

Pedagogical Chatbots and the Quality of Student Learning: A Qualitative Study in Higher Education

Running head: Pedagogical Chatbots and Learning Quality

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ABSTRACT:

Purpose: The recent rise of large-language-model chatbots is transforming learning practices in higher education, particularly in pre-service teacher training; this article analyses how pedagogical chatbots influence the quality of student learning, asking whether they strengthen or weaken it, and how usage modalities shape motivation and engagement. **Approach:** A conceptual model articulating technology acceptance, cognitive and self-regulatory support (planning, monitoring, cognitive load), and socio-relational motivation (autonomy, competence, relatedness) guided thirty semi-structured interviews with undergraduate education students at ESEF, Ibnou Zohr University, analysed lexically and thematically. **Findings:** Chatbots are widely accepted when useful and easy to use; they support self-regulation and reduce some cognitive load while exposing students to overload and superficial processing; they mainly strengthen autonomy and competence rather than social presence. **Implications:** Chatbots improve learning quality as critical, complementary tools, but substitutive use weakens deep learning and widens inequalities.

Keywords: pedagogical chatbot, learning quality, self-regulated learning, self-determination theory, technology acceptance

Introduction

The development of conversational agents built on large language models is profoundly reshaping learning environments in higher education, extending the broader movement of digitisation and educational AI described by Bond et al. (2021) and Zawacki-Richter et al. (2019). In

universities, pedagogical chatbots are progressively being integrated into training arrangements to answer student questions, clarify complex concepts, propose activities, or support the organisation of work, in continuity with the intelligent tutoring systems analysed by Graesser et al. (2012) and Winkler and Söllner (2018).

However, their effects on the quality of learning — understood as the articulation of academic performance, study processes, engagement, and the student experience (Biggs & Tang, 2011; Fredricks et al., 2004; Kuh et al., 2006) — remain ambivalent: recent studies highlight both the cognitive and motivational support potential of chatbots and the risks of overload, superficiality, or inequalities of access (Debets et al., 2025; Smutny & Schreiberova, 2020; Zawacki-Richter et al., 2019).

In this vein, our proposal aims to analyse the role of pedagogical chatbots in the learning of university students, based on a conceptual model combining three complementary theoretical frameworks.

We thus draw on the Technology Acceptance Model (TAM), which allows us to examine how perceptions of usefulness and ease of use condition the intention to use, and the actual use, of educational technologies (Davis, 1989, 1993; Hsiao et al., 2018; Kemp et al., 2024; Susilawati et al., 2025; El-Sisi, 2025). Next, research on Self-Regulated Learning and cognitive load theory allows us to analyse how chatbots support planning, monitoring, self-evaluation, and the management of extraneous load, with possible effects on the depth of study approaches and on performance (Pintrich, 2004; Zimmerman, 2002; Sweller et al., 1998; Debets et al., 2025). Finally, thanks to Self-Determination Theory and research on social presence, we have a framework for analysing how these tools can satisfy — or not — the needs for autonomy, competence, and relatedness, and thereby influence autonomous motivation, engagement, and persistence (Ryan & Deci, 2000; Deci & Ryan, 2008; Niemiec & Ryan, 2009; Fredricks et al., 2004; Kuh, 2009; Tinto, 2012; Winkler & Söllner, 2018).

From this framework, the research problem can be formulated as follows: to what extent does the use of pedagogical chatbots influence the quality of student learning in higher education? Two research questions structure our inquiry. The first asks how the use of pedagogical chatbots in university teaching contributes, or not, to improving the quality of student learning,

apprehended through motivation, engagement, study approaches, and certain indicators of academic success, in line with the works cited above. The second examines how usage modalities of chatbots — frequency, types of tasks, degree of guidance, more or less critical posture — influence motivation, engagement, and satisfaction, drawing on the joint contributions of SDT (Ryan & Deci, 2000, 2008) and technology-acceptance models.

To answer these questions, the study adopts a qualitative, comprehensive methodology, based on semi-structured interviews conducted with a sample of thirty students enrolled in different undergraduate education tracks at the École Supérieure de l'Éducation et de la Formation d'Agadir (ESEFA), Ibnou Zohr University. This approach fits within the dynamic of works that stress the importance of analysing in depth self-regulation strategies, motivational perceptions, and the situated uses of educational technologies (Pintrich, 2004; Zimmerman, 2002; Bond et al., 2021). The interviews, centred on experiences of chatbot use, representations of their usefulness, and their perceived effects on academic work, were subjected to a thematic analysis, preceded by an exploratory lexical analysis, guided by the conceptual model articulating TAM, SRL/CLT, and SDT.

The article is structured in four main sections. The first presents the conceptual framework as well as the three theoretical frameworks mobilised. The second section details the methodology (context, sample, interview protocol, and data-analysis procedures). The third section presents the results of the lexical and thematic analysis, testing them against the conceptual model and the two research questions. Finally, the fourth section discusses the contributions and limitations of the study and outlines avenues for regulation and future research, echoing the recommendations formulated by Bond et al. (2021) and Zawacki-Richter et al. (2019) regarding the regulation of AI uses in higher education.

2. Fundamental concepts

Recent developments in artificial intelligence in education, and in particular the rapid spread of chatbots powered by large language models, are profoundly reconfiguring the conditions of learning in higher education. In universities, these conversational agents are progressively being integrated into training arrangements, whether to answer student questions, provide individualised support, or accompany flexible and massified learning pathways. This evolution is part of a broader movement of digitisation of learning environments, in which AI is called upon to play a structuring role in the mediation of knowledge, the orchestration of activities, and the personalisation of training experiences.

In this context, analysing the role of chatbots in the quality of student learning first requires clarifying several fundamental concepts. On the one hand, it is important to define precisely what is meant by "pedagogical chatbots" and to situate them in relation to intelligent tutoring systems and general-purpose conversational agents, by drawing on existing typologies that articulate pedagogical purpose, level of "intelligence", and contexts of use (Winkler & Söllner, 2018; Pérez-Marín, 2021). On the other hand, the notion of learning quality in higher education must be made explicit through its main indicators — performance, process, engagement, student experience — and the issues it raises in the era of digital environments and educational AI (Biggs & Tang, 2011; Pintrich, 2004; Zimmerman, 2002; Zawacki-Richter et al., 2019). Finally, it is worth situating the concrete pedagogical uses of chatbots at university, in order to relate these concepts to contextualised teaching and learning situations and to prepare the empirical examination of their effects on learning quality.

2.1. Definition and typology of pedagogical chatbots

Pedagogical chatbots can be defined as conversational agents specifically designed to support teaching, learning, and student guidance through natural-language interactions, thus distinguishing them from general-purpose chatbots with an essentially informational or

commercial purpose (Winkler & Söllner, 2018; Smutny & Schreiberova, 2020).

They thus extend the legacy of intelligent tutoring systems by taking up their diagnostic, adaptation, and feedback functions, while articulating them with natural-language-processing technologies that allow for more flexible and dialogic exchanges (Graesser et al., 2012; Zawacki-Richter et al., 2019).

Based on the specialised literature, we support the idea that chatbots are organised around three axes: pedagogical purpose (tutoring, formative assessment, metacognitive support, organisational support), level of autonomy and "intelligence" (rule-based systems, Intelligent Tutoring System architectures, chatbots based on large language models), and context of use (in-person higher education, distance learning, adaptive learning environments) (Winkler & Söllner, 2018; Pérez et al., 2020).

This (three-axis) typology is heuristic in that it articulates a techno-functional conception with pedagogical objectives, but it shows overlaps and does not yet satisfactorily integrate unavoidable dimensions such as social presence or ethical issues, even though these aspects condition the effects of chatbots on teaching and learning practices (Zawacki-Richter et al., 2019).

2.2. Quality of learning in higher education: indicators and issues

The quality of learning in higher education is a multidimensional construct that refers to the articulation between academic outcomes, learning processes, and the student experience. Classic indicators include performance (grades, success, graduation, persistence), but these measures remain insufficient to capture the depth of understanding, the transferability of knowledge, and the development of transversal competencies (Biggs & Tang, 2011). Hence the importance of integrating indicators concerning study approaches (deep vs. surface approaches), self-regulation strategies, time management, and cognitive effort, which constitute essential markers of the quality of learning processes (Pintrich, 2004; Zimmerman, 2002). Student

engagement — behavioural, cognitive, and affective — as well as satisfaction and perceptions of the quality of the learning environment are also considered key dimensions, as they are associated with better outcomes, persistence, and a more satisfying training experience (Fredricks et al., 2004; Kuh et al., 2006; Tinto, 2012).

The rise of educational technologies and digital learning environments further broadens this conception of quality by incorporating indicators of online activity, mediated interaction, and the development of digital competencies, as well as students' capacity to self-regulate in highly autonomous contexts (Bond et al., 2021; Zawacki-Richter et al., 2019).

These developments raise normative and political issues, insofar as the choice of indicators reflects different conceptions of the purposes of the university (employability, generic competencies, critical citizenship, personal fulfilment) and calls for a pluralistic approach combining measures of performance, engagement, process, and experience, while taking into account inequalities and the diversity of student populations (Biggs & Tang, 2011; Kuh, 2009; Tinto, 2012).

Within this framework, the evaluation of the contribution of AI and intelligent tutoring systems cannot be limited to performance gains, but must consider their effects on the depth of learning, autonomy, equity, and the overall quality of the educational experience.

2.3. Pedagogical uses of chatbots at university

The pedagogical uses of chatbots at university are structured around several recurring functions, which reflect the diversification of training arrangements and the massification of student populations. A first set of uses consists of employing chatbots as virtual tutors or study assistants, tasked with answering student questions about content, rephrasing or illustrating complex notions, proposing avenues for problem-solving, and providing immediate feedback on formative exercises or quizzes (Winkler & Söllner, 2018; Smutny &

Schreiberova, 2020). These systems are then integrated into courses, MOOCs, or institutional platforms and aim to extend support beyond classroom time, increasing the perceived availability of pedagogical support and sustaining engagement in tasks (Pérez et al., 2020; Zawacki-Richter et al., 2019). A second set of uses concerns metacognitive and organisational support: some chatbots are designed to help students plan their work, set goals, track task progress, receive deadline reminders, and reflect on their learning strategies, which positions them as tools supporting self-regulation in contexts marked by high student autonomy (Pintrich, 2004; Zimmerman, 2002; Winkler & Söllner, 2018).

In addition, universities deploy chatbots for orientation, support with administrative procedures, and academic socialisation, thereby contributing to improving the overall student experience and reducing certain extraneous burdens that may hinder engagement in learning (Kuh et al., 2006; Tinto, 2012; Zawacki-Richter et al., 2019). In this perspective, chatbots act as mediators of the university environment, providing contextualised information on procedures, available resources, or participation opportunities, and integrating socio-emotional dimensions (encouragement, normalisation of difficulties) that contribute to a sense of belonging and persistence (Fredricks et al., 2004; Kuh, 2009).

The most recent uses, driven by large language models, further extend this spectrum by enabling more open activities of co-writing, idea generation, or dialogue simulation, which opens up new pedagogical possibilities but also raises questions of regulation, academic integrity, and alignment with objectives of developing critical competencies (Zawacki-Richter et al., 2019).

These various uses show that chatbots are not a simple tool for automated response, but that they interfere directly with the way students organise their work, regulate their learning, and engage in the proposed activities. As a result, they act simultaneously on cognitive and metacognitive processes, on the informational load to be

processed, and on the motivational and socio-emotional dimensions of the student experience, which suggests contrasting effects on the quality of learning.

To analyse these effects, it appears necessary to mobilise theoretical frameworks that can jointly account for self-regulation of learning, cognitive load, and the motivational and relational determinants of engagement. The following section is devoted to the main theoretical frameworks retained to shed light on the role of pedagogical chatbots in higher education.

3. Theoretical frameworks and initial conceptual model of the influence of chatbots on learning quality

The progressive spread of pedagogical chatbots in higher education raises the question of the theoretical mechanisms through which these devices may influence the quality of student learning, whether on a cognitive, motivational, or technological level (Biggs & Tang, 2011; Pérez-Marín, 2021; Winkler & Söllner, 2018). In this perspective, we draw on conceptual frameworks capable of helping us analyse how chatbots support self-regulated learning processes and modulate cognitive load (Pintrich, 2004; Sweller et al., 1998; Zimmerman, 2002), how they act on motivation by contributing to the satisfaction of the needs for autonomy, competence, and relatedness through a credible social presence (Deci & Ryan, 2008; Fredricks et al., 2004; Kuh, 2009; Ryan & Deci, 2000; Tinto, 2012). These frameworks will finally be used to explore how students' adoption of chatbots depends on perceptions of usefulness and ease of use highlighted by the Technology Acceptance Model (Davis, 1989, 1993; El-Sisi, 2025; Hsiao et al., 2018; Kemp et al., 2024; Susilawati et al., 2025).

This section thus articulates three complementary axes — support for self-regulated learning and cognitive load, motivation and social presence, perception of usefulness and ease of use — in order to propose a theoretical model integrating these different dimensions to account for how the use of chatbots can jointly contribute to deeper study approaches, higher cognitive

engagement, and better academic performance (Bond et al., 2021; Debets et al., 2025; Smutny & Schreiberova, 2020; Zawacki-Richter et al., 2019).

3.1. Support for self-regulated learning and cognitive load in chatbot use

Research on self-regulated learning conceives of the student as an actor capable of planning, monitoring, and regulating their cognitions, emotions, and behaviours in relation to learning goals, through recursive cycles of planning, implementation, self-observation, and self-evaluation (Pintrich, 2004; Zimmerman, 2002). In this perspective, the quality of learning largely depends on students' capacity to mobilise planning strategies (time organisation, goal-setting), cognitive and metacognitive strategies (elaboration, self-questioning, comprehension monitoring), as well as strategies for managing effort and motivation (Pintrich, 2004; Zimmerman, 2002).

Pedagogical chatbots, when designed as virtual tutors or study coaches, can fit within this framework by offering deadline reminders, helping to break a complex task down into sub-tasks, inviting the student to make their goals explicit or to reflect on their errors, and providing immediate feedback on the strategies employed (Pérez-Marín, 2021; Winkler & Söllner, 2018). These functionalities are likely to support the different phases of self-regulated learning, by making planning and monitoring processes more explicit and by offering additional opportunities for guided self-evaluation.

At the same time, cognitive load theory posits that learning performance is conditioned by the limited capacity of working memory and by how the total load is distributed between intrinsic load (linked to task complexity), extraneous load (linked to how information is presented), and germane load (linked to schema construction) (Sweller et al., 1998). Within this framework, chatbots can, in principle, help reduce extraneous load by providing targeted explanations, clarifying instructions, directing the student toward relevant resources, and avoiding lengthy and disorganised information searches (Debets et al., 2025; Pérez et al., 2020). They can thus free

up cognitive resources for the in-depth processing of content and favour a greater allocation of load to relevant meaning-construction activities, but poorly designed or overly voluminous interactions can, on the contrary, generate informational overload and encourage superficial processing strategies (Debets et al., 2025; Smutny & Schreiberova, 2020).

The intersection between self-regulated learning and cognitive load thus leads to the hypothesis that the more students perceive that the chatbot supports their self-regulation processes while reducing extraneous load, the higher the quality of their learning — in terms of deep approaches, cognitive engagement, and performance (Biggs & Tang, 2011; Winkler & Söllner, 2018).

This perspective nonetheless highlights another determining dimension, linked to how students subjectively experience their relationship with the chatbot: the satisfaction of their fundamental psychological needs and the perception of a credible social presence.

3.2. Motivation, psychological needs, social presence, and relationship with chatbots

The analysis of student motivation in the use of pedagogical chatbots at university largely draws on Self-Determination Theory, which posits that the quality of motivation depends on the satisfaction of three fundamental psychological needs: autonomy, competence, and social belonging. Unlike lectures, chatbots allow students to remain "in the driver's seat" and to actively control their own learning process. This fosters intrinsic motivation because the student perceives their actions as self-generated. As for the development of competence, chatbots support this need by providing immediate and personalised feedback. Thus, when a system allows learners to detect their progress, this reinforces their sense of self-efficacy and their satisfaction. The satisfaction of the need for a sense of belonging depends on the "social presence" of the chatbot. The chatbot's personality (conversational tone, perceived empathy, use of the student's name) is essential to creating a supportive relationship and reducing

the learner's sense of isolation (Ryan & Deci, 2000). When these needs are satisfied, students develop autonomous motivation (intrinsic motivation and identified/integrated regulation) associated with sustained engagement, deep study approaches, and better academic outcomes (Deci & Ryan, 2008; Niemiec & Ryan, 2009).

In the context of digital learning environments, this theory has been used to show that arrangements that support autonomy (choice, perceived control), competence (informative feedback, adapted challenges), and relatedness (socio-emotional support, quality interactions) foster persistence and the quality of learning (Jeno et al., 2018; Kynndt et al., 2011).

Pedagogical chatbots can be analysed as artefacts likely to act on these psychological needs in various ways. In terms of autonomy, they offer flexible, on-demand access to explanations, examples, or advice, allowing students to initiate the interaction themselves, to choose the moment and type of support they need, which can reinforce the sense of control over the learning process (Pérez et al., 2020; Winkler & Söllner, 2018). In terms of competence, chatbots can provide immediate, specific, and sometimes individualised feedback on answers or study strategies, contributing to the perception of progress and self-efficacy, provided the answers are reliable and pedagogically relevant (Debets et al., 2025; Smutny & Schreiberova, 2020). Finally, some chatbots are designed to incorporate messages of encouragement, normalisation of difficulties, and recognition, which can contribute to a sense of being supported and of not being alone in facing academic demands, especially in distance or massified contexts (Kuh, 2009; Tinto, 2012; Zawacki-Richter et al., 2019).

Studies on conversational agents and chatbots show that certain design traits — language style, personalisation, the ability to remember information about the user, socio-emotional expressions — can increase the perception of social presence and the acceptance of the agent as an interaction partner (Winkler & Söllner, 2018; Smutny & Schreiberova, 2020). In a university context, a chatbot perceived as

"present", responsive, and caring can strengthen the sense of belonging and support, which is associated with better autonomous motivation and greater persistence (Fredricks et al., 2004; Tinto, 2012).

However, this humanisation of chatbots also raises critical questions. A social presence judged too "strong" or too anthropomorphised can generate unrealistic expectations, confusion between artificial agent and human tutor, or even excessive dependence on the device to the detriment of student initiative (Winkler & Söllner, 2018; Zawacki-Richter et al., 2019). Moreover, if the chatbot provides erroneous or poorly nuanced answers while being perceived as highly credible, the risk of an "illusion of competence" and misplaced trust can negatively affect the quality of learning (Debets et al., 2025; McGrath et al., 2024). The literature thus suggests that the motivational and socio-relational effects of chatbots depend on how they balance support for autonomy and competence, perceived social presence, and transparency about their limitations (Ryan & Deci, 2000; Jeno et al., 2018). A hypothesis that follows is that the more students perceive that the chatbot supports their motivation (needs for autonomy, competence, and relatedness), through a socially credible but controlled interaction, the higher their autonomous motivation and engagement in university learning activities, and the better the quality of learning.

3.3. Perceived usefulness, ease of use (TAM), and impact on learning quality

Within the framework of the Technology Acceptance Model (TAM), perceived usefulness and ease of use constitute two central determinants of the acceptance and actual use of educational technologies, including pedagogical chatbots. Perceived usefulness refers to the degree to which a student believes that using a system improves their academic performance, while ease of use refers to the degree to which they consider the use of this system to be free of significant effort (Davis, 1989; Davis, 1993). Numerous studies conducted in higher education show that these two perceptions influence

attitude toward the technology, intention to use, and, ultimately, the actual use of digital learning devices (Hsiao et al., 2018; Susilawati et al., 2025). In the case of chatbots, research indicates that students adopt them more readily to support their studies when they judge them to be both useful for improving the efficiency of their academic tasks (quick clarification, help with comprehension, time savings) and easy to use on technical and interactional levels (intuitive interface, fluent natural language) (El-Sisi, 2025; Winkler & Söllner, 2018). These studies also suggest that the perception of usefulness and ease of use is not limited to explaining the intention to use the chatbot, but is indirectly linked to the quality of learning, insofar as more frequent and more strategic use of the tool is associated with better engagement, deeper study approaches, and better academic outcomes (Kemp et al., 2024; Bond et al., 2021; Zawacki-Richter et al., 2019).

We can summarise by saying that the higher the perceived support for self-regulation by the chatbot (planning, monitoring, self-evaluation), the more students perceive a reduction in their extraneous cognitive load (clearer instructions, easier access to information, less overload), and the higher the quality of their learning — apprehended through deep approaches, high cognitive engagement, and better academic performance.

The more students perceive that the chatbot supports their fundamental psychological needs for autonomy, competence, and relatedness through a socially credible but controlled interaction, the higher their autonomous motivation and engagement in university learning activities, which translates into better learning quality (deep approaches, cognitive engagement, performance).

The more students perceive the chatbot as useful and easy to use for their university activities, the more positive their attitude and intention to use it, which increases the likelihood of regular use oriented toward high-value-added learning tasks, and translates into an improvement in the quality of learning, apprehended in terms of cognitive

engagement, deep approaches, and academic performance.

Taken together, these relationships allow us to propose a theoretical model articulating three complementary dimensions of the influence of pedagogical chatbots on learning: a cognitive and self-regulatory dimension (support for planning, monitoring, and self-evaluation processes, and reduction of extraneous cognitive load), a motivational and socio-relational dimension

(support for the needs for autonomy, competence, and relatedness via a credible social presence), and a technology-acceptance dimension (perception of usefulness and ease of use guiding the intention and regular use of the chatbot). This theoretical model, built from the SRL, cognitive load, self-determination theory, and TAM frameworks, thus offers an integrated reading grid of the mechanisms by which the use of chatbots at university is likely to jointly act on the quality of student learning.

[Figure 1]

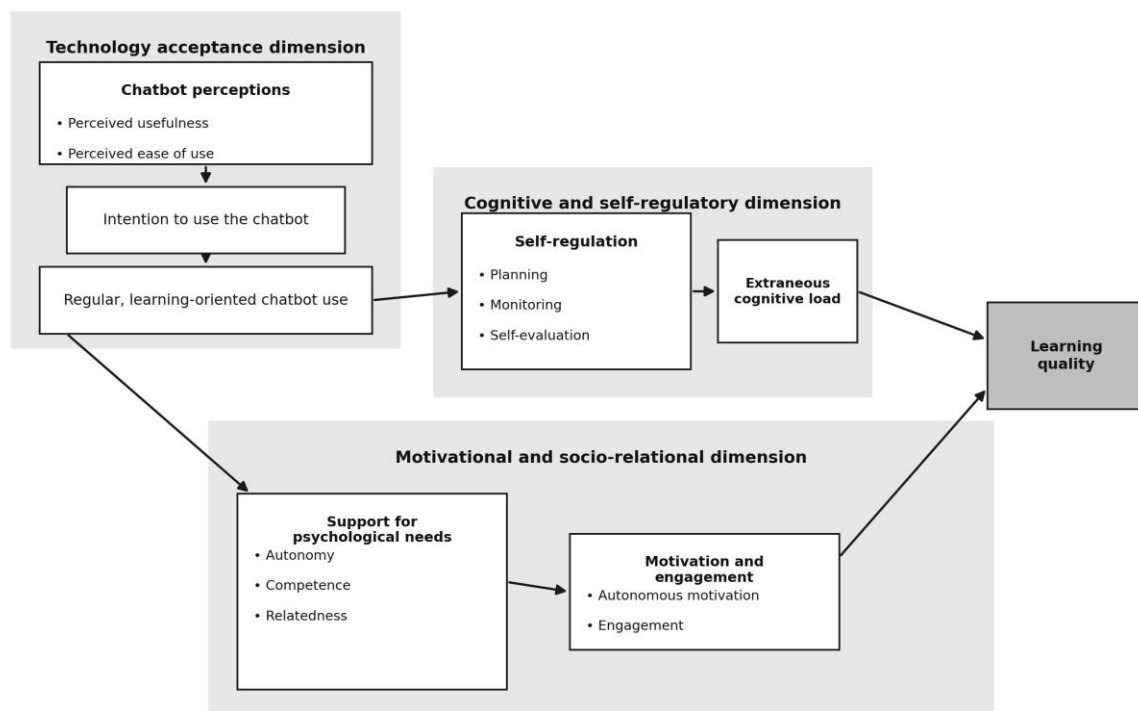


Figure 1. Theoretical model of the influence of pedagogical chatbots on the quality of learning in higher education

Source: Authors.

This entire theoretical framework, and the theoretical model that derives from it, provides an integrated reading grid of the mechanisms by which pedagogical chatbots are likely to influence the quality of learning in higher education. In order to empirically examine the relevance of these relationships and to allow any unanticipated adjustments or dimensions to emerge, the remainder of this article is devoted to presenting the methodological approach adopted and the empirical study conducted from an exploratory qualitative perspective, whose choices (field,

sampling, data-collection and analysis tools) are detailed below.

4. Methodology

4.1. Design

The research adopts a qualitative methodology based on semi-structured interviews conducted with thirty students enrolled at the École Supérieure de l'Éducation et de la Formation d'Agadir (ESEFA), part of Ibnou Zohr University. This comprehensive design was chosen in order to explore in depth students'

situated uses, representations and perceived effects of pedagogical chatbots.

4.2. Participants and sample

The sample comprised thirty students enrolled in different education tracks at ESEFA (French, English, mathematics, life and earth sciences, and primary education), as reflected in the excerpts reported in the results section. Participants were selected through purposive sampling so as to diversify the tracks represented. Three inclusion criteria were applied: being enrolled at ESEFA, having used a chatbot in the context of their studies, and agreeing to participate voluntarily after being informed of the study's objectives.

4.3. Instruments

The interviews, lasting between 20 and 40 minutes, were conducted using a guide structured around chatbot uses, perceptions of their usefulness, their effects on the organisation of work, motivation, and the quality of learning.

4.4. Procedure

Participants were informed of the study's objectives and their rights. The principle of confidentiality and anonymity was guaranteed: the data were pseudonymised, and no element allowing direct identification of respondents appears in the verbatim quotations used. All interviews were fully recorded and then transcribed before being imported into the qualitative-analysis software NVivo to facilitate the organisation and processing of the data.

4.5. Data analysis

The analysis was conducted in two stages: an exploratory lexical analysis (word frequencies and word cloud generated in NVivo), followed by a thematic analysis. A first open coding pass allowed categories related to perceptions, forms of use, and perceived effects of chatbots to emerge, and then axial coding was carried out, articulating these categories with the three dimensions of the conceptual model (technology acceptance, cognitive and self-regulatory support, motivation and social presence). Over the course of data collection, it appeared that from the twenty-sixth interview onward, new data no

longer provided substantially novel information, which was interpreted as an indicator of theoretical saturation.

Thematic analysis then allowed regularities, nuances, and tensions in the discourse to be identified, in order to answer the research questions on the conditions under which chatbots do, or do not, contribute to the quality of learning.

Note on translation: interviews were conducted, transcribed, and coded in French, the participants' language of instruction. All quotations reproduced below are the authors' translations of the original French verbatim; the original French terms and their frequencies are preserved in Table 1 and the accompanying translation table, and in Figure 2 (word cloud), to keep the lexical analysis auditable.

5. Analysis and interpretation

This section presents the detailed results of the study, articulating, first, a lexical analysis and, second, a thematic analysis of the interviews. The aim is to move from an overall view of lexical regularities to a fine-grained understanding of the meanings students attribute to the use of pedagogical chatbots, in relation to our conceptual model and our research questions.

The lexical analysis identifies the most salient terms and highlights the broad semantic fields structuring the discourse (tool, study activity, competencies, subjective experiences), while the thematic analysis aims to reconstruct the logics of use, the perceived mechanisms of influence on learning, and the conditions under which chatbots are judged beneficial or problematic. Together, these two levels of analysis provide a basis for analysing, in an argued manner, how students perceive the role of chatbots in the quality of their university learning.

5.1. Lexical analysis

The analysis here focuses on the 20 most recurrent words in the corpus, among which "chatbot", "pedagogical", "use", "really", "language", "how", "I use it", "work", "students/pupils", "competence", "tool", "own",

"teach", "develop", "Arabic", "course", "a lot", "do", and "ask".

This lexical core gives a first overview of how students situate chatbots in their learning practices and allows the reported uses to be linked to the three theories mobilised: support for self-regulated learning and cognitive load, motivation and social presence, perceived usefulness/ease of use, and impact on the quality of learning.

We note from the outset that these 20 words are all anchored in study activity (course, work, students, competence), in instrumentation through the tool (chatbot, pedagogical, tool, use, I use it), and in the subjective experience of effectiveness or value ("really", "a lot"), which makes them particularly relevant for shedding light on the research problem "How do chatbots influence the quality of student learning?".

[Table 1] **Table 1. The 20 most frequent words in the corpus, with English translation**

Original French word	English translation	Occurrences	Weighted %
chatbot	chatbot	1273	1.57
pédagogiques	pedagogical	374	0.46
utiliser	to use	420	0.44
vraiment	really	328	0.41
langue	language	280	0.35
comment	how	288	0.33
l'utilise	I use it	242	0.30
travail	work	245	0.30
élèves	students / pupils	235	0.29
compétence	competence	215	0.27
outil	tool	215	0.27
propres	own	202	0.25
enseigner	to teach	198	0.24
développer	to develop	197	0.24
arabe	Arabic	195	0.24
cours	course / class	195	0.24

Original French word	English translation	Occurrences	Weighted %
beaucoup	a lot	189	0.23
faire	to do	233	0.23
demande	ask / request	198	0.23
scientifique	scientific	178	0.22

Source: NVivo output. Interviews were conducted and coded in French; original terms are kept for auditability, with the authors' English translation alongside.

On the level of self-regulated learning and cognitive load, the strong presence of "use", "I use it", "how", "do", and "ask" indicates that students describe very concretely how they integrate the chatbot into their "work" and "course" tasks. These action verbs relate to the classic phases of SRL (planning what one is going to do with the chatbot, implementing targeted requests, monitoring and adjusting one's answers), which confirms the role of the chatbot as a support for planning, monitoring, and self-evaluation highlighted in the article. The fact that "language" and "Arabic" are among the 20 most frequent words suggests intensive use of the chatbot to overcome linguistic obstacles (comprehension, translation, rephrasing), which, in Cognitive Load Theory, corresponds to a reduction of the extraneous load linked to linguistic decoding or information-seeking, and thus to greater cognitive availability for the in-depth understanding of "scientific" content.

The association of these 20 words with "competence", "develop", "own", and "scientific" shows that students are not limited to occasional or superficial use of the chatbot: they anchor it in a dynamic of disciplinary competence development and personal production. For example, the pairing "competence/develop" refers to the active appropriation of knowledge, and "own" signals a concern for preserving personal work (own words, own ideas), which is consistent with a quality of learning defined in terms of deep approaches, cognitive engagement, and knowledge transfer. In this perspective, the 20 most frequent words clearly illustrate Research

Question 1: chatbot use is described as a lever for working better on courses, strengthening competencies (notably linguistic and scientific ones), and producing more accomplished work, which contributes to motivation, engagement, and ultimately academic success.

From a motivational and relational standpoint, the notable frequency of the adverb "really" and the quantifier "a lot" in this top 20 signals the importance of the subjective evaluation of the tool ("it really helps", "I use it a lot") in the discourse. This echoes Self-Determination Theory: students test the extent to which the chatbot supports their needs for autonomy (being able to choose when and how to use it), competence (feeling that they are progressing, that they understand better), and relatedness (getting feedback, a form of socio-cognitive presence), which conditions the quality of their motivation (more or less autonomous) and their persistence.

Even though terms explicitly linked to social presence do not appear among these top 20 words, items such as "ask" and the implicit opposition between "teach" and letting oneself be "assisted" by the tool indicate a dialogic relationship with the chatbot, analysed as a factor in the sense of support and belonging when it is perceived as responsive and credible.

Finally, the 20 most frequent words read very clearly through the lens of the technology-acceptance models (TAM/UTAUT) mobilised in this study. On the one hand, the centrality of "chatbot", "tool", "use", "I use it" reflects a

strong focus on the conditions of use and refers to perceived ease of use: students question how, concretely, to use it in their "courses" and their "work", which conditions their intention to use it regularly. On the other hand, the surrounding lexical environment — "competence", "develop", "scientific", "language", "Arabic", "pedagogical" — shows that perceived usefulness is explicitly linked to gains in efficiency and quality in academic tasks: understanding better, producing

higher-quality texts, improving one's linguistic or disciplinary competencies.

In the article's conceptual model, this usefulness/ease-of-use pairing feeds the intention to use, which favours regular use oriented toward high-value-added tasks for learning, and thus contributes, jointly with support for self-regulation and the satisfaction of psychological needs, to improving the quality of students' learning.

[Figure 2]

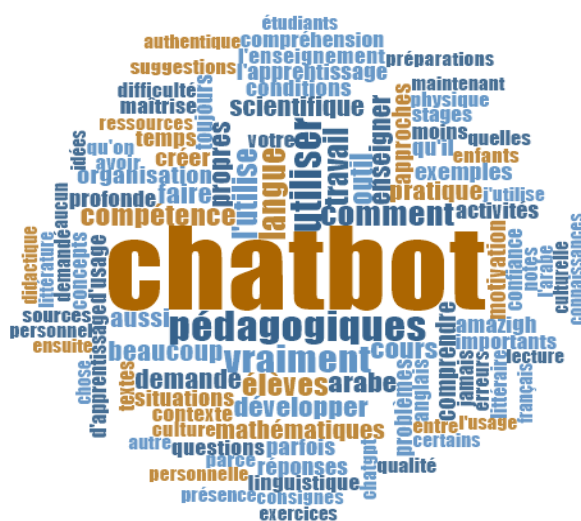


Figure 2. Word cloud of the corpus (original French terms — see Table 1 for English translation)

Source: NVivo output.

The word cloud visually synthesises the lexical structure of the corpus, showing at a glance the most salient terms and their symbolic relations. The size of the words reflects their frequency of occurrence, while their central or peripheral position and the colour code (brown, dark blue, light blue) allow different semantic registers around the pedagogical chatbot to be distinguished. This graphic device complements the frequency tables by offering a more intuitive representation of the dominant themes and notions associated with the effects of chatbots on the quality of student learning.

At the centre of the cloud, the term "chatbot", in brown and very large, occupies the nodal position, which confirms its status as the focal object of the discourse and the pivot of the learning experience described by the interview participants. Just around it, still in a central

position but with a slightly smaller size, appear words such as "pedagogical", "really", "use", "work", "students", "competence", "develop", "Arabic", "course", and "scientific", mainly in dark blue. This central ring signals the dimensions directly associated with the chatbot, both as a tool ("pedagogical", "use") and as a mediator of academic activities ("work", "course", "students") and as a lever for competencies and learning quality ("competence", "develop", "scientific", "Arabic" for the linguistic dimension).

Moving toward the periphery of the cloud, we observe more words of smaller size, referring to more contextual or secondary aspects, such as "exercises", "examples", "questions", "preparations", "children", "internships", or mentions of other disciplines ("mathematics", "physics", "Amazigh"). Their peripheral position and smaller size suggest that they contribute to

the diversification of uses (variety of tasks, disciplinary contexts, or audiences) without challenging the central core formed by the tool–activity–competence triptych. The colour contrast reinforces this hierarchy: brown highlights the central object (the chatbot itself), dark blue signals the dimensions strongly linked to the heart of the research problem (pedagogical uses, quality of learning, competencies, languages, coursework), while light blue groups the background elements (situations, examples, contexts) that support, without structuring, student representations of the role of chatbots in university learning.

To deepen this first lexical reading, we now complement it with a thematic analysis, in order to move beyond simple word frequency and enter into the logic of the discourses. Indeed, the same terms ("competence", "use", "really", "course", "Arabic", etc.) can refer to very different experiences and evaluations depending on the context of the sentences, co-occurrences, and the polarity of the statements. A thematic analysis, based on coding text segments, allows statements to be grouped into categories (for example: support for self-regulation, reduction of cognitive load, competence development, motivations and reluctance, perceived social presence, perceptions of usefulness/ease of use), and thus better relates students' uses and attitudes to the theoretical frameworks mobilised (SRL, cognitive load, SDT, social presence, TAM) and to the research problem of learning quality.

5.2. Thematic analysis

The results from the thematic analysis show that pedagogical chatbots influence the quality of learning according to the three dimensions of our conceptual model — technology acceptance, cognitive and self-regulatory support, motivation and social presence — which allows us to answer both of our research questions positively. Indeed, the reported uses confirm, in line with Pérez-Marín (2021), Winkler and Söllner (2018), and Debets et al. (2025), the potential of chatbots as virtual tutors that help plan, understand, and design activities. However, we also subscribe to the warnings of Debets et al. (2025) and Smutny

and Schreiberova (2020) regarding the risks of dependence, informational overload, errors, or illusion of competence.

Thus, overall, our results support the idea that chatbots contribute to improving the quality of learning when students mobilise them as tools supporting self-regulation, competence development, and pedagogical creativity, within a framework of critical and supervised use. Conversely, when these chatbots substitute for cognitive effort or personal reflection, they can weaken conceptual mastery, which leads us to qualify our answer to the research problem.

On the level of technology acceptance (Research Question 2), the majority of respondents attribute high perceived usefulness to the chatbot, but selectively depending on the task. An undergraduate education student, for example, explains that she sees the chatbot as "a tutor available 24/7" that gives her "immediate explanations" on difficult concepts (Response 1), while another student (in mathematics) considers it "extremely useful for generating varied exercises and different pedagogical approaches" while stressing its low value for learning proofs (Response 2). Other respondents — for example in life sciences (Responses 11 and 21) — stress its usefulness for structuring presentations or simplifying complex notions, but judge the tool unreliable for content in molecular biology or very precise recall.

These results corroborate the central role of perceived usefulness in TAM (Davis, 1989, 1993) and echo Hsiao et al. (2018) as well as Kemp et al. (2024) by showing that acceptance depends on the alignment between the technology and task requirements. Ease of use is also widely acknowledged — several undergraduate and graduate students stress that "you just have to ask the question in natural language" (Responses 2, 5, 14) — but they mention a genuine "learning curve" linked to the art of formulating precise requests (level, duration, targeted competencies), which relates to the dimension of perceived ease of use in TAM and to the findings of Susilawati et al. (2025) on the role of usage skills in acceptance. Thus, in line with our model, high

perceived usefulness combined with progressively mastered ease of use fuels a high intention to use and regular use oriented toward high-value-added learning tasks (course preparation, conceptual clarification), in answer to the second research question.

The cognitive and self-regulatory dimension (Research Questions 1 and 2) also appears central: many respondents describe how the chatbot fits into their organisation of work to plan, monitor, and adjust their activities. A student in French didactics explains that she starts by "reading the instructions and [her] course notes", then turns to the chatbot to "clarify concepts" and better "plan [her] work" (Response 1), while a mathematics student indicates that he first sets his objectives, then uses the chatbot "in brainstorming mode" to generate activities and ideas that he then filters (Response 2). Others, in education (primary cycle) or foreign-language tracks, mention the tool for breaking a task down into sub-tasks ("I ask it to propose a multi-step progression", Responses 3, 9, 18) or to obtain examples applied to the classroom context.

These practices illustrate the processes of planning, monitoring, and self-evaluation highlighted by SRL (Pintrich, 2004; Zimmerman, 2002) and echo the works that describe the chatbot as a study coach (Pérez-Marín, 2021; Winkler & Söllner, 2018).

In terms of cognitive load, several students report a reduction in extraneous load thanks to summaries and structured plans ("I don't have to search through 15 different sources — I get a quick synthesis", Response 1; "I prepare exercise sets in 20 minutes that would have taken me two hours", Responses 2 and 10), which is consistent with Debets et al. (2025) and Pérez et al. (2020). However, students in science and humanities also highlight overload effects ("it gave me too much information on competency-based assessment, I was lost", Response 1; "when I ask for too many examples, I have to spend a lot of time sorting them", Responses 8 and 16), confirming the risks of increased extraneous load and superficial

processing identified by Debets et al. (2025) and Smutny and Schreiberova (2020).

Within our model, these elements show that the chatbot contributes to a better quality of learning — in terms of comprehension, cognitive engagement, and task structuring — when its use is targeted and regulated, which sheds light on the "cognitive and self-regulatory dimension" part of the conceptual diagram.

On the motivational and socio-relational level, the results fit the logic of Self-Determination Theory (Ryan & Deci, 2000; Deci & Ryan, 2008), while qualifying the role of artificial social presence. Several students from varied backgrounds (French, mathematics, science) state that the chatbot strengthens their sense of autonomy: one respondent explains that she "stays in control" of her learning choices and sees the chatbot as "an assistant that proposes but does not decide" (Response 1), another states that he defines the "specifications" of exercises himself (Response 2), and an English student notes that the tool allows her to "try several ways of teaching a concept before choosing the one that suits [her] class" (Response 12). These accounts echo the analyses of Kyndt et al. (2011) and Jenő et al. (2018) on the link between perceived control, autonomous motivation, and engagement. The need for competence is also very present: several respondents consider that the chatbot helps them feel more competent at explaining concepts ("I feel more confident speaking up in class", Response 1; "my lesson plans are more professional", Responses 7, 15, 19), which converges with Niemiec and Ryan (2009) and research on informative feedback.

However, students in French didactics, mathematics, and science mention an "impostor syndrome" ("I feel like a fake teacher", Response 1; "would I be capable of doing this without ChatGPT?", Response 2; "sometimes I feel guilty for not having produced everything myself", Response 24), which illustrates the risks of illusion of competence described by Debets et al. (2025) and McGrath et al. (2024).

Regarding social presence, perceptions are mixed: some minimise it ("to me it's just software, not a

teacher", Response 2; "there's no emotional relationship", Response 20), while others chiefly value the possibility of asking questions "without being judged" (Responses 1, 6, 13) or of practising a language in "pressure-free dialogue" (Responses 3, 12, 22). This suggests, in line with Fredricks et al. (2004), Kuh (2009), and Tinto (2012), that in this setting, the chatbot supports autonomous motivation mainly by reducing fear of judgement and reinforcing competence, more than by playing the role of a humanised relational partner as described in some studies (Winkler & Söllner, 2018; Smutny & Schreiberova, 2020).

The fourth major dimension refers to the quality of learning in the sense of Biggs and Tang (2011) — performance, deep vs. surface approaches, engagement — and allows us to answer the first research question on the improvement of learning quality (motivation, engagement, success).

Many respondents indicate that their practical assignments are more structured and richer since they started using chatbots: a primary-education student stresses that her lesson sequences are "more varied and adapted to levels" and that "students participate more" (Response 3), while a mathematics student notes that his "didactics files and lesson preparations are graded better" (Response 2) and another in science observes that "presentations are clearer and better organised" (Responses 11 and 17).

These observations echo the works of Bond et al. (2021) and Zawacki-Richter et al. (2019) on the link between digital technologies, diversification of activities, and increased engagement. By contrast, the impact on theoretical exams or deep conceptual mastery appears much more limited: several students mention the absence of any notable gain for tests requiring memorisation, formal reasoning, or proofs ("for theory exams, I don't see any difference", Response 1; "for pure mathematics, the chatbot doesn't help me, quite the opposite", Response 2; "I don't trust it to learn biology or geology", Response 21).

All converge on the idea that the depth of learning depends on the strategy of use: when they merely "copy-paste" the chatbot's answers,

they clearly identify a "surface processing" (Responses 4, 16, 23), whereas a use as a "starting point to deepen, critique, and adapt" is associated with "more solid learning" and a better capacity for explanation (Responses 1, 2, 9, 27).

This result confirms the distinctions proposed by Biggs and Tang (2011) between surface and deep approaches and corroborates our model's hypothesis that regular chatbot use only improves the quality of learning when it is part of an active self-regulation process and complementarity with other resources.

6. Discussion

Taken together, the findings answer the two research questions by showing that the effects of pedagogical chatbots on learning quality are conditional rather than uniform. With regard to the first question, chatbots appear to improve the quality of learning mainly through better task structuring, higher cognitive engagement and a greater diversification of activities, which is consistent with the potential described by Winkler and Söllner (2018), Pérez-Marín (2021) and Debets et al. (2025). Their contribution to deep conceptual mastery nonetheless remains limited, particularly for proofs, formal reasoning and memorisation tasks. With regard to the second question, usage modalities prove decisive: targeted, regulated and critical use is associated with deep approaches, whereas "copy-paste" use is associated with surface processing, in line with the distinction drawn by Biggs and Tang (2011).

From a theoretical standpoint, the results support the articulation of TAM, SRL/CLT and SDT within a single model. Perceived usefulness and ease of use explain the intention to use and regular use (Davis, 1989, 1993), but they do not by themselves guarantee learning quality, which depends on the self-regulatory processes that students engage in (Pintrich, 2004; Zimmerman, 2002) and on the satisfaction of their needs for autonomy and competence (Ryan & Deci, 2000). The results also invite a qualification of the role of social presence in the model: in this context, the chatbot supports motivation more by reducing the fear of judgement than by acting as a humanised relational partner.

From a practical standpoint, these findings argue for integrating chatbots into teacher-training curricula through explicit training in request formulation, information verification and critical use, together with pedagogical scenarios and assessments that value students' own reasoning. At the institutional level, they call for usage guidelines that regulate rather than prohibit these tools, so as to limit the risks of dependence, illusion of competence and inequalities between students (Bond et al., 2021; Zawacki-Richter et al., 2019).

These interpretations should nevertheless be read in light of the limitations of the study, in particular the size and single-institution nature of the sample and the self-reported nature of interview data; these limitations are detailed in the conclusion.

7. Conclusion

This research aimed to understand how pedagogical chatbots influence the quality of student learning, by articulating two research questions: on the one hand, how their use in university teaching can improve the quality of learning (motivation, engagement, academic success); on the other hand, how usage modalities (frequency, type of tasks, level of guidance) affect students' motivation, engagement, and satisfaction.

To answer these questions, a qualitative approach was favoured, based on in-depth interviews with education students, allowing the conceptual model — structured around technology acceptance (TAM), cognitive and self-regulatory support (SRL/CLT), and motivation/social presence (SDT) — to be empirically confronted with actual chatbot-use practices.

The results first show that the technology-acceptance dimension is largely confirmed: in line with TAM (Davis, 1989, 1993; El-Sisi, 2025; Hsiao et al., 2018; Kemp et al., 2024; Susilawati et al., 2025), high perceived usefulness and progressively mastered ease of use lead to regular use oriented toward high-value-added learning tasks, particularly pedagogical preparation and conceptual clarification, especially when students

benefit from at least minimal training in the critical use of chatbots.

The cognitive and self-regulatory dimension is also corroborated: the interviews show that students mobilise chatbots to plan, monitor, and clarify their tasks, which can reduce extraneous cognitive load and support deeper study approaches, while also revealing risks of informational overload and superficial processing already flagged by Debets et al. (2025) and Smutny and Schreiberova (2020).

Finally, the motivational and socio-relational dimension converges with Self-Determination Theory (Deci & Ryan, 2008; Ryan & Deci, 2000; Niemiec & Ryan, 2009) with regard to support for autonomy and competence, but qualifies the role of artificial social presence: in this field, motivation appears to be driven more by professional aspiration, a sense of self-efficacy, and recognition by teachers than by a deep humanisation of the conversational agent (Fredricks et al., 2004; Kuh, 2009; Tinto, 2012).

With regard to the central research problem — "How do chatbots influence the quality of student learning?" — the study leads to a nuanced conclusion. Chatbots can indeed improve the quality of learning when they are integrated as complementary tools in the service of a process of self-regulation, critical verification of information, and complementarity with traditional resources. Under these conditions, they favour better structuring of work, higher cognitive engagement, and a diversification of learning activities.

By contrast, when they substitute for the cognitive effort necessary for the appropriation of knowledge, are used without pedagogical oversight or regulation, or become a permanent crutch, they risk weakening deep learning, feeding illusions of competence, and widening inequalities between students, thus echoing the calls of Bond et al. (2021) and Zawacki-Richter et al. (2019) to regulate rather than ignore these uses.

This research nonetheless presents certain limitations. The sample, although diversified in

terms of tracks, remains limited in size and focused on pre-service students, which restricts the generalisability of the results to the entire student population. The field is also confined to a specific institutional and geographical context, marked by certain curricular and digital characteristics that may influence chatbot uses. Finally, the choice of a qualitative approach gives access to the depth of representations and strategies, but does not allow quantitative measurement of the extent of effects on academic performance or engagement at scale.

These limitations open up some interesting avenues: conducting a quantitative or mixed-methods study could help test the model on larger and more varied samples; comparisons between institutions and disciplines would also help identify the contexts most favourable to virtuous chatbot use. Finally, "interventional" research could evaluate the impact of training and usage-regulation arrangements (usage guides, pedagogical scenarios, aligned assessments) on students' capacity to mobilise these tools in the service of genuinely deep and equitable learning.

8. References

- Biggs, J., & Tang, C. (2011). *Teaching for Quality Learning at University. What the Student Does* (4th ed.). McGraw-Hill Education.
- Bond, M., Bedenlier, S., Marín, V. I., & Händel, M. (2021). Emergency remote teaching in higher education: Mapping the first global online semester. *International Journal of Educational Technology in Higher Education*, 18(1), 1–24. <https://doi.org/10.1186/s41239-021-00282-x>
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340. <https://doi.org/10.2307/249008>
- Davis, F. D. (1993). User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. *International Journal of Man-Machine Studies*, 38(3), 475-487.
- Debets, T., Banihashem, S. K., Joosten-ten Brinke, D., Vos, T. E. J., Maillette de Buy Wenniger, G., & Camp, G. (2025). Chatbots in education: A systematic review of objectives, underlying technology and theory, evaluation criteria, and impacts. *Computers & Education*, 234, 105323. <https://doi.org/10.1016/j.compedu.2025.105323>
- Deci, E. L., & Ryan, R. M. (2008). Self-Determination Theory: A Macrotheory of Human Motivation, Development, and Health. *Canadian Psychology*, 49(3), 182-185. <https://doi.org/10.1037/a0012801>
- El-Sisi, S. A. (2025). Behavioral Intention to Use AI-Chatbot among University Tourism Students: The Mediating Role of Learning Motivations. *International Journal of Tourism, Archaeology, and Hospitality (IJTAH)*, 5(1), 1-19. <https://doi.org/10.21608/IJTAH.2025.344530.1139>
- Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School Engagement: Potential of the Concept, State of the Evidence. *Review of Educational Research*, 74(1), 59-109.
- Graesser, A. C., Conley, M. W., & Olney, A. (2012). Intelligent tutoring systems. In K. R. Harris, S. Graham, & T. Urdan (Eds.), *APA educational psychology handbook: Vol. 3. Application to learning and teaching* (pp. 451–473). American Psychological Association. <https://doi.org/10.1037/13275-018>
- Hsiao, H., Wang, P., & Lu, S. (2018). Using the Technology Acceptance Model to Analyze the Learning Outcome of Open Education Resources. *Chinese Business Review*, 17(9), 479-487. <https://doi.org/10.17265/1537-1506/2018.09.004>
- Jeno, L. M., Danielsen, A. G., & Raaheim, A. (2018). A prospective investigation of students' academic achievement and dropout in higher education: a Self-Determination Theory approach. *Educational Psychology*, 38(9), 1163-1184. <https://doi.org/10.1080/01443410.2018.1502412>
- Kemp, A., Palmer, E., Strelan, P., & Thompson, H. (2024). Testing a novel extended educational technology acceptance model using student attitudes towards virtual classrooms. *British Journal of Educational Technology*, 55(5), 2110–2131. <https://doi.org/10.1111/bjet.13440>
- Kuh, G. D. (2009). *The National Survey of Student Engagement: Conceptual and empirical foundations*. New Directions for Institutional Research, 141, 5-20. <https://doi.org/10.1002/ir.283>

- Kuh, G. D., Kinzie, J., Buckley, J. A., Bridges, B. K., & Hayek, J. C. (2006). What Matters to Student Success: A Review of the Literature. National Postsecondary Education Cooperative.
- Kyndt, E., Dochy, F., Struyven, K., & Cascallar, E. (2011). The direct and indirect effect of motivation for learning on students' approaches to learning through the perceptions of workload and task complexity. *Higher Education Research & Development*, 30(2), 135-150. <https://doi.org/10.1080/07294360.2010.501329>
- McGrath, C., Farazouli, A., & Cerratto-Pargman, T. (2024). Generative AI chatbots in higher education: A review of an emerging research area. *Higher Education*, 89(6), 1533–1549. <https://doi.org/10.1007/s10734-024-01288-w>
- Niemiec, C. P., & Ryan, R. M. (2009). Autonomy, competence, and relatedness in the classroom: Applying self-determination theory to educational practice. *Theory and Research in Education*, 7(2), 133-144. <https://doi.org/10.1177/1477878509104318>
- Pérez, J. Q., Daradoumis, T., & Puig, J. M. M. (2020). Rediscovering the use of chatbots in education: A systematic literature review. *Computer Applications in Engineering Education*, 28(6), 1549–1565. <https://doi.org/10.1002/cae.22326>
- Pérez-Marín, D. (2021). A review of the practical applications of pedagogic conversational agents to be used in school and university classrooms. *Digital*, 1(1), 18–33. <https://doi.org/10.3390/digital1010002>
- Pintrich, P. R. (2004). A Conceptual Framework for Assessing Motivation and Self-Regulated Learning in College Students. *Educational Psychology Review*, 16(4), 385-407.
- Ryan, R. M., & Deci, E. L. (2000). Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being. *American Psychologist*, 55(1), 68-78.
- Smutny, P., & Schreiberova, P. (2020). Chatbots for learning: A review of educational chatbots for the Facebook Messenger. *Computers & Education*, 151, 103862. <https://doi.org/10.1016/j.compedu.2020.103862>
- Susilawati, E., Ekalestari, S., Chairina, Khaira, I., Harahap, E. S., Kesuma, S., & Mardiana, N. (2025). Analysis of the Technology Acceptance Model (TAM) in the implementation of the curriculum review course: A study on students' understanding and acceptance of technology at Universitas Islam Sumatera Utara. *International Journal on E-Learning and Higher Education*, 20(2), 19–39.
- Sweller, J., van Merriënboer, J. J. G., & Paas, F. G. W. C. (1998). Cognitive architecture and instructional design. *Educational Psychology Review*, 10(3), 251–296. <https://doi.org/10.1023/A:1022193728205>
- Tinto, V. (2012). *Completing college: Rethinking institutional action*. University of Chicago Press.
- Winkler, R., & Söllner, M. (2018). Unleashing the potential of chatbots in education: A state-of-the-art analysis [Paper presentation]. Academy of Management Annual Meeting (AOM), Chicago, IL, United States.
- Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education — where are the educators? *International Journal of Educational Technology in Higher Education*, 16(1), 39. <https://doi.org/10.1186/s41239-019-0171-0>
- Zimmerman, B. J. (2002). Becoming a Self-Regulated Learner: An Overview. *Theory Into Practice*, 41(2), 64-70.

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10. Author declaration

The authors confirm that this manuscript is original, has not been published previously and is not under consideration for publication elsewhere.

The authors declare that they have no conflicts of interest.