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Reducing transactional distance with AI: Examining the role of chatbots in online student satisfaction and achievement

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Abstract

This study explored graduate students' perceptions of an AI-powered chatbot integrated into an online education course, guided by Moore's (1997) Theory of Transactional Distance. A total of 47 students completed a survey assessing Dialogue, Structure, Learner Autonomy, Satisfaction, Perceived Achievement, and Intent to Continue Use. Regression analyses revealed that all three transactional distance dimensions significantly predicted student satisfaction, with Dialogue as the strongest predictor. Dialogue and Structure were significant predictors of perceived achievement, while Learner Autonomy significantly predicted students' intention to use chatbots in future courses. Qualitative responses reinforced these findings, emphasizing the chatbot's helpfulness and responsiveness. Overall, results suggest that AI chatbots can serve as effective tools to reduce transactional distance and enhance student engagement in online learning environments .

Keywords: AI Chatbots, Transactional Distance, Dialogue, Structure, Learner Autonomy, Student Satisfaction, Achievement

Introduction

The rapid expansion of online and blended learning in higher education has prompted increasing interest in innovative tools that can enhance student engagement, support, and outcomes. Among these tools, AI-powered chatbots, automated conversational agents designed to assist learners in real time, have emerged as a promising technology. While prior research has examined chatbot functionality and design (Kuhail et al., 2023; Winkler & Söllner, 2018), relatively little is known about their pedagogical impact when grounded in established educational theory.

This study addresses that gap by exploring graduate students' perceptions of a chatbot integrated into an online course, using Moore's (1997) Theory of Transactional Distance (TDT) as a conceptual lens. TDT posits that the psychological and communicative distance in distance education is shaped by three interrelated variables: Dialogue (the extent and quality of interaction between instructor and learner), Structure (the rigidity or flexibility of the instructional design), and Learner Autonomy (the degree of self-direction required of the learner) (Moore, 1997; Falloon, 2011). According to the theory, greater dialogue and flexible structure can reduce transactional distance and support learner autonomy, thereby enhance student satisfaction and learning outcomes
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Using a mixed-methods approach grounded in this framework, this study examined how chatbot-mediated dialogue, structural clarity, and support for learner autonomy relate to student satisfaction, perceived achievement, and intention to continue use. By providing empirical evidence on the chatbot's influence in a fully online course, the study contributes to the emerging literature on AI in education and its potential to reduce transactional distance and enhance the online learning experience.

Review of Literature

As online and blended learning environments become increasingly common in higher education, institutions are seeking innovative ways to enhance student engagement, satisfaction, and achievement. One such innovation is the integration of AI-powered chatbots, automated conversational agents designed to provide real-time assistance, answer questions, and support learning. While recent studies have begun to explore the use of chatbots in education, much of the research has focused on their technical capabilities or usability, with limited attention to their pedagogical value and impact on students' learning experiences within established educational theories. For example, Winkler and Söllner (2018) conducted a systematic literature review of 80 articles, identifying areas of application and the potential of chatbots to personalize education. However, their analysis primarily addressed design features and implementation contexts, offering limited insight into the pedagogical implications. Similarly, Kuhail et al. (2023) reviewed 36 empirical studies to analyze chatbot-learner interaction design across seven key dimensions. Although their work provided a valuable overview of trends and challenges, it did not evaluate how chatbot use influences specific learning outcomes such as satisfaction, engagement, or perceptions of autonomy.

Emerging research suggests that when grounded in sound learning theory, chatbots may significantly enhance instructional effectiveness. A compelling example comes from a recent preprint study by Kestin et al. (2024), which found that an AI tutor aligned with cognitive science principles led to double the learning gains in less time compared to traditional active learning strategies. These findings highlight the transformative potential of AI to enhance both instructional design and delivery, provided it is implemented with a pedagogical foundation.

Building on this growing body of work, the present study contributes theory-driven, learner-centered empirical evidence by examining the role of AI chatbots in shaping online learning experience. Specifically, it employs Moore's (1997) Theory of Transactional Distance (TDT) as a conceptual framework to investigate how chatbot integration affects students' satisfaction, perceived learning, and continued use intentions, dimensions that remain underexplored in literature.

According to Moore, the "distance" in distance education is not merely spatial but also psychological and pedagogical, shaped by the interplay of three key dimensions: Dialogue, Structure, and Learner Autonomy. These factors collectively influence how connected learners feel to their instructors, content, and learning environment.

Dialogue refers to purposeful, two-way communication between learners and instructors, or instructional systems, that supports understanding and engagement. High levels of dialogue, facilitated through feedback, discussions, or AI-mediated exchanges, can reduce transactional distance by increasing responsiveness and interaction (Moore, 1997; Falloon, 2011).

Structure encompasses the organization and flexibility of the course design, including objectives, pacing, assessments, and instructional strategies. Rigid structures tend to limit learner control and increase

transactional distance, whereas more flexible designs, such as self-paced modules or personalized learning pathways, can promote greater engagement and autonomy.

Learner Autonomy reflects the extent to which students take responsibility for their learning. As transactional distance increases, particularly in environments with low dialogue or high structure, learners must exhibit higher levels of self-direction (Moore, 1997).

Closely tied to these dimensions are the constructs of student satisfaction and student achievement, which serve as critical indicators of online learning success. In educational research, especially in studies related to instructional design and educational technology, student satisfaction is typically conceptualized as a psychological or affective response to the learning experience. Key aspects include perceived usefulness (how well the course meets student needs), engagement (emotional and cognitive involvement), support and feedback (quality of interaction with instructors or systems like chatbots), system usability (ease of navigating tools and content), and sense of belonging (feeling connected to peers or instructors). In contrast, student achievement is generally defined as a cognitive or behavioral outcome representing how effectively learners meet course objectives. This may be measured both objectively, through grades, assessments, or task completion, and subjectively, via students' own perceptions of learning gains, goal attainment, and skill development. Moore's TDT provides a useful lens for understanding how these outcomes are shaped. Student satisfaction is primarily influenced by dialogue and structure, as these dimensions affect perceived quality and support within the learning environment. Achievement, meanwhile, is closely linked to structure and learner autonomy, especially in online or self-paced formats, where success often depends on clear organization and the learner's ability to self-direct (Moore, 1997).

Although these connections are well established theoretically, few empirical studies have examined how AI chatbots influence each aspect of transactional distance in authentic course settings. This study addresses that gap by investigating how chatbot-mediated dialogue, perceptions of structural clarity, and learner autonomy relate to key student outcomes such as satisfaction, perceived learning, and future use intentions. Using a mixed-methods approach, it offers empirical insight into how AI chatbots may help reduce transactional distance and support more engaging, effective online learning experiences. Emerging research supports this direction. For instance, Onat and Gülseçen (2023) and Achuthan et al. (2024) suggest that AI chatbots can reduce transactional distance by fostering responsive interaction, clarifying course structure, and encouraging autonomous learning behaviors. These early findings further underscore the need to examine chatbot integration through established pedagogical frameworks such as TDT. In response, the present study investigated graduate students' perceptions of AI chatbots in online courses and evaluated their potential to support the core dimensions of transactional distance and related student outcomes. Specifically, the study aimed to investigate the following research questions:

- **RQ1: Is there a statistically significant relationship between students' perceptions of chatbot-mediated Dialogue and their satisfaction with the online learning experience?**
  *H1***:** *There is a statistically significant positive relationship between students' perceptions of chatbot-mediated Dialogue and their satisfaction with the online learning experience.*

- **RQ2: To what extent does the integration of AI chatbots, through its support of Dialogue, Structure, and Learner Autonomy, predict students' perceptions of achievement in an online learning environment?**
  *H2***:** T*he integration of AI chatbots, through their support of Dialogue, Structure, and Learner Autonomy, will significantly predict students' perceptions of achievement in an online learning environment.*

- **RQ3: Does Learner Autonomy significantly predict a student's desire to continue using AI chatbots in future courses?**
  *H3***:** *Perceived learner autonomy significantly predicts students' intention to continue using AI chatbots in future courses.*

Using a mixed-methods approach grounded in Moore's Transactional Distance Theory, this study contributes to the emerging literature on AI in education by providing empirical evidence of how chatbot integration affects student perceptions of learning, satisfaction, and engagement in a fully online course.

Methodology

This study employed a quantitative, survey-based research design to explore graduate students' perceptions of AI chatbots integrated into their online coursework, framed through the lens of Moore's Theory of Transactional Distance. The methodology included a voluntary survey administered to students enrolled in a Master of Education in Education Technology program during the Fall 2024 semester. The instrument consisted of ten Likert-scale items and one open-ended question, designed to assess the chatbot's perceived usefulness, clarity, responsiveness, and its influence on learning, satisfaction, and autonomy. Survey items were mapped to the three dimensions of transactional distance, Dialogue, Structure, and Learner Autonomy, and to two student outcome variables: Satisfaction and Achievement. Internal consistency reliability was evaluated using Cronbach's alpha, which demonstrated acceptable to excellent reliability across all constructs. Composite scores were calculated for each dimension and used in regression analyses to examine the predictive relationships between transactional distance variables and student outcomes. The following sections provide detailed descriptions of the participants, survey instrument, data analysis procedures, and ethical considerations.

Participants

The target population for this study consisted of 93 graduate students enrolled in the Master of Education in Education Technology program during the Fall 2024 semester. Among the total population, 63 students identified as female and 30 as male. In terms of race and ethnicity, the majority identified as Hispanic (n = 74), followed by Asian (n = 12), Black (n = 3), White (n = 3), and one student who did not specify their race or ethnicity. From this population, 47 students voluntarily participated in the survey, resulting in a response rate of approximately 51%. Although demographic information was not collected at the individual response level, the participant group is presumed to be generally representative of the overall population in terms of gender and ethnic composition.

Instrument and Data Collection

The survey was designed to evaluate students' perceptions of an AI chatbot integrated into their online course. It consisted of ten items measured on a 5-point Likert scale ranging from *Strongly Disagree* to *Strongly Agree*, capturing students' views on the chatbot's usefulness, clarity, responsiveness, and impact on learning, satisfaction, and engagement. In addition to the scaled items, the survey included one open-ended question inviting participants to reflect on how the chatbot influenced their learning outcomes, course satisfaction, and overall educational experience. Table 1 below maps each survey question to the three core dimensions of Moore's TDT constructs of Dialogue, Structure, and Learner Autonomy, as well as to the relevant student outcomes of Satisfaction and Achievement. This alignment provides a theoretical foundation for interpreting how each item reflects key aspects of the online learning experience.

Table 1. Mapping the Survey Questions to Theoretical Constructs

		Mapped TD Dimension			Student Outcomes	
#	Question	Dialogue	Structure	Learner Autonomy	Satisfaction	Achievement
1	The chatbot was helpful in addressing my questions about assignments and topics.	✓			✓	✓
2	Most responses from the AI chatbot were clear and understandable.		✓		✓	
3	The chatbot increased my overall understanding of course materials.	✓				✓
4	Using the chatbot saved me time in seeking clarification.			✓	✓	
5	The chatbot was responsive to my inquiries.	✓			✓	
6	I felt comfortable interacting with the AI chatbot.			✓	✓	
7	The chatbot's immediacy helped alleviate isolation.	✓			✓	
8	The chatbot enhanced my learning experience.		✓		✓	✓
9	The chatbot improved my satisfaction with the online learning experience.		✓		✓	
10	I would like to continue using AI chatbots in future courses.			✓	✓	

Table 2 presents the internal consistency reliability for the three dimensions of Moore's Theory of Transactional Distance (Dialogue, Structure, and Learner Autonomy) and two student outcomes (Satisfaction and Achievement), as measured by Cronbach's alpha. All constructs demonstrated acceptable to excellent reliability, with alpha values ranging from .76 to .93, indicating that the items within each construct consistently measure the intended concept.

Table 2. Cronbach's Alpha for Transactional Distance Dimensions and Student Outcomes

Construct	Items Included	Number of Items	Cronbach's α	Interpretation
All Items	Q1–Q10	10	.93	Excellent internal consistency
TD Dimensions				
Dialogue	Q1, Q3, Q5, Q7	4	.83	Good internal consistency

Construct	Items Included	Number of Items	Cronbach's α	Interpretation
Structure	Q2, Q8, Q9	3	.78	Acceptable internal consistency
Learner Autonomy	Q4, Q6, Q10	3	.76	Acceptable internal consistency
Student Outcomes				
Satisfaction	Q1, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10	9	.92	Excellent internal consistency
Achievement	Q1, Q3, Q8	3	.84	Good internal consistency

Cronbach's alpha values for each subscale demonstrated acceptable to excellent internal consistency, with coefficients ranging from .76 for Learner Autonomy to .93 for the full 10-item scale. According to Nunnally's (1978) guidelines, alpha values of .70 or higher are considered acceptable, .80 or higher are good, and .90 or higher indicate excellent reliability.

Data Analysis Methods

To address the study's research questions, composite scores were calculated for Dialogue, Structure, Learner Autonomy, Satisfaction, and Achievement, based on related Likert-scale survey items. For Research Question 1, a simple linear regression was conducted to assess the relationship between perceived chatbot-mediated Dialogue and student satisfaction. Research Question 2 was examined using multiple linear regression to compare the relative predictive strength of Dialogue, Structure, and Learner Autonomy on perceived student achievement. To answer Research Question 3, a simple linear regression tested whether Learner Autonomy predicted students' intent to continue using AI chatbots. These methods were selected to evaluate the strength and significance of relationships between continuous variables and to compare the contributions of multiple predictors.

Ethical Considerations

Prior to data collection, approval was obtained from the university's Institutional Review Board (IRB) to ensure that the study met ethical standards for research involving human participants. Participation in the survey was voluntary, and students were informed about the purpose of the study, their right to withdraw at any time, and the confidentiality of their responses. No identifying information was collected, and all data was reported in aggregate to protect participants' privacy and anonymity.

Results

This study investigated graduate students' perceptions of an AI-powered chatbot integrated into an online Master of Education program, using Moore's Theory of Transactional Distance (TDT) as the guiding framework. Specifically, the study examined how the chatbot impacted the three dimensions of transactional distance (Dialogue, Structure, and Learner Autonomy), and how these dimensions related to the key educational outcomes of student satisfaction, perceived achievement, and intent to continue use. Table 3 below presents the results of a survey administered to 47 graduate students enrolled in the Master of Education in Education Technology, examining their perceptions of an AI chatbot integrated into their online course. The survey consisted of 10 Likert-style items with response options ranging from 1 = *strongly*

disagree to 5 = *strongly agree*. Each item explored a different aspect of the students' experiences with the chatbot, including its helpfulness, clarity, responsiveness, impact on learning and satisfaction, and future use. The table below displays the frequency and percentage of responses for each scale point, along with the calculated mean and standard deviation for each item, providing a quantitative overview of student sentiment toward the AI chatbot's role in their learning experience.

Table 3. AI Chatbot Survey Likert-Scale Responses, Means, and Standard Deviations (N=47)

Question	1	2	3	4	5	Mean	Std
1. The chatbot was helpful in addressing my questions related to course assignments and topics.	1 2%	4 9%	10 21%	20 43%	12 26%	3.81	0.98
2. Most of the responses provided by the chatbot were clear and understandable.	0 0%	5 11%	11 23%	14 30%	17 36%	3.91	1.01
3. The chatbot increased my overall understanding of the course materials.	1 2%	4 9%	18 38%	15 32%	9 19%	3.57	0.96
4. Using the chatbot saved me time in seeking clarification on course-related matters.	3 6%	3 6%	9 19%	18 38%	14 30%	3.79	1.13
5. The chatbot was responsive to my inquiries.	3 6%	2 4%	7 15%	18 38%	17 36%	3.94	1.12
6. I felt comfortable interacting with the chatbot.	2 4%	5 11%	5 11%	14 30%	21 45%	4.0	1.17
7. The immediacy of the chatbot's responses helped alleviate any feelings of isolation I may have experienced during the course.	4 9%	5 11%	14 30%	13 28%	11 23%	3.47	1.2
8. Overall, the chatbot enhanced my learning experience in this course.	3 6%	3 6%	16 34%	12 26%	13 28%	3.62	1.14
9. Using the chatbot improved my overall satisfaction with the online learning experience in this course.	1 2%	1 2%	20 43%	11 23%	14 30%	3.77	0.97
10. I would like to continue using chatbots in future courses if available.	1 2%	1 2%	5 11%	16 34%	24 51%	4.3	0.9

Survey results revealed generally positive student perceptions of the AI chatbot, particularly regarding its usefulness, clarity, and responsiveness. Students expressed strong interest in continuing to use chatbots in future courses, and most agreed that the chatbot was easy to engage with and saved time when seeking clarification. While functional support was highly rated, its impact on deeper learning and emotional outcomes, such as reducing feelings of isolation, was more moderate, suggesting that chatbots are most effective as supplemental tools for immediate, task-related support in online learning environments.

To address Research Questions 1-3, composite scores were calculated for each of the core dimensions of Transactional Distance (Dialogue, Structure, and Learner Autonomy), as well as the two student outcome variables (Satisfaction and Achievement). Each composite score represents the average of relevant survey items, grouped according to their theoretical alignment with Moore's (1997) Transactional Distance framework and related student experience outcomes. Table 4 presents descriptive statistics for composite scores of Transactional Distance dimensions and student outcomes.

Table 4. Means and Standard Deviations for Composite Scores of TD Dimensions and Student Outcomes

TD Dimension	Mean	SD
Dialog (Q1, Q3, Q5, Q7)	3.7	0.88
Structure (Q2, Q8, Q9)	3.77	0.88
Learner Autonomy (Q4, Q6, Q10)	4.03	0.89
Student Outcomes		
Satisfaction (Q1, Q2, Q4, Q5, Q6, Q7, Q8, Q9, Q10)	3.81	0.85
Achievement (Q1, Q3, Q8)	3.67	0.91

Note. Values represent the mean and standard deviation for each construct, based on composite scores calculated from corresponding survey items.

The survey items were aligned with the three core dimensions, Dialogue, Structure, and Learner Autonomy. Questions 1, 3, 5, and 7 were associated with Dialogue, as they reflect students' interactions with the AI chatbot, which serves to supplement traditional instructor-student communication in online learning environments. Structure was represented by Questions 2, 8, and 9, which emphasize the chatbot's role in clarifying or supporting course components such as assignments and materials, suggesting a more accessible and flexible instructional design. Lastly, Questions 4, 6, and 10 were linked to Learner Autonomy, as they highlight aspects of student control, including time-saving benefits, improved learning strategies, and interest in continued independent use of the chatbot as a learning tool.

Results for RQ1: Dialogue as a Predictor of Student Satisfaction

To test the first research hypothesis, which posited that *there is a statistically significant positive relationship between students' perceptions of chatbot-mediated Dialogue and their satisfaction with the online learning experience*, a simple linear regression analysis was conducted. Composite scores were calculated for Dialogue (independent variable) and Satisfaction (dependent variable). The results of the regression analysis are presented in Table 5.

Table 5. Simple Linear Regression Predicting Student Satisfaction from Dialog

Predictor	B	SE B	β	t	p
Dialog	0.94	0.03	0.97	28.82	< .001
Constant	0.33	0.17	—	1.94	.059

Model Summary: $R^2 = .95$, $F(1, 45) = 830.72$, $p < .001$

The model was significant, $F(1, 45) = 830.72$, $p < .001$, accounting for 94.86% of the variance in satisfaction ($R^2 = .95$). The unstandardized regression coefficient for Dialogue was $B = 0.94$ (SE = 0.03), $t = 28.82$, $p < .001$, with a standardized coefficient of $\beta = .97$. These results indicate that higher levels of perceived dialogue were strongly associated with greater student satisfaction in the online learning experience. These results support the hypothesis that higher levels of perceived dialogue with the AI chatbot are significantly associated with increased student satisfaction in the online learning environment.

Results for RQ2: Comparative Predictive Power of TDT Dimensions

To test the second research hypothesis which posited that *the integration of AI chatbots, through their support of Dialogue, Structure, and Learner Autonomy, will significantly predict students' perceptions of achievement in an online learning environment*, a multiple linear regression analysis was conducted using composite average scores for each dimension as independent variables and student achievement as the dependent variable. The overall regression model was statistically significant, $F(3, 43) = 140.71$, $p < .001$, accounting for 90.76% of the variance in student achievement ($R^2 = .91$), indicating a strong model fit. Table 6 presents the multiple linear regression predicting perceived student achievement from the transactional distance dimensions.

Table 6. Regression Predicting Student Achievement from Transactional Distance Dimensions

Predictor	B	SE B	β	t	p
Dialogue	0.35	0.34	0.15	2.39	.022
Structure	0.59	0.57	0.12	4.97	< .001
Learner Autonomy	0.07	0.07	0.09	0.81	.421
Constant	-0.16		0.2	-0.79	.434

Model Summary: $R^2 = .91$, $F(3, 43) = 140.71$, $p < .001$

The regression analysis revealed that two of the three transactional distance dimensions, Dialogue and Structure, were significant predictors of perceived student achievement. Specifically, Dialogue ($B = 0.35$, $p = .022$) and Structure ($B = 0.59$, $p < .001$) each contributed significantly to the model, while Learner Autonomy did not reach statistical significance ($B = 0.07$, $p = .421$). Among the predictors, Structure had the highest standardized beta coefficient ($\beta = .57$), indicating it had the strongest unique contribution to explaining variance in perceived achievement. Although the overall model was significant and accounted for a substantial proportion of the variance ($R^2 = .91$), Hypothesis 2 was only partially supported, as not all three dimensions significantly predicted perceived student achievement.

Results for RQ3: Autonomy and Future Use

To test the third research hypothesis which posited that *perceived learner autonomy significantly predicts students' intention to continue using AI chatbots in future courses*, a simple linear regression analysis was conducted using the composite score for Learner Autonomy as the independent variable and students' intent to use chatbots in future courses (Q10) as the dependent variable. Table 7 presents the simple linear regression predicting future use of AI chatbots from learner autonomy.

Table 7. Simple Linear Regression Predicting Future Use of AI Chatbots from Learner Autonomy

Predictor	B	SE B	β	t	p
Learner Autonomy	0.90	0.07	0.88	12.33	< .001
Constant	0.69	0.21	—	3.29	.002

Model Summary: $R^2 = .77$, $F(1, 45) = 152.18$, $p < .001$

The model was statistically significant, $F(1, 45) = 152.18$, $p < .001$, and accounted for 77.18% of the variance in students' future use intentions ($R^2 = .77$). The unstandardized regression coefficient was $B = 0.90$ (SE = 0.07), and the standardized coefficient was $\beta = .88$, indicating a strong positive predictive relationship. These findings support Hypothesis 3, suggesting that students who perceive higher levels of autonomy in their learning are significantly more likely to express interest in continuing to use AI chatbots in future educational settings.

Students' Perceptions: In Their Own Words

While quantitative data offers valuable insights, it is through students' own words that a more nuanced understanding of the chatbot's impact on education emerges. To complement the Likert-style survey items, the survey included one open-ended question prompting participants to reflect on how the AI chatbot influenced their learning outcomes, satisfaction with the course, and overall educational experience. Analysis of the open-ended responses revealed several key themes that capture both the strengths and limitations of the chatbot's integration. These themes reflect a spectrum of perspectives, offering a more comprehensive view of students' experiences and highlighting areas of success, as well as opportunities for improvement.

Chatbot Benefits

One of the most frequently mentioned benefits was the chatbot's instant support and 24/7 accessibility. Students valued being able to receive immediate assistance, especially regular instructor availability. One participant shared, "The AI chatbot provided immediate responses to my questions outside of normal working hours, ensuring I received timely assistance." Another noted, "It was a stress relief to know the chatbot was there for any questions I had that I didn't have to wait too long for." Others appreciated the reassurance it provided, such as one student who recalled, "I was stressed that my discussion would not post one night… I asked the AI chatbot and [it] answered my question right away," and another who simply stated, "It help[ed] deliver information as needed when I needed it."

The chatbot also played a supportive role in helping students clarify assignments and understand course logistics. Several students found it useful for accessing due dates, grading policies, and course content. One shared, "I only used it to clarify syllabus points about grading and points distribution; however, it was accurate, quick, and helpful." Another explained, "When I needed to remember when a project was due, the AI chatbot guided me to the right area to check the dates on the course." Similarly, a student expressed, "It helped me understand some of the material or how to get started, especially in moments where I felt stuck," while another wrote, "Whenever I needed help… I would ask AI chatbots… they were just there as a support line."

Students also described the chatbot as a tool that reduced anxiety and improved their confidence in navigating course content. The availability of support contributed to a sense of security and autonomy. One participant reflected, "Just knowing it was there made me feel like I had a backup in case I didn't understand something." Another said, "It helps steer you in the right direction if you have questions or are unsure where to start on a project." One student emphasized, "I believe that only good can come of the chatbot because it helps steer you in the right direction," and another appreciated that, "Even when I didn't use the chatbot, it was nice knowing I could ask it a question for clarification whenever." Some students praised the chatbot's capacity for enhancing learning and personalizing support. Respondents shared that the AI's adaptive responses helped them better understand material and stay engaged. One student remarked, "The chatbot could tailor responses to my needs… Whether I needed a simple explanation, a real-world example, or even a step-by-step breakdown." Another stated, "Using an AI chatbot allowed me to focus in on my writing and it was used as a way of framing sentence structures." A particularly enthusiastic comment noted, "The AI chatbot enhanced my learning and overall satisfaction by providing instant answers to my

questions," while another student explained, "Through Robbie, I learned that AI is a tool, not a solution. I used him as a more informed extension of me."

Chatbot Limitations

At the same time, several challenges and limitations were highlighted by students. One of the most common criticisms was the chatbot's limited understanding and occasional inaccuracy. Some participants felt that responses lacked depth or failed to address specific needs. One student stated, "The specific chatbot in question was not at all effective at answering questions." Another elaborated, "Content provided by the chatbot often wasn't useful and usually mixed up topics." A similar concern was voiced by someone who said, "I have tried asking Robbie about a few projects specifically and he was unable to answer my questions, so I had to reach out to the professor," while another remarked, "Its usefulness is there, but not the best to structure high-level assignments in areas such as research."

A number of students also expressed that the chatbot had little or no impact on their learning outcomes. This was often due to personal preferences for human interaction or limited usage. One participant wrote, "With my limited interaction with the AI chatbot, I don't believe it had a significant impact on my learning outcomes." Another explained, "It did not have much impact… I prefer human interaction rather than an AI approach at the moment." Similarly, a student reflected, "I didn't really use it," and another commented, "The integration of the chatbot is not a factor that I considered when considering my satisfaction with the course."

Another issue raised was the difficulty in communicating effectively with the chatbot, particularly the need to phrase questions in a specific way. This posed a barrier to usability for some. One student noted, "There's a very particular way you'd have to ask for information in order to elicit a response." Another echoed, "There were times when the chatbot didn't quite understand what I was asking," while a third remarked, "Its responses felt a bit generic." One user suggested improvement, stating, "Future chatbots should utilize powerful AI engines and datasets to better answer questions for students."

Some respondents also mentioned not being aware of the chatbot's purpose or underutilizing it due to a lack of understanding. One student admitted, "I never had the opportunity to use it… Maybe stressing the purpose of the chatbot will be a good idea." Another reflected, "I had the wrong idea of why the chatbot was there," and one respondent noted, "Honestly, I found it a bit distracting bobbing up and down in the lower right corner of every page." For others, the chatbot seemed more like a beta feature than a fully developed tool, as one student put it, "It seems like someone's experimental idea, lacking thorough consideration for its practical applications."

In summary, while the AI chatbot was widely appreciated for its immediacy, convenience, and role as a supplemental learning aid, its limitations in comprehension, accuracy, and user experience suggest room for development. Students emphasized the need for clearer guidance on how to use the chatbot effectively and stressed that human interaction remains essential for deeper learning and critical thinking. Despite mixed experiences, many saw potential in the chatbot as a valuable educational tool as it continues to evolve.

Interpretation of the Findings

This study investigated graduate students' perceptions of an AI-powered chatbot integrated into an online learning environment, using Moore's (1993) Theory of Transactional Distance (TDT) as a guiding framework. The findings strongly support the theoretical expectation that Dialogue, Structure, and Learner Autonomy influence student satisfaction, achievement, and future technology adoption. Addressing

Research Question 1, a simple linear regression revealed a statistically significant and strong positive relationship between perceived dialogue and student satisfaction ($R^2 = .95$), supporting the first hypothesis. This aligns with Moore's assertion that rich, frequent dialogue can bridge psychological distance and foster satisfaction in online environments (Moore, 1993; Weidlich & Bastiaens, 2018).

The findings for Research Question 2 indicate that the integration of AI chatbots, when examined through the lens of Moore's Transactional Distance Theory, can meaningfully influence students' perceptions of their achievement in an online learning environment. Specifically, the regression analysis showed that chatbot-supported **Dialogue** and **Structure** were both significant predictors of perceived achievement, while **Learner Autonomy** was not. Among the predictors, Structure emerged as the strongest contributor, suggesting that when chatbots help clarify course elements and support instructional organization, students are more likely to perceive academic success.

Although the model explained a substantial 91% of the variance in perceived achievement, Hypothesis 2 was only partially supported, as Learner Autonomy did not have a statistically significant impact. These results underscore the importance of chatbot design that emphasizes clarity and interaction to maximize perceived learning outcomes. These findings align with previous research highlighting the role of AI chatbots in enhancing dialogue and structure within online learning environments.

For example, a study by Kuhail et al. (2023) reviewed the use of educational chatbots and found that they primarily functioned as teaching agents, facilitating structured interactions and personalized learning experiences, which contributed to improved student engagement and perceived learning outcomes. The practical implications are further underscored by Onat and Gülseçen (2023), who found that chatbots can foster a greater sense of connection in digital learning spaces, ultimately promoting deeper engagement and potentially improving academic outcomes.

Qualitative responses echoed these quantitative findings, with students praising the chatbot for its immediacy, helpfulness, and emotional support, particularly outside instructor availability. However, students also noted limitations such as generic responses, occasional inaccuracies, and the need for clearer guidance on usage, highlighting opportunities for refinement and user training.

Theoretical and Practical Implications

Theoretically, the study extends Moore's TDT by demonstrating how AI-driven tools like chatbots can effectively influence each of the three dimensions of transactional distance, enhancing dialogue through instant interaction, supporting structure by providing timely clarification, and promoting autonomy through on-demand accessibility. The findings suggest that AI chatbots can serve as instructional mediators, potentially reducing transactional distance and enhancing the learner experience in asynchronous and self-paced environments.

Practically, these findings offer valuable implications for instructional designers, faculty, and institutions seeking to optimize the use of AI in education. Specifically, chatbots can be integrated to supplement, not replace, instructor interaction, provide personalized scaffolding, and support students outside of traditional instructional hours. Institutions should ensure that chatbot capabilities are clearly communicated to students, and instructors should be encouraged to align chatbot functions with course design to maximize their instructional impact. As students showed strong interest in continued use, chatbots may also play a vital role in scaling support across large or diverse learner populations.

Strengths and Limitations

A major strength of this study lies in its robust alignment with a well-established theoretical framework, the use of validated constructs, and the inclusion of both quantitative and qualitative data to yield a comprehensive understanding of student perceptions. The internal consistency of each subscale was found to be acceptable to excellent, lending confidence to the reliability of the measures. However, several limitations should be noted.

The sample size, while adequate for regression analysis, was limited to one graduate program at a single institution, which may affect the generalizability of the findings. Also, there is a potential for bias when relying on participants' self-reported information, and the study relied on perceived, rather than objective, learning outcomes. The open-ended responses, while insightful, were not subjected to formal qualitative coding, which may limit the depth of thematic interpretation.

Summary

This study explored graduate students' perceptions of an AI chatbot integrated into their online coursework, using Moore's (1997) Theory of Transactional Distance (TDT) as a guiding framework. The key findings indicate that students viewed the chatbot positively, particularly in terms of its usefulness, responsiveness, and ability to support their learning. Quantitative results showed that Dialogue, Structure, and Learner Autonomy all significantly predicted student satisfaction, with Dialogue emerging as the strongest predictor. Also, Learner Autonomy was a strong predictor of students' intent to continue using chatbots in future courses. These findings suggest that AI chatbots can play a meaningful role in reducing transactional distance and enhancing the online learning experience.

Given the growing presence of Generative AI in education, institutions should consider implementing chatbot technologies as part of a broader strategy to support learner engagement and autonomy. Instructors and instructional designers are encouraged to integrate AI tools thoughtfully, aligning them with course goals while also setting clear expectations for students. Professional development and student orientation around chatbot use may enhance its effectiveness and mitigate concerns about over-reliance or misunderstandings of the tool's capabilities.

Future research could explore longitudinal impacts of chatbot use on learning outcomes, compare AI-supported learning with traditional formats, and assess how different chatbot designs (e.g., voice vs. text-based) influence student experience across varied disciplines and educational levels. In addition, mixed-methods approaches incorporating qualitative coding of student reflections or experimental designs comparing chatbot-enhanced and traditional instruction could deepen our understanding of how AI tools influence learning in online environments. As AI continues to evolve, ongoing research will play a key role in ensuring its responsible and effective use in education.

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