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The contribution of chatbots to student engagement: A case study from a Business School in Mexico

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Abstract

The implementation of artificial intelligence tools, in a context of higher education and specifically in a Business School, promotes the opportunity to strengthen iterative evaluation and; consequently, it has an impact on student motivation and commitment. Under this premise, the research analyses how the application of artificial intelligence through a programmed chatbot affects the level of student engagement of a sample of a Business School in Mexico. To this end, an exploratory study of 14 students and a confirmatory study of 62 students who used the Noodle Factory Platform and whose impact was measured on engagement was carried out. The results suggest that the implementation of educational chatbots has a significant positive impact on student learning and engagement. Along with this, the potential for application or scaling in similar contexts for careers related to international business is highlighted.

Keywords: *Higher education, artificial intelligence, teaching methodologies, chatbot, educational innovation*

1. Introduction

The use of artificial intelligence (AI) in higher education has gained prominence for its ability to enhance personalized learning and improve the efficiency of academic processes (Timms, 2016). Among AI applications, chatbots stand out as promising tools to support teaching, learning, and particularly assessment, by enabling ongoing, personalized interaction with students (Abbas et al., 2022; Okonkwo & Ade-Ibijola, 2021). This is especially relevant in disciplines such as international business, where mastering complex regulatory frameworks requires not only theoretical knowledge but also applied practice (García-Rodríguez et al., 2024).

This study examines the effectiveness of chatbot-based iterative assessments in fostering student engagement and topic mastery within a business school in Mexico. Through an exploratory and a confirmatory study, it analyzes how repeated interactions with an AI-driven chatbot influence students' learning experiences and motivation. We hypothesize that the use of chatbots for formative assessment enhances student engagement, facilitates deeper understanding, and contributes to the development of applied competencies.

This study begins with a review of the literature on chatbots and iterative assessment in higher education, followed by the theoretical framework and methodology. The results are then presented and discussed, concluding with implications for educational practice and suggestions for future research.

2. Theoretical framework

Artificial intelligence (AI) in higher education is defined as a computerized system that interacts with human learning processes such as adaptation, synthesis, and decision-making (Popenici & Kerr, 2017). In this context, chatbots are AI-based tools designed to communicate through natural language and support educational functions such as tutoring, assessment, and feedback (Winkler & Söllner, 2018; Hobert, 2019). Their ability to simulate conversation enables personalized interaction, while their adaptive capabilities position them as valuable tools for active learning (Pérez et al., 2020). These applications are grounded in constructivist theories by Piaget and Vygotsky, who view learning as an active process of building knowledge through experience (Ertmer & Newby, 2013).

In turn, Davis's (1989) technology acceptance model (TAM) postulates that the acceptance and use of a new technology is mainly determined by two key factors: perceived usefulness (PU) and perceived ease of use (PFU). In relation to PU, it refers to the extent to which students believe that using the chatbot will improve their academic performance and facilitate mastery of the subjects; and PFU, refers to the extent to which students believe that using the technology will be effortless (Szajna, 1996). Chung et al. (2020) found that when students perceive that a technological tool can help them achieve their learning goals more efficiently, they are more likely to adopt and use it regularly. Li and Wong (2023) suggest that the intuitive interface and the ability of chatbots to provide clear instructions and immediate feedback contribute significantly to high PFU. According to García-Rodríguez et al. (2024), one of the main uses of chatbots in education is to support evaluation processes, adding this to the research of Zhang and Brown (2021) who highlight the potential of this tool to provide adaptive assessments, adjusting the difficulty of the questions according to the student's performance.

Hence, iterative assessments and the feedback that they entail align with Bloom's (1968) mastery learning theory and are supported by Taylor et al. (2022) who argue that repeated practice with immediate feedback is crucial for mastery of complex skills. Hernandez and Kim

(2024) argue that chatbots offer an ideal platform to implement this approach, allowing students to practice until they reach the desired level of competence required in their training process. Nguyen et al. (2023) suggest that the use of chatbots for iterative assessment can foster deeper and more applied learning.

3. Methodology

It was developed in two sequential phases: an initial exploratory study and a subsequent confirmatory study with a larger sample. We used a quantitative research design with a descriptive approach in both phases. For the confirmatory study, a pre-test-posttest design was carried out with a sample for convenience and informed consent and acceptance of the participants. In both phases, the study was developed during a full academic semester consisting of 16 weeks.

Due to institutional and ethical constraints regarding student assessment, it was not feasible to establish a separate control group not exposed to the chatbot. Instead, a within-subjects design was implemented, comparing students' results before and after using the chatbot in the same cohort. This approach allowed us to measure progress while controlling for individual variation.

3.1. Instruments

1. *Questionnaire*: measure engagement by evaluating, on a scale of 1 to 100.

Table 1. Dimensions of engagement

Vigor	**High willingness to exert effort and persist in the face of adversity.**
Dedication	It refers to being strongly involved and experiencing a sense of excitement, inspiration, pride, challenge, and meaning.
Absorption	It is characterized by being totally concentrated and happily immersed, in such a way that time passes quickly and you experience unpleasantness for having to stop activities.

Cronbach's alpha for the entire measurement instrument was 0.93, and for the dimensions: vigor (0.82), dedication (0.90) and absorption (0.84). The validation was carried out using a sample of 116 professional students from Tecnológico de Monterrey, which was provided by the Institute for the Future of Education. It is worth mentioning that the original tool was developed by Shaufeli, Bakker and Salanova called the Ultrech Work Engagement Scale.

2. *Knowledge exam*: a specific exam was designed to evaluate student learning. The same exam was administered at the beginning and at the end of the course. The instrument was designed with a consistent structure, scope and difficulty level, allowing for valid comparisons of learning outcomes.

3. *Experience questionnaire*: The experience questionnaire included items on perceived fairness of evaluation, usefulness of feedback, reflection on learning, and the perceived applicability of the course. Each item was rated on a scale from 0 to 100, and the instrument was developed based on existing scales used in digital learning environments.

3.2. Phase 1: Exploratory study

The initial sample consisted of 14 undergraduate students (N = 14) enrolled in the fourth semester of the International Business (LIN) career at the Saltillo Campus Business School, with a demographic distribution of 9 women (64.3%) and 5 men (35.7%), and an average age of 20.35 years. The study measured learning gains using a pre-test and post-test instrument. To measure engagement and user experience with technology, only a post-test instrument was applied. The exploratory study yielded positive results regarding the use of chatbots both in the area of engagement and in the user experience and learning. However, standard deviations greater than 30 were observed in all dimensions, so it was decided to conduct a second experiment with a larger sample.

3.3. Phase 2: Confirmatory study

The sample was expanded to 62 students, with 40 women (64.5%) and 22 men (35.5%) participating, maintaining similar characteristics in terms of age (20.5 years), academic level, and area of study.

Before using the chatbot, students completed a pre-test that included both an engagement questionnaire and a knowledge exam, to establish their baseline scores. The engagement instrument was administered again as a post-test at the end of the course, using the same items to ensure comparability and consistency in measurement.

The chatbot used in this study was implemented through the Noodle Factory platform, which enables automated formative assessment through natural language interactions. The chatbot provided immediate, personalized feedback on open-ended responses and guided students through repeated practice cycles. This iterative process is aligned with mastery learning principles and intended to enhance knowledge retention and engagement.

At the end of the course, students were again given the knowledge test (same structure and difficulty as the initial one), the engagement instrument, and a questionnaire on their experience with the educational technology. This final instrument included items on perceived fairness, usefulness of feedback, learning reflection, and the practical applicability of course activities.

3.4. Data analysis

Descriptive statistical analyses were performed including: measures of central tendency, analysis of variability, pre-test and post-test comparisons.

4. Results

The comparative pre-test/post-test analysis showed improvements in the items analyzed.

4.1. Engagement

The comparative analysis of pretest and posttest results showed a consistent increase across all three dimensions of engagement. The mean score in vigor rose from 79.3 to 82.9, in dedication from 82.0 to 85.2, and in absorption from 81.4 to 83.9. Although these increases were not statistically significant ($p > 0.29$), the trend is positive. The effect sizes (Cohen's $d \approx 0.16–0.17$) suggest small but consistent improvements in student engagement after using the chatbot-based feedback. The results by dimension are shown below:

Table 2. Results by dimensions.

Dimension: Vigor		**+15.8 Gain Points**	**With the largest increase**
Energy	My coursework made me feel energized	+18.0 points	Item with the highest increase
Vigor	I felt strong and vigorous when I am studying or going to the course	+16.1 points	
Motivation	When I got up in the morning, I wanted to go to my course	+13.3 points	
Dimension: Dedication		**+11.5 Win Points**	**With the smallest of increases**
Enthusiasm	I was excited about my course	+7.4 points	Item with the lowest increase
Inspiration	My course inspired me with new things	+15.7	
Pride	I was proud to do this course	+11.5	
Dimension: Absorption		**+13.8 points**	**It registered an increase**
Happiness	I was happy to do my homework related to my course	+17.1	
Immersion	I felt immersed in my course	+11.8	
Commitment	I got carried away when I was doing my coursework as a student	+12.7	

When disaggregating the engagement data by gender, we observed a distinct pattern. Female students showed statistically significant improvements in the dimension of vigor ($p = 0.022$), with a moderate effect size (Cohen's $d = 0.59$). Smaller, non-significant improvements were also noted in dedication ($d = 0.28$) and absorption ($d = 0.36$).

In contrast, male students showed a slight decrease or no improvement in their engagement scores across dimensions, with no statistically significant changes observed. These results

suggest that chatbot-based feedback may have a more positive impact on female students, potentially due to differences in learning styles, interaction preferences, or receptivity to automated feedback. Further research is needed to explore these factors in depth.

4.2. Knowledge

The difference between the scores in the knowledge test showed an improvement of 24%, going from an average pre-test score of 57.8 points to an average post-test score of 76 points. Although the rating improvement cannot be attributed solely to the use of chatbots, the results are encouraging.

4.3. Experience with educational technology

The study revealed improvements in key indicators in the areas of feedback and evaluation
- My rating was fair: 82.0
- The feedback helped me identify the difficult topics in my course: 84.6
- The feedback provided made me reflect on my way of working in the course.: 84.6
- My course activities helped me learn better.: 86.3
- Educational technology helped me apply the knowledge I gained in this course in a real-world context: 83.8
- Educational technology was difficult for me to use: 60.6%

5. Discussion

The results of this study provide valuable insights into the use of chatbots, specifically Noodle Factory, for iterative assessment in higher education, particularly in the context of learning international business regulatory frameworks. The results reveal an overall positive level of engagement among students. This finding aligns with previous studies such as that of Anderson et al. (2024), which found high levels of satisfaction among students using educational chatbots.

The high score in the user experience dimension (81.4) suggests a positive perception among students. This is aligned with Davis' (1989) Technology Acceptance Model, which posits the importance of the perception of ease of use in the adoption of new technologies. However, the lowest score in the learning experience dimension was difficulty of use (60.6), indicating that the perception of usefulness could be improved by training users in the use of the tool and making the connection between the tool and the learning objectives of the courses more explicit.

While students' perceptions were generally positive, it is important to note that this study did not include a control group, which limits the ability to isolate the specific contribution of the chatbot to the learning outcomes. This decision was based on ethical and logistical constraints related to instructional design within a single course. Instead, we used a within-subjects pre-post design, allowing for comparisons over time within the same cohort. Similarly, the need to

adjust the design of the activities and the feedback provided by the chatbot to increase its perception of usefulness was observed, preferably through the personalization of the evaluations, as suggested by Hernández and Kim (2024).

Although the overall increase in engagement was not statistically significant, the gender-based analysis revealed that female students benefited more strongly from the use of chatbot feedback. This aligns with previous studies that suggest differentiated responses to educational technologies based on gender. These findings highlight the need for future research to explore adaptive feedback mechanisms that can be customized according to student profiles.

The results of the knowledge test provide direct and quantifiable evidence of students' mastery of topics. The 18.2 points improvement suggests that the use of chatbots has allowed students to practice and refine their knowledge effectively throughout the course, which could be attributed to both the dosage of the learner's cognitive load, and repeated practice with immediate feedback for the mastery of complex skills (Taylor et al., 2022). In addition, these quantitative results support the high overall satisfaction reported by students. Their perception that Noodle Factory helps them connect knowledge is validated by the objective improvement in their academic performance.

These findings indicate that the tool is not only perceived as useful, but that it is effectively facilitating deep and applied learning, which is particularly relevant in the context of learning normative frameworks, where accuracy and practical application of knowledge are crucial. In addition, although the chatbot provided rapid and iterative feedback, it is not intended to replace human feedback, but rather to complement it. Students still benefit from the teacher’s perspective, particularly in complex or subjective areas. Future research should explore how both sources of feedback interact and whether personalization of AI feedback can be enhanced to better support deep learning.

5.1. Theoretical and practical implications

Theoretically, this study contributes to the literature on the use of chatbots in higher education by providing empirical evidence on their effectiveness. The results support the idea that chatbots can facilitate deeper, more applied learning, as suggested by Nguyen et al. (2023), but they also reveal the complexity of this process and the need to consider additional factors such as gender differences and the need for tool customization. In practical terms, the findings suggest that implementing chatbots like Noodle Factory can improve the learning experience for students, but they also indicate areas for improvement. Educators and ed-tech designers should consider: Improving the connection between chatbot activities and learning objectives, developing methods to directly assess how iterative chatbot use contributes to mastery of complex topics such as international business regulatory frameworks, adapting chatbot design to address gender differences in perception and use of the tool.

5.2. Limitations

It is important to recognize the following: the study was carried out in a single semester, which does not allow evaluating the long-term effects of the use of chatbots, the lack of a control group makes it difficult to directly attribute the results to the use of the chatbot. The study focused on students' perception and did not directly measure academic performance or mastery of topics. Additionally, despite the advances in research on educational chatbots, there are several significant gaps in relation to the current literature, such as: scarcity of longitudinal studies on the long-term impact of chatbot use on learning, limited research on the effectiveness of chatbots in different disciplines and educational levels, lack of studies examining how iterative assessment using chatbots affects long-term knowledge retention and transfer, need for more research on how to optimize chatbot design for different learning styles and student preferences.

Furthermore, the results indicate possible gender-related variations in engagement outcomes. While not the primary focus of this study, these differences suggest a need for more targeted investigations into how students of different genders perceive and respond to chatbot-based feedback in educational settings.

6. Conclusions

This study provides promising evidence on the potential of chatbots as iterative assessment tools in higher education having a significant positive impact on student learning and engagement, particularly in the field of international business. However, it also reveals the complexity of implementing these technologies effectively and equitably.

Further research and refinement of these tools is needed to ensure that they truly enhance the learning experience and contribute to the mastery of critical knowledge in higher education students. In line with what has been studied, we suggest for future research: to conduct longitudinal studies to evaluate the long-term impact of chatbot use on knowledge learning and retention, to further investigate the reasons for gender differences in the perception and use of educational chatbots, to develop and validate methods to directly measure how the iterative use of chatbots contributes to the mastery of complex topics in international business.

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