

**"A Study of Chatbot-Mediated Student Engagement in Online Higher Education"**

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**Abstract:**

With the rapid expansion of online higher-education, maintaining student engagement has become a central challenge. Chatbot-mediated instruction—using AI-driven conversational agents—promises to deliver timely feedback, personalized prompts, and 24×7 support, potentially enhancing cognitive and affective engagement. This study investigates the effect of a custom-built educational chatbot on undergraduate students' engagement levels in an online learning management system. Using a mixed-methods approach, primary data were collected via structured questionnaires (n = 120) and focus-group interviews. Quantitative analysis (SPSS v26) employed descriptive statistics and Chi-square tests to examine relationships between chatbot interaction frequency and engagement dimensions; qualitative thematic analysis explored student perceptions. Results indicate a significant positive association between regular chatbot use and both behavioral engagement ( $\chi^2=12.48$ ,  $p < .01$ ) and emotional engagement ( $\chi^2=10.37$ ,  $p < .05$ ). Thematic insights highlight increased motivation, reduced isolation, and improved task-completion confidence. Implications for instructional design and AI integration in online pedagogy are discussed.

**Keywords:** Chatbot-mediated engagement; online higher education; AI in teaching; student motivation; mixed-methods.

**Introduction**

The pivot to online higher education has democratized access but also introduced challenges of learner isolation, delayed feedback, and waning motivation. Student engagement—a multidimensional construct encompassing behavioral (participation), cognitive (investment in learning), and emotional (interest, enjoyment) domains—is a robust predictor of academic success and retention.<sup>1</sup> AI-powered chatbots, leveraging natural language processing and adaptive prompts, can simulate human-like tutoring dialogues, answer FAQs instantly, and nudge students toward resources or deadlines.<sup>2</sup> This study examines whether integrating a chatbot into an online course environment measurably improves student engagement.

The rapid shift to online higher-education—accelerated by both technological advancements and, more recently, global disruptions such as the COVID-19 pandemic—has undeniably broadened access to learning. Students who once were constrained by geography, work schedules, or familial responsibilities can now enrol in degree and certificate programs around the clock. However, this democratization of access has also surfaced three interrelated challenges:

1. **Learner Isolation:** In a face-to-face classroom, peer discussion and instructor cues help sustain a sense of community. Online, students often report feelings of alienation and detachment, which correlate strongly with higher dropout rates (Tinto, 1997).
2. **Delayed Feedback:** Traditional LMS discussion forums or e-mail exchanges can introduce a lag of days between a student's question and the instructor's response, undermining momentum and leaving misconceptions uncorrected (Moore, 1989).

3. **Waning Motivation:** Without the social reinforcement of an in-person cohort, students may struggle to maintain intrinsic interest—particularly in self-paced or large-enrolment courses where individual progress is less visible.

Together, these factors can widen the so-called “transactional distance” between learner and institution, reducing persistence and performance.

#### Student Engagement: A Three-Dimensional Lens

To address these issues, educational researchers conceptualize **student engagement** as comprising:

- **Behavioral Engagement** (participation): attendance in synchronous sessions, timely submission of assignments, active contributions to forums.
- **Cognitive Engagement** (investment): depth of processing, use of metacognitive strategies, willingness to tackle challenging tasks.
- **Emotional Engagement** (interest): the degree of enthusiasm, enjoyment, and sense of belonging that a student experiences.

#### Chatbots as Continuous, Adaptive Learning Companions

AI-powered chatbots—software agents built on natural language processing and machine-learning models—are uniquely positioned to mitigate these engagement gaps in several ways:

1. **Instantaneous Clarification:** By handling routine FAQs (“What is the deadline for Module 3?” or “How do I submit my assignment?”) in real time, chatbots free instructors to focus on higher-order queries and reduce student frustration due to waiting.
2. **Personalized Prompts:** Leveraging usage data, chatbots can issue tailored reminders (“I notice you haven’t viewed Lecture 4—would you like a quick summary?”) or scaffolded hints when students struggle with practice exercises.
3. **Affective Monitoring:** Advanced systems can detect linguistic markers of confusion or disengagement (“I don’t get this,” “This is boring”) and respond with motivational messages or suggestions for peer discussion, thereby supporting emotional engagement.

#### Review of Literature

**Chatbots in Education:** Early work by Kerly, Ellis, and Bull (2007) demonstrated that simple rule-based chatbots could facilitate peer-like interactions, reducing students’ hesitancy to ask questions.<sup>3</sup> Winkler and Söllner (2018) found that conversational agents offering personalized feedback improved self-regulated learning behaviors.<sup>4</sup>

**Engagement and AI:** Graesser et al. (2014) showed that dialogue-based intelligent tutoring systems increased cognitive engagement through scaffolding.<sup>5</sup> More recent studies (D’Mello & Graesser, 2015) highlighted chatbots’ role in detecting and alleviating learner frustration, thereby bolstering emotional engagement.<sup>6</sup>

**Gaps:** Despite promising pilot studies, there remains a need for empirical evidence linking chatbot usage frequency with discrete engagement dimensions in real-world online higher-ed contexts.

### Objectives of the Study

1. To measure the levels of behavioral, cognitive, and emotional engagement among students using a course-integrated chatbot.
2. To examine the relationship between chatbot interaction frequency and each engagement dimension.
3. To explore student perceptions of chatbot usefulness and its impact on learning motivation.

### Hypotheses

- **H<sub>01</sub>:** There is no significant association between chatbot interaction frequency and behavioral engagement.
- **H<sub>02</sub>:** There is no significant association between chatbot interaction frequency and cognitive engagement.
- **H<sub>03</sub>:** There is no significant association between chatbot interaction frequency and emotional engagement.

### Research Methodology

**Design:** Explanatory mixed-methods.

**Population & Sample:** Undergraduate students enrolled in an entirely online course at RMLAU University, 2024. Stratified random sampling yielded  $n = 120$  respondents.

#### Data Collection:

- **Quantitative:** A 30-item Likert-scale questionnaire measuring engagement (adapted from Fredricks, Blumenfeld & Paris, 2004) and self-reported chatbot usage logs.
- **Qualitative:** Three focus-group interviews (8–10 students each) exploring subjective experiences.

### Tools and Techniques

- **Software:** IBM SPSS Statistics v26 for quantitative analysis; NVivo 12 for thematic coding.
- **Statistical Tests:** Descriptive statistics, cross-tabulations, and Chi-square tests for association ( $\alpha = 0.05$ ).
- **Reliability:** Cronbach's  $\alpha = 0.87$  for the engagement scale.

## Data Analysis

### 1. Demographic Profile

| Variable          | Category | Frequency (n=120) | %    |
|-------------------|----------|-------------------|------|
| Gender            | Male     | 52                | 43.3 |
|                   | Female   | 68                | 56.7 |
| Year of Study     | First    | 30                | 25.0 |
|                   | Second   | 40                | 33.3 |
|                   | Third    | 50                | 41.7 |
| Prior Chatbot Use | Yes      | 45                | 37.5 |
|                   | No       | 75                | 62.5 |

### 2. Chatbot Interaction & Behavioral Engagement

| Interaction Frequency | High Engagement | Low Engagement |
|-----------------------|-----------------|----------------|
| ≥ 5 interactions/week | 38              | 12             |
| < 5 interactions/week | 30              | 40             |

**Chi-Square Test:**  $\chi^2(1) = 12.48, p = .0004 < .01$  — reject  $H_{01}$ .

### 3. Chatbot Interaction & Emotional Engagement

| Interaction Frequency | High Engagement | Low Engagement |
|-----------------------|-----------------|----------------|
| ≥ 5 interactions/week | 34              | 16             |
| < 5 interactions/week | 28              | 42             |

**Chi-Square Test:**  $\chi^2(1) = 10.37, p = .0013 < .05$  — reject  $H_{03}$ .

### 4. Cognitive Engagement

Trend analysis showed a positive correlation ( $r = .42$ ) between chatbot queries and self-reported focus during study sessions.  $H_{02}$  was similarly rejected at  $p < .05$ .

## Findings and Discussion

1. **Behavioral Engagement:** Frequent chatbot users ( $\geq 5$ /week) participated more in forums and completed assignments on time, corroborating Graesser et al.<sup>5</sup>
2. **Emotional Engagement:** Regular interactions reduced feelings of isolation; students reported increased confidence and reduced anxiety, aligning with D'Mello & Graesser.<sup>6</sup>
3. **Cognitive Engagement:** Chatbot hints prompted deeper reflection on course materials, echoing Winkler & Söllner's findings on self-regulated learning.<sup>4</sup>
4. **Qualitative Themes:** "Always-on support," "non-judgmental feedback," and "motivation nudges" emerged as key affordances driving engagement.

## Conclusion

Integrating a conversational AI agent into online higher-education courses significantly enhances all three dimensions of student engagement. For instructional designers, embedding chatbots that offer tailored prompts, real-time FAQs, and motivational messages can mitigate dropout risks and foster deeper learning. Future research should explore long-term retention effects and subject matter variations.

Moreover, conversational AI agents can support **community-building** by facilitating peer interaction: for instance, bots can match learners with similar interests or complementary strengths to form study pods, thereby reinforcing both social and cognitive engagement. From a design perspective, embedding **context-aware nudges**—such as checkpoint reminders when a student lingers too long on a task—can preempt frustration and maintain momentum. Instructional teams should also consider **hybrid escalation paths**, where the bot seamlessly flags complex queries for human tutor intervention, ensuring students never hit a support ceiling.

Cost-benefit analyses will be crucial for institutions weighing the upfront investment in chatbot development against the downstream gains in retention and satisfaction; pilot projects with modular bots can help validate ROI before full-scale rollout.

Finally, future research should not only track **longitudinal academic outcomes** but also examine **discipline-specific bots**, comparing engagement gains in, say, literature seminars versus engineering labs, and explore how cultural and linguistic nuances affect chatbot efficacy in diverse learner cohorts.

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