text mining, they showed willingness to follow up on learning related content after participating (answers 4-5). Furthermore, they expressed in the post-survey that the use of ChatGPT lowered barriers to learning programming and text mining.

Answer 1. '*It was amazing that through ChatGPT, I could easily analyse data without writing the code. I think the insight of interpreting graphs and analysing content will become more prominent in the future*'.

Answer 2. '*I asked ChatGPT to write a graph, and ran the code written in Colab, and the table was actually created. I will be able to proceed very efficiently when writing my reports later*'.

Answer 3. '*The code that derives correlations between variables felt new. When asking questions to ChatGPT, I think it is more efficient to be as specific as possible*'.

Answer 4. '*I learned how to deal with various data in earnest, and I was proud of the time I had spent trying to solidify the basics, in that, I could only understand the new content if I was fully familiar with the previous class content*'.

Answer 5. '*While taking the class, I felt that the scope of research methods could be further expanded through coding; I thought it would be great to improve my skills through many practices and projects*'.

DISCUSSION AND IMPLICATIONS

Observation of exploratory analysis and research agenda

In this study, we explored the changes in learners' perceptions of ChatGPT in a ten-day programming course using ChatGPT. Learners participated in a survey consisting of perceived psychological anthropomorphism, privacy concerns, trust in ChatGPT, and intention to continue using ChatGPT before and after the course. In the analysis, changes in the items constituting each construct were examined using t-tests. Consequently, the perceived psychological anthropomorphism of ChatGPT was found to have significantly increased after participation compared to before participation (H1). After the course, the perception level of ChatGPT, its awareness, reasoning ability, creativity, imagination, and passion were higher than in the pre-survey. Trust in ChatGPT increased significantly after participation in the course (H2). Additionally, privacy concerns owing to ChatGPT increased significantly (H3). There was no significant difference in the intention to continue using ChatGPT before and after participation; however, since it had been high even before participation, confirming the effect of course participation was difficult (H4). Table 8 illustrates the results of four hypotheses.

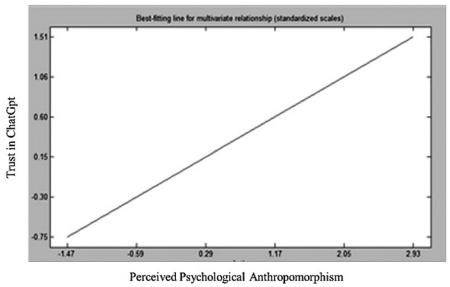
Table 8. Results of analysis

Hypothesis	Results
H1. Learner's perceived psychological anthropomorphism toward ChatGPT increases after participating in a programming course using ChatGPT.	Support

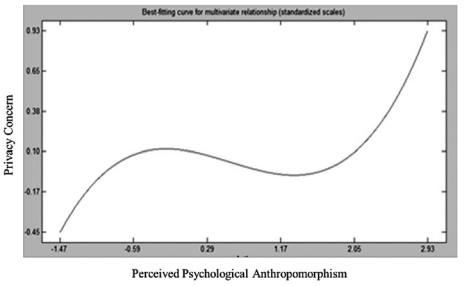
H2. Trust in ChatGPT increases after participating in a programming course using ChatGPT.	Support
H3. Privacy concerns increase after participating in a programming course using ChatGPT.	Support
H4. Continuance intention to use ChatGPT increases after participating in a programming course using ChatGPT.	Not Support

This was a pilot study that examined changes in participants' perceptions of ChatGPT and examined the validity and reliability of measurement items for each construct. The validity and reliability of the measurement model were confirmed and the relationships between them were visualised (Figure 2). We examine the correlation between the major constructs and suggest future research contents.

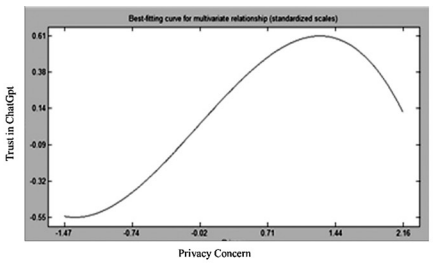
Figure 2. Best fitting curve for multivariate relationship (standardised scales)



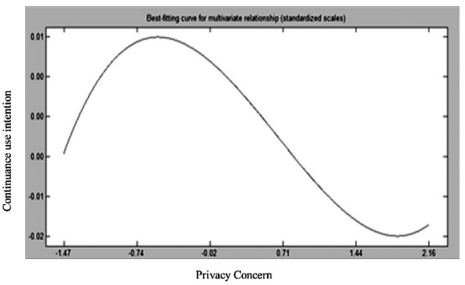
a. PPA and TR



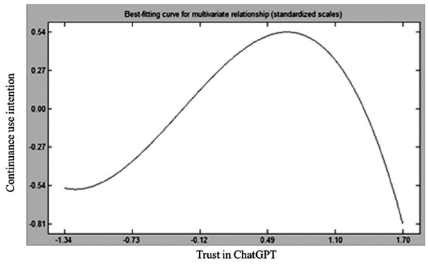
b. PPA and PC



c. PC and TR



d. PC and CI



e. TR and CI

Perceived psychological anthropomorphism and trust in ChatGPT were positively correlated (Figure 2. a). The more the people feel that an AI has its own personality, consciousness, reasoning, creativity, imagination, and compassion, the more they trust it. This is consistent with the results of previous chatbot-related research (e.g., Cheng et al., 2022). Can trust in a product like Figure01, which combines ChatGPT's LLM with a robot, increase when elements of anthropomorphism are included? A study that investigated people's preferences when a robot's appearance was anthropomorphised showed an inverse U-curve. However, unlike physical anthropomorphism, psychological anthropomorphism increases trust in a service; therefore, in the case of a robot with an appearance like Figure01, it is worth conducting research on the degree of anthropomorphism, favourability, and trustworthiness in terms of both appearance and language.

Perceived psychological anthropomorphism and privacy concern levels were positively correlated (Figure 2.b). Up to a certain level of perceived psychological anthropomorphism, the correlation was not high; therefore, privacy concerns were also not very high; however, once it exceeded a certain level, it showed a high correlation. The two may not appear to be related, but as the degree of anthropomorphism of ChatGPT increases, people's concerns about privacy infringement increase significantly; therefore, further research is necessary to ascertain this relationship. For example, future studies can examine the kind of anthropomorphism that is sufficient to make people concerned about privacy breaches, and assess if is it possible to establish the criteria for this degree.

Privacy concerns and trust in ChatGPT were positively correlated (Figure 2.c). Previous studies in other contexts have shown mixed results, such as both positive and negative correlations between the two (e.g., Park et al., 2021; Wu et al., 2012). In our study, trust in ChatGPT increased as privacy concerns increased; however, trust decreased when privacy concerns exceeded a certain level. These results can be expanded to examine the results of previous studies and study contextual factors such as service, user, and technology characteristics, or whether there are certain other criteria.

Privacy concerns and continuation intention to use ChatGPT showed a negative correlation after a certain level (Figure 2.d). This was intuitive and consistent with the results of previous studies. As people become more concerned about their personal information, they will discontinue using ChatGPT. However, a privacy paradox occurs on social media. The phenomenon of being concerned about one's information being violated, but at the same time, wanting tailored information and services, and wanting to express oneself through photos, texts and thoughts, is called the privacy paradox. This can also appear in the use of ChatGPT. People may

feel concerned about privacy violations in ChatGPT but, at the same time, may voluntarily provide personal information to obtain more desired results. Therefore, it is necessary to examine whether the privacy paradox phenomenon appears when using a GAI service and its causes.

Trust in ChatGPT and the intention to continual usage were positively correlated, which is a typical result (Figure 2.e). Interestingly, the graph exhibits an inverse U-curve. As trust in ChatGPT increased, the usage intention also increased; however, when it exceeded a certain level, usage intention decreased. Figure 2.e shows that the results differ from those of previous studies; therefore, it is necessary to expand the sample and examine this relationship.

The anthropomorphism of AI influences a positive attitude toward AI and ease of use. Meanwhile, previous studies warn of the dangers of anthropomorphizing objects. A representative example of this is the Eliza effect, which refers to the tendency of users to anthropomorphize computer systems (Weizenbaum, 1977). The name comes from an early chatbot, which allegedly encouraged a Belgian man to commit suicide (Xiang, 2023).

The results of this study showed that after participating in a programming course using ChatGPT, learners' psychological anthropomorphism toward AI increased. Instructors and educational policymakers need to make efforts to reduce the adverse effects of AI anthropomorphism. For example, when conducting educational courses using ChatGPT, instructors should caution learners against unconditionally accepting the program-related code or answers provided by GAI. They can structure the classes in a way that encourages learners to actively assess whether the provided code or answers are appropriate, explore alternative solutions, engage in discussions with fellow learners, or conduct additional searches. When establishing class policies related to the use of GAI, guidelines can be provided that emphasize students' critical thinking, rather than leaving it entirely up to instructors.

In addition, after participating in the course, learners' privacy concerns and trust in ChatGPT also increased. Previous conducted in various contexts, such as e-commerce and social media environments, have shown a strong negative correlation between privacy concerns and trust (e.g., Eastlick et al., 2006; Kim et al., 2023). However, although this study is exploratory, it reveals that privacy concerns and trust in GAI not only significantly increased after participating in the course, but also showed a positive correlation between them. This result contradicts previous studies and may reflect the intervention effect of the GAI-integrated course. Considering the nature of the programming course and the educational content provided in Table 1, it is unlikely that learners interacted with ChatGPT in a private manner. Nevertheless, learners' psychological anthropomorphism toward ChatGPT and concerns about personal

information exposure increased. While analysing the causes of these results is beyond the scope of this study, several contextual factors can be considered. For instance, an instructor may have pointed out issues with ChatGPT, such as privacy concerns or hallucinations, and provided guidelines for using it in the course. Some students might have encountered errors or inaccuracies when using the ChatGPT recommendation codes. Additionally, some students may have used ChatGPT independently of the course content. In programming learning using GAI, participants appear to develop a better understanding of GAI, leading them to be concerned about the potential for personal information leakage, while simultaneously increasing their trust due to the useful and appropriate guidance on programming procedures or code provided by ChatGPT (Jian et al., 2024). Therefore, future research on this possibility needs to be conducted in depth through longitudinal studies to examine the causal relationship (Chan and Zhou, 2023).

Contributions

This study contributes theoretically to the literature as follows. First, we examined the moderation effect of data processing and analysis training using ChatGPT on ChatGPT perception. In particular, there was a significant difference before and after training in characteristics recognised as uniquely human, such as compassion and creativity. Additionally, privacy concerns and trust in ChatGPT increased significantly. There have been many cases of applying ChatGPT to learning; however, research on the impact of GAI on learners is still in its early stages. This study can contribute to adding evidence to determine what kind of change in perception it brings about in terms of psychological anthropomorphism, privacy concerns, and trust. Second, the measurement model confirmed the items measured for each construct in the context of GAI and examined the correlation between major constructs such as psychological anthropomorphism, privacy concerns, trust, and continuance intention. Third, as GAI-related research progresses, this study contributes to future research by presenting several research questions that require verification.

The practical contributions of the study are threefold. First, this study presents experimental results on the effectiveness of ChatGPT in education, providing a basis for judging the future use of ChatGPT in various learning contexts. Learners not only increased their psychological anthropomorphism, privacy concerns, and trust in ChatGPT but also showed self-efficacy for programming. In particular, as can be seen through the learners' open responses, participants unfamiliar with programming not only participated in classes efficiently with the help of ChatGPT but also showed a sense of efficacy for the program by comparing and judging codes. In classes using GAI, lower learning barriers can be expected for non-majors. Second, this study

was conducted in a programming process so that the results of each class could be evaluated quantitatively; additionally, the method of interaction with ChatGPT was also quite structured. Similar results can be expected when using GAI in similar lectures; however, further research is required on the use and effectiveness of GAI in other types or unstructured lectures. Third, this study applied ChatGPT to one training course and examined changes in participants' perceptions. Currently, GAI is developing at a rapid pace, and its scope of application extends beyond education to various industries and services. In services that utilise GAI, users may psychologically personify or increase their trust in chatbots through interaction with GAI, and users' expectations may vary depending on their experience using GAI; therefore, this needs to be taken into consideration for designing services.

Limitations

This study has several limitations. First, the sample size was relatively small because ChatGPT is not yet widely used by students and is certainly not incorporated into the curricula. However, small sample sizes are not uncommon in early studies on technology integration, including ChatGPT (Firat, 2023), smartphone use (Tossell et al., 2014) and robots (Donnermann et al., 2020) – presenting a trade-off between the impact of novel technology use and the generalisability of results. Although we employed mixed methods to complement small samples, further studies should diversify the educational backgrounds, technical skills, experience, and regions of research participants to ensure the generalizability of research findings. Second, the data-processing course was highly structured and specified in terms of how students worked with ChatGPT. This may have constrained the use of ChatGPT and students' perceptions of it. Future research can attempt to incorporate ChatGPT into other courses, such as creative writing, and examine the research model. Finally, most participants were undergraduate humanities and social science students. Their education on human factor processes, including knowledge elicitation through survey-based user feedback methods, may have influenced their responses. Further studies should examine the research approach with participants from diverse backgrounds and compare the results to confirm the generalisability of our findings.

Furthermore, future studies could include a comparison of the cognitive changes in participants who do not use ChatGPT, serving as a control group, in order to strengthen the causal inference of the research results.

CONCLUSION

This study exploratively examined changes in the perception of ChatGPT among participants who took a ten-day data processing and analysis course. The results showed that perceived psychological anthropomorphism, privacy concerns, and trust in ChatGPT significantly increased after participating in the course. In addition, the study confirmed the measurement model for major constructs and suggested future research agendas by examining the relationships between concepts. Amid the rapid development of the GAI and its application in various industries and services, including education, academic discussions and verified results are insufficient. Despite being an although exploratory study, it contributes to the accumulation of data on empirical research results in related fields.

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Promjene u percepciji polaznika o ChatGPT-u tijekom deset dana: usmjerenost na psihološki antropomorfizam, čuvanje osobnih podataka i povjerenje

SAŽETAK

S obzirom na sve veću popularnost generativne umjetne inteligencije (GAI) među studentima, ovo istraživanje ispitivalo je iskustva polaznika prije i nakon pohađanja tečaja programiranja u programskom jeziku Python koji je uključivao korištenje ChatGPT-a, a koji se provodio kao dio kolegija usmjerenog na obradu podataka. Istraživanjem provedenim prije i nakon pohađanja tečaja prikupili smo podatke od 23 sudionika kako bismo ispitali promjene u percepciji ChatGPT-a, uključujući percipirani psihološki antropomorfizam, pitanje čuvanja osobnih podataka i povjerenje u ChatGPT te namjeru njegova daljnjeg korištenja. Kvantitativna analiza pokazala je da su percipirani psihološki antropomorfizam, pitanje čuvanja osobnih podataka i povjerenje značajno porasli nakon sudjelovanja u tečaju. Istraživanje je također pokazalo da su unatoč početnoj razini programiranja polaznici pokazali spremnost za daljnje istraživanje srodnog sadržaja nakon završetka tečaja. Sudionici su također izrazili mišljenje da je korištenje ChatGPT-a smanjilo prepreke u učenju programiranja i rudarenja teksta. Ovi rezultati trebaju se uzeti u obzir pri budućem planiranju i oblikovanju obrazovnih programa unaprjeđenja pismenosti u području generativne umjetne inteligencije.

Ključne riječi: ChatGPT, tečaj programiranja u Pythonu, čuvanje osobnih podataka, psihološki antropomorfizam, povjerenje, svijest polaznika.