DOI
https://doi.org/
10.18690/um.fov.4.2025.11

ISBN
978-961-286-998-4

Technological Frames and Learning Experiences: Students' Interpretations of Rule-Based Chatbots in Higher Education

Merja Alanko-Turunen, Olli-Jaakko Kupiainen, Mari Raaska

Haaga-Helia University of Applied Sciences, Helsinki, Finland
merja.alanko-turunen@haaga-helia.fi, olli.kupiainen@haaga-helia.fi,
mari.raaska@haaga-helia.fi

This study examines how students construct technological frames of rule-based chatbots and how these frames relate to their learning experiences, particularly information processing and reflection. This research is grounded in the social construction of technology and technological frames theory. Semi-structured interviews were conducted with 45 undergraduate students at a University of Applied Sciences. Through thematic analysis, three distinct technological frames were identified: collaborative, completion-driven, and unhelpful. Each frame was found to shape how chatbot technology was engaged with and integrated into students' learning processes. This study extends technological framing theory to the educational field, linking technological frames to students' learning experiences. We also provide an empirically grounded framework that helps understand student learning experiences within chatbot-supported learning environments. This research contributes to an understanding of how interpretations of technology construct educational experiences and emphasizes the critical relationship between pedagogy and technology.

Keywords:
rule-based chatbot,
technological frame,
educational technology,
learning experience,
higher education

University of Maribor Press

1 Introduction

Chatbots have become an increasingly common feature in higher education, offering students structured learning support and facilitating interactions in online environments (Følstad et al., 2019; Kuhail et al., 2023; Labadze et al., 2023; Okonkwo & Ade-Ibijola, 2021; Wollny et al., 2021). While AI-driven chatbots are now widely available in higher education (Almogren et al., 2024; Ayanwale & Ndlovu, 2024; Stöhr et al., 2024; Tlili et al., 2023) rule-based chatbots are still relevant because their structured design efficiently guides students through pre-defined learning paths, while allowing learners also to take ownership of their educational journey. Rule-based chatbots empower students to engage with course material at their own pace, in their preferred location, and at times that best suit their individual learning, offering the opportunity for a more personalized learning experience (e.g. Vanichvasin, 2021; Winkler & Söllner, 2018).

Rule-based chatbots have been utilized in higher education in various ways. They support students' goal setting and social presence in online learning (Hew et al., 2023) and provide personalized guidance tailored to individual learning needs (Papakostas et al., 2024). Research shows that rule-based chatbots have been used in language teaching (Fryer et al., 2018; Lee et al., 2020) and they have had a positive impact on learning outcomes in science education (Yin et al., 2020). However, it is important to note that rule-based chatbots are typically rigid communication systems operating strictly through predefined scripts. As a result, they are not particularly "intelligent" and cannot answer questions they were not programmed to answer (Adamopoulou & Moussiades, 2020; Kohnke et al., 2023).

Integration of new technologies into educational settings inevitably transforms students' learning experiences; it represents an interconnected, co-evolving phenomenon arising from complex social, technological, and pedagogical interactions (Anderson, 2016; Marell-Olsson & Jahnke, 2019). The rule-based chatbots in this study were designed to support the constructivist learning approach by scaffolding learners' active knowledge construction and integration of new concepts with existing knowledge. More importantly, the role of the rule-based chatbots was to promote reflection during learning (Kirkwood & Price, 2013).

While the widely used Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) explain why students adopt chatbots (e.g. Al-Abdullatif, 2023; Güldal & Dinçer, 2024; Malik et al., 2021; Strzelecki, 2024), they do not capture how students interpret and integrate them into their actual study practices. These models fail to address how students' framing of chatbot technology influences their theoretical understanding and practical way of utilizing these applications. To explore this, our research question *was how students construct technological frames of rule-based chatbots, and how these frames relate to their learning experiences, especially information processing and reflection.*

Data was collected through semi-structured interviews with 45 undergraduate students. We investigated how students actively constructed and framed (Orlikowski & Gash, 1994) rule-based chatbots. This approach allows us to highlight the constructive dynamics that shape technology adoption in educational settings.

Our findings highlight three technological frames for chatbot interaction: collaborative, completion-driven, and unhelpful. While some students engaged collaboratively, others approached chatbots superficially or found them technologically limited. This study extends technological framing theory to the educational field, linking technological frames to students' learning experiences. We also provide an empirically grounded framework that helps understand student learning experiences within chatbot-supported learning environments. This suggests that effective educational chatbots must align with student expectations and learning experiences, while incorporating more adaptive features. The study emphasizes student's active role in educational technology adoption.

2 Theoretical Background

2.1 Technological frames

The social construction of technology (SCOT) is one of the constructivist ways of studying science and technology. It provides a theoretical framework for understanding the relationship between society and technology (Bijker, 2001). The significance of SCOT for our research is important as it challenges the assumption of technological determinism by offering an alternative perspective: technology alone does not determine human behaviour. Instead, technology is culturally shaped and interpreted through processes involving multiple actors with their own interests and agendas (e.g. Silverstone, 2006). This perspective is complemented by the concept of technological framing, which emphasizes that interpretive frames of technology can change as individuals engage with applications in particular contexts, rather than being predetermined by the features of the technology (Davidson & Pai, 2004). These two perspectives enable our research to analyse the social construction of technology and the users' interpretive framings.

Individuals' experiences, resources, expectations and beliefs about technology can lead to different technological interpretations (Treem et al., 2015). Technological framings are central to structuring individuals' experiences, interpreting ambiguous situations, and reducing uncertainty. They provide a basis for action in changing circumstances (Lin & Silva, 2005).

Technological applications shape learning experiences through their affordances (Conole & Dyke, 2004; Van Osch & Mendelson, 2011). Affordance as a concept originates from ecological psychology, where it refers to the possibilities for action that the environment offers to the agent (Gibson, 2014). The concept has been extended to the field of design, distinguishing between real and perceived affordances (Norman, 1999). According to Gaver (1991), technological affordances are both social and material constructions (see also Selwyn, 2012), which relates directly to the framework of our study on the social construction of technology. Students actively interpret and adapt these affordances to serve their learning needs and contexts (Oliver, 2013; Squire & Dikkers, 2012).

Technological frames (Orlikovski & Gash, 1994; Kaplan & Tripsas, 2008; Spieth et al., 2021) are cognitive structures that individuals and groups use to understand and make sense of technology. Their studies emphasized the importance of making sense of new technologies in business organizations. Our study builds on these perspectives on technological framing, examining how students apply these frames in higher education. For example, when examining how students frame technological applications, focus can be placed on how they interpret the nature of technology (Orlikowski & Gash, 1994). Technology can be perceived as a learning enabler when students recognize its role in achieving learning outcomes. Additionally, students' assumptions, expectations, and prior user experiences shape their technology-in-use, influencing how different technological applications are actively utilized for learning (Orlikowski & Gash, 1994). For example, a student may use an application as a ready-made stimulus for learning or simply as a content provider. Students rely on their technological frames to interpret technology's functionality and assess its implications (cf. Treem et al., 2015).

A recent study examined how students framed a mobile interaction application designed to engage them during online lectures. They largely rejected the application, describing it as inappropriate for the context, socially uncomfortable and an unacademic way of learning (Drew & Mann, 2018). In contrast, another study found that students valued mobile devices as learning aids for quickly accessing information and engaging on social networks. Mobile devices empowered students to work efficiently and achieve their goals through collaboration with peers, teachers, and employers (Squire & Dikkers, 2012). Social and technical factors influence how students frame technology, and these frames evolve through experience and reflection, particularly in group work (Bjørn et al., 2006). Thus, prior research highlights the diversity and contextual dependency of technology framing.

2.3 Integrating educational technology and learning experience in this study

Learning experiences, inherently intertwined with technology in contemporary education, have been examined through diverse theoretical lenses (Anderson, 2016; Jahnke, 2023; Shrerer et al., 2019). In this study, we define a learning experience as the multifaceted technology-mediated interactions between learners, content, educators, and peers that facilitate information processing, skill development, and reflection while promoting attitudinal and personal growth (Liu et al., 2023). Furthermore, Chen et al. (2018) emphasize that the perception of a learning experience is influenced by learners' personal epistemologies, their sense of competency, self-efficacy beliefs, and attitudes toward learning.

We assigned three pedagogical roles to the rule-based chatbots: they served as a learning assistant to enhance information processing and reflection (Wollny et al., 2021), a teaching assistant to engage students (Kuhail et al., 2023) and a provider of feedback to students. On the technological side, the chatbot relied on chatbot-driven conversations, meaning that the chatbot controls the flow of the conversations (Kuhail et al., 2023). We built the chatbots on *Landbot.pro* which is an intuitive nocode conversational chatbot builder. External technological expertise was required to develop a pedagogical script to ensure a balanced learning experience encompassing content, user experience, and social interaction (e.g. Huhtanen, 2020). Subsequently, the chatbots were piloted with students.

Designing for learning involves creating scripts and scaffolds that shape learners' activity. These scaffolds influence how activity unfolds, while the activity itself continuously modifies and reconstructs the learning environment (Goodyear & Dimitriadis, 2013). While designing the content, we focused on practically applicable material. This was achieved by incorporating brief videos in which an educator explained the core content and then encouraged students to apply and reflect on its meaning in relation to their own experiences. We designed the content and user experience to feature interactive chatbot conversations with both open-ended and multiple-choice questions (cf. Kuhail et al., 2023). We created learning activities for the students to do (Figure 1) during the session with the chatbot (e.g. students reflected their project planning competences after watching the educator's video of topic). However, what the students do with the activities may diverge from what we intended—since students often engage with tasks in ways that reflect their own interpretations and preferences (e.g. Goodyear et al., 2021; Ellis & Goodyear, 2010).

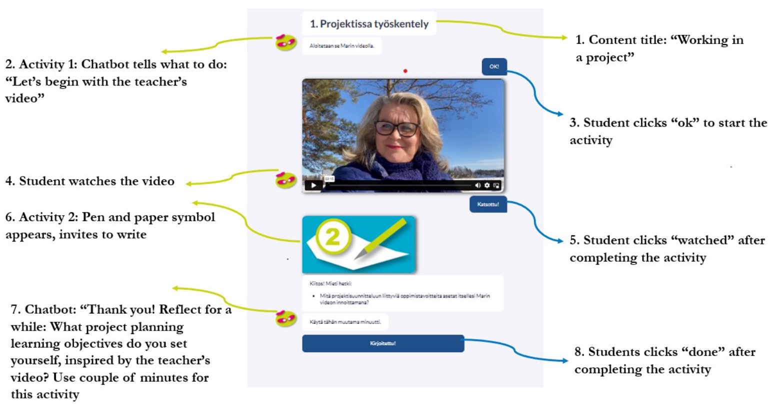

Figure 1: Joors Truli ("Yours truly" in English) chatbot

When designing the social experience, we aimed to enhance student motivation and engagement. To achieve this, we used a conversational style and everyday language to guide students, while the chatbot also asked clarifying questions (Følstad et al., 2019; Kim et al., 2019). Additionally, the chatbot facilitated participation experiences, providing students with opportunities to engage in meaningful conversations while receiving guidance (Chang et al., 2023; Lin & Chang, 2023). For example, in one chatbot conversation, students reflected on their project work priorities and connected their insights to previously studied Belbin team roles

3 Methodology

3.1 Research context

Our interpretative study explores how undergraduate business students of a University of Applied Sciences frame educational technology and how the framing relates to their learning experiences, especially their information processing and reflection. The courses (5 ECTS each) were a mandatory *Teamwork and Project Skills* and an elective *Leadership Skills*. Students engaged in online interactions with a rule-based chatbot on the Moodle learning platform as part of their required course work; these interactions formed the basis for their subsequent reflective essays. The chatbots addressed one specific theme in each course – developing teamwork and project planning skills in the former, and the latter introduced team leader's role in advancing team members' work well-being (cf. Lindebaum, 2024). These themes are important because as modern workplaces require understanding of teamwork components (Salas et al., 2015) and higher education students need leadership practice (Siewiorek et al., 2012).

3.1 Participants and data collection

We interviewed 45 voluntary students who had used chatbots in their courses in the spring of 2023. Participant recruitment was conducted via announcements on the Moodle platform. The semi-structured interview questionnaire was inspired by the Metacognitive Awareness Inventory (MAI) (Schraw & Dennison, 1994) which builds on Flavell's (1979) metacognition theory. The operationalization through MAI examined cognitive dimensions by exploring how students constructed understanding of chatbot effects on their information processing. Skill-related dimensions focused on students' goal setting, planning, and strategic integration of chatbots into personalized learning. Attitudinal dimensions interpreted how students reflected on chatbot utility and constructed their perspectives on these tools as learning support.

Interviews were conducted using MS Teams application, which allowed us to take an advantage of automatic transcription feature. Interviews were conducted by a course educator from the research team and an experienced external educator. All the interviews lasted between 15 and 25 minutes and followed a semi-structured format. To ensure anonymity, informants' personal information was removed from the transcripts. A short summary was added at the beginning of each transcript to guide the subsequent analysis of the interviews.

3.2 Analysis process

Our thematic analysis was informed by Braun and Clarke (2006). The analysis was iterative and collaborative, involving regular reflective discussions throughout the process. In the initial discussions about the research material, we observed that students' interpretations of technology varied. Some students criticized its functionality, others highlighted the importance of peer interaction in classrooms, and many felt that educational technology supported their learning. Our discussions were critical in understanding the data from a theoretical perspective (Carlsson, 2023) eventually formalizing our understanding of students' technological frames (Orlikowski & Gash, 1994) and their learning experiences. We identified key themes, e.g., a positive learning experience students had with the chatbots. We then consulted literature and decided to focus on our analysis especially on the nature of technology and technology-in-use (Orlikowski & Gash, 1994) as well as to students learning experiences. Table 1 illustrates the coding process which we explain below.

We reconvened to discuss our insights and findings, which allowed us to identify three overarching themes of technological frames. Those were collaborative thinking frame, completion-driven frame and unhelpful frame. Subsequently, we proceeded with independent coding for the remaining data. Finally, we integrated our coding, using Atlas.ti co-occurrence analysis. It helped us discuss to form a joint understanding of different technological frames and what kind of learning experiences they entailed.

Table 1: Illustrative example of analytical process

Quote (Student # 14)	Initial coding	Themes	Technological framing
It guided well; At first there was some theory and then you had to write down and really think about and you really had to do it yourself […]. It was nice that there were tasks throughout the discussion. It was for yourself, and you had to be able to understand the most important competencies. Then (using pen and paper) you had to write it down.	Chatbot guides; chatbot is a content provider; learning as an active process; learning as a reflective process; self-paced learning; relationship with technology is positive	Relationship with chatbot is constructed positively and it enables learning by providing guidance and content that a learner must actively process	Collaborative thinking frame

4 Findings and discussion

The collaborative thinking frame refers to the way students interpret their interactions with the chatbot, leading to the development of a positive relationship. This relationship emerged as students actively constructed new understandings through dialogue with the chatbot, which provided prompts that facilitated their reflective thinking processes. For example, students felt as though the chatbot was thinking alongside them, motivating them to engage more deeply with the learning material. One student described this experience as follows: *Well, it helped me a lot because I am bad at concentrating […] it always stopped me, and I just could not run through the material […] especially when it asked me what I was thinking about some things (the course material) […] it encouraged me to process it much deeper* (Student #8).

The chatbots served as scaffolding tools that enabled students to actively reconstruct their learning objectives beyond the interaction with the chatbot: *I refined my learning objectives during the chatbot and after that as well. Perhaps I had too superficial learning objectives originally for the course. Chatbot made to sharpen my personal goals (of the course).* (Student #26). More importantly, the chatbot's pedagogically formulated open questions facilitated a collaborative thinking frame by guiding discussions that included course content. This combination of questions and guidance helped students learn and encouraged them to actively reflect on their experiences in relation to the course material. One student explained this experience as follows: *When the chatbot asked the right kind of questions (about project management and teamwork) that you really had to think about—not just yes and no questions (closed questions)—it made me reflect more deeply. The* *chatbot also provided information before I had to answer those questions, which helped me understand the material better.* (Student #5). Therefore, in educational contexts, students actively construct technological interpretations, which both shape and are shaped by their engagement with intended learning outcomes. A student's refinement of learning goals following chatbot engagement suggests the evolution of technological frames beyond static mental models. As Kaplan and Tripsas (2008) observe, these frames initially emerge from user assumptions but undergo modification through continued interaction. The chatbot's pedagogically structured questions provided scaffolding that enabled students to reconstruct their technological frames in ways that enhanced their educational experience. *I think it was a good system […]so it kind of helped in that way, also in terms of learning* (Student #3).

Students actively constructed interpretations of the chatbot as a collaborative thinking partner through their technological frames (Orlikovski & Gash, 1994). The chatbot's interventions promoted engagement with learning materials. *I started to think somethings I've learned on this course […] then I realized that maybe I want to read about (course materials) before I do the report* (Student #22). This collaborative thinking frame enabled the students to externalize their thinking processes. The chatbot's overall questioning strategy was able to facilitate reflection, demonstrating how this technological frame support metacognitive processes.

Possible factors contributing to the collaborative thinking frame could include that students with strong self-regulatory behaviour are more likely to engage in collaborative activities (Scager et al., 2017) even when using technological applications (Sharma et al., 2024). Such students may find chatbot interaction intellectually stimulating rather than disruptive to their learning process. Students with positive prior technological experiences may also be more inclined to perceive chatbot interactions as beneficial (e.g., Pesonen, 2021).

The completion driven frame characterizes how students develop an instrumental relationship with chatbots, using them primarily as information retrieval tools rather than learning partners. This frame emerged when students approached chatbots as content delivery mechanisms, focusing on extracting course-related information rather than engaging in learning processes. For example, some students recalled videos that were embedded in the chatbots, without further reflection: *There were* *videos, which told some of the course content. It told me facts throughout the discussion.* (Student #21)

When another student was asked how the chatbot helped to think of what one should learn about project management, initially s/he responded and later emphasized the utility function of the chatbot: *How projects work from the beginning to the end. How and when goals should be set […] Why budget is important, and you need to know your own skills and groups' skills […] That piece of information (course content) was useful. At least I can concentrate on things (skills) that require most developing.* (Student #16)

In the completion driven frame, clicking to the next step was import: *(Through questions) I was able to think what I should learn about project work […] when you clicked one option, it explained it.* (Student #18). Although the chatbots provided valuable information, the students typically approached their tasks with a focus on completion rather than genuine learning. The following quote demonstrates this: *I kind of felt as we still must write one more report for the course, where we need to comment on the chatbot we reviewed […] It seemed something like that affected the assignment. It was clear that this might be something to keep in mind and made me definitely feel maybe this is something that matters.* (Student #7)

The completion driven frame illustrates a different kind relationship between technological frames (Orlikowski & Gash, 1994). Our analysis shows these students typically approached the chatbots with a practical, utilitarian mindset. They saw these rule-based chatbots mainly as ways to access information rather than as partners in the learning process. This completion-driven frame heavily influenced how they understood and used the technology in their studies.

Their framing revealed a perception of chatbots as offering fixed, linear paths through pre-set content—a rigid tool with set procedures rather than an adaptive system capable of responsive engagement. References to "clicking" through options highlight their mechanical understanding of the learning.

Students might adopt this completion-driven approach due to practical pressures. Time constraints and course structures encourage quick answers over deep engagement. When educational technology is framed by students as merely a content delivery system rather than a collaborative medium, their engagement naturally follows this limiting perception. *At the beginning, I set myself the goal of passing the course, and it (chatbot) certainly helped* (Student # 4). The background in traditional education, combined with assessment methods that reward specific knowledge rather than exploration, could reinforce this task-oriented behaviour.

The unhelpful frame refers to the way students interpret their interactions with the chatbot, contributing to the development of a somewhat negative relationship. This relationship emerged when students paid attention to the technological shortcomings, and not realizing the meaningful course content or the provided learning affordances (Van Osch & Mendelson, 2011). Some students compared the chatbots with more advanced technologies, expecting more guidance as illustrated by the following quote: *I'd say it didn't help. […] Other chatbots were much better, for example ChatGPT, which I've used quite actively when writing essays and other things. It didn't really give any feedback, which would have been useful […] It just matches definitions to the text. So, in my opinion, you did not get any particularly good feedback and constructive criticism from it.* (Student # 33)

When students focused on the technological features, such as using "stars" to identify the most meaningful content for themselves in each section of the chatbot, they missed opportunities to reflect on the course material. The following example illustrates this: *I feel that I did not reflect much what I should do. By using stars, it was done badly. I went those sections through quickly, and you don't think about them.* (Student #19)

The unhelpful frame of chatbots was marginal in our study. In this frame, students constructed technological frames around the technological user experience, focusing on its shortcomings and comparing it to more advanced technologies. This reveals a clear incongruence (Orlikowski & Gash, 1994) between our learning design intentions and students' interpretations. While the chatbots were designed as tools for reflection to deepen engagement with course material, students primarily focused on the technological interface itself rather than the affordances (Gaver, 1991; Norman, 1999) it provided. Arguably, this attention to technological limitations overshadowed educational benefits, with students evaluating the technology rather than engaging with course concepts, leading to limited perceived learning value. These findings suggest that effective educational technology implementation requires careful alignment between technological design, pedagogical learning outcomes, and student expectations to avoid superficial engagement.

5 Conclusions

This study shows how students' technological frames (Orlikowski & Gash, 1994) function as active interpretive structures through which they process information and reflect on their learning in individualized ways (Chen et al., 2018; Li & Xiu, 2023), thereby forming learning experiences within social and technological contexts (Huhtanen, 2020). Educational technology affordances—the action possibilities they offer (Norman, 1999) —mediate how students' technological frames translate into their learning, either amplifying or limiting engagement based on alignment with their framings (Treem et al., 2015).

From a theoretical perspective, the study advances the understanding of technological frames (Orlikowski & Gash, 1994) in higher education by illustrating how these frames mediate students' learning experiences. It reinforces the idea that technology is not a neutral medium but is shaped by pedagogical contexts and user interactions (Fawns, 2022; Oliver, 2011). This study extends technological framing theory to the educational field, linking technological frames to students' learning experiences. We also provide an empirically grounded framework that helps understand student learning experiences within chatbot-supported learning environment. These findings suggest that effective educational technology implementation requires careful alignment between technological design, pedagogical learning outcomes, and student expectations to foster meaningful engagement (Li & Xue, 2023; Liu et al., 2023.) rather than superficial interaction.

In practical terms, chatbot design should aim to align closely with students' expectations and learning experiences. AI-driven chatbots need enhanced adaptability and context-awareness to foster meaningful engagement. As Treem et al. (2015) have demonstrated, individuals' experiences, resources, expectations, and beliefs about technology lead to different technological interpretations. Therefore, educational technologies should not merely serve as content delivery mechanisms but actively support collaborative and engaging learning experiences.

Despite its contributions into rule-based chatbot integration into business education, our study has generalizability limitations due to its social science focus and single-institution sample (Polit & Beck, 2010). While statistical generalization is unattainable (e.g. Lee & Baskerville, 2003), the research offers theoretical transferability through its identified frames (Orlikowski & Gash, 1994). Future research should explore diverse institutional settings, academic disciplines, and technological contexts (including comparative analyses of rule-based versus AI-driven chatbots), employ longitudinal tracking to assess frame evolution, and address these limitations to enhance theoretical robustness (Williams, 2000) and pedagogical understanding of rule-based chatbot integration in higher education.

Acknowledgements

We want to sincerely thank our colleague Heli Bergström for her invaluable contributions and active engagement throughout the development and research process of the chatbots. Her insights and collaboration were important in shaping this paper.

References

Adamopoulou, E., Moussiades, L. (2020). Chatbots: History, technology, and applications. Machine Learning with Applications, *2*, 100006. https://doi.org/10.1016/j.mlwa.2020.100006

Al-Abdullatif, A. M. (2023). Modeling students' perceptions of chatbots in learning: Integrating technology acceptance with the value-based adoption model. Education Sciences, *13*(11), 1151. https://doi.org/10.3390/educsci13111151

Almogren, A. S., Al-Rahmi, W. M., & Dahri, N. A. (2024). Exploring factors influencing the acceptance of ChatGPT in higher education: A smart education perspective. Heliyon, *10*(11), e31887. https://doi.org/10.1016/j.heliyon.2024.e31887

Anderson, T. (2016). Theories for learning with emerging technologies. In G. Veletsianos (Ed.), Emergence and Innovation in Digital Learning: Foundations and Applications (pp. 35-50). Edmonton, AB: Athabasca University Press.

Ayanwale, M. A., Ndlovu, M. (2024). Investigating factors of students' behavioral intentions to adopt chatbot technologies in higher education: Perspective from expanded diffusion theory of innovation. Computers in Human Behavior Reports, 14, 100396. https://doi.org/10.1016/j.chbr.2024.100396

Bijker, W. E. (2001). Understanding technological culture through a constructivist view of science, technology, and society. In S. H. Cutcliffe & C. Mitcham (Eds.), Visions of STS. Counterpoints in science, technology, and society studies (pp. 19–34).

Bjørn, P., Scupola, A. & Fitzgerald, B. (2007) Expanded technological frames towards mediated collaboration: groupware adoption in virtual learning teams, Scandinavian Journal of Information Systems, Vol 18, No, 2, pp. 28-47

Braun, V., Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Carlsson, L. (2023). Strategizing organizational capabilities for industrial digitalization – exploring managers' technological frames. Journal of Manufacturing Technology Management, *34*(9), 20–39. https://doi.org/10.1108/JMTM-07-2022-0252

Chang, D.H., Lin, M.P.-C., Hajian, S., & Wang, Q.Q. (2023). Educational design principles of using AI chatbot that supports self-regulated learning in education: Goal setting, feedback, and personalization. Sustainability, 15, 12921. https://doi.org/10.3390/su151712921

Chen, J., Wang, M., Kirschner, P. A., & Tsai, C.-C. (2018). The role of collaboration, computer use, learning environments, and supporting strategies in CSCL: A meta-analysis. Review of Educational Research, 88(6), 799–843. https://doi.org/10.3102/0034654318791584

Conole, G., Dyke, M. (2004). What are the affordances of information and communication technologies? 12(2). https://doi.org/10.1080/0968776042000216183

Davidson, E., Pai, D. (2004). Making sense of technological frames: Promise, progress, and potential. In B. Kaplan, D. P. Truex, D. Wastell, A. T., Wood-Harper, & J. I. DeGross (Eds.), Information Systems Research. IFIP International Federation for Information Processing, https://doi.org/https://doi.org/10.1007/1-4020-8095-6_26

Drew, C., Mann, A. (2018). Unfitting, uncomfortable, unacademic: a sociological reading of an interactive mobile phone app in university lectures. International Journal of Educational Technology in Higher Education, 15(43). https://doi.org/10.1186/s41239-018-0125-y

Ellis, R., Goodyear, P. (2010). Students' experiences of e-learning in higher education: The ecology of sustainable innovation. Routledge.

Fawns, T. (2022). An entangled pedagogy: Looking beyond the pedagogy-technology dichotomy introduction: Moving past the technology-pedagogy dichotomy. Postdigital Science and Education. https://doi.org/10.1007/s42438-022-00302-7

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry. American Psychologist, *34*(10), 906–911. https://doi.org/10.1037/0003-066X.34.10.906

Fryer, L. K., Nakao, K., & Thompson, A. (2018). Chatbot learning partners: Connecting learning experiences, interest and competence. Computers in Human Behavior, 93, 279–289. https://doi.org/10.1016/j.chb.2018.12.023

Følstad, A., Skjuve, M., & Brandtzaeg, P. B. (2019). Different chatbots for different purposes: Towards a typology of chatbots to understand interaction design. Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 11551 LNCS, 145–156. https://doi.org/10.1007/978-3-030-17705-8_13

Gaver, W. W. (1991). Technology affordances. In Conference on Human Factors in Computing Systems - Proceedings (pp. 79-84) https://doi.org/10.1145/108844.108856

Gibson, J. J. (2014). The ecological approach to visual perception. Houghton Mifflin.

Goodyear, P., Carvalho, L., & Yeoman, P. (2021). Activity-centred analysis and design (ACAD): Core purposes, distinctive qualities and current developments. Educational Technology Research and Development, 69(2), 445-464. https://doi.org/10.1007/s11423-020-09926-7

Goodyear, P., Dimitriadis, Y. (2013). In medias res: Reframing design for learning. In Research in Learning Technology Vol. 21, 1. Association for Learning Technology. https://doi.org/10.3402/rlt.v21i0.19909

Güldal, H., Dinçer, E. O. (2024). Can rule-based educational chatbots be an acceptable alternative for students in higher education? Education and Information Technologies. https://doi.org/10.1007/s10639-024-12977-5

Hew, K. F., Huang, W., Du, J., & Jia, C. (2023). Using chatbots to support student goal setting and social presence in fully online activities: Learner engagement and perceptions. Journal of Computing in Higher Education, 35(1), 40-68. https://doi.org/10.1007/s12528-022-09338-x

Huhtanen, A. (2019) Verkko-oppimisen muotoilukirja & Oppimismuotoilun työkalupakki [The design book for online learning]. Avointen oppimateriaalien kirjasto. https://urn.fi/urn:nbn:fi:oerfi-202209_00022860_4

Jahnke, I. (2023). Quality of digital learning experiences – effective, efficient, and appealing designs? The International Journal of Information and Learning Technology, 40(1), 17–30. https://doi.org/10.1108/IJILT-05-2022-0105

Kaplan, S., Tripsas, M. (2008). Thinking about technology: Applying a cognitive lens to technical change. Research Policy, *37*, 790–805. https://doi.org/10.1016/j.respol.2008.02.002

Kim, S., Lee, J., & Gweon, G. (2019). Comparing data from chatbot and web surveys: Effects of platform and conversational style on survey response quality. In CHI '19: Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (Paper No. 86, pp. 1-12). Association for Computing Machinery. https://doi.org/10.1145/3290605.3300316

Kirkwood, A., & Price, L. (2013). Technology-enhanced learning and teaching in higher education: What is 'enhanced' and how do we know? A critical literature review. Learning, Media and Technology, 39(1). https://doi.org/10.1080/17439884.2013.770404

Kohnke, L., Moorhouse, B. L., & Zou, D. (2023). ChatGPT for language teaching and learning. RELC Journal, 54(2), 537–550. https://doi.org/10.1177/00336882231162868

Kuhail, M. A., Alturki, N., Alramlawi, S., & Alhejori, K. (2023). Interacting with educational chatbots: A systematic review. Education and Information Technologies, 28(1), 973–1018. https://doi.org/10.1007/s10639-022-11177-3

Labadze, L., Grigolia, M., & Machaidze, L. (2023). Role of AI chatbots in education: systematic literature review. International Journal of Educational Technology in Higher Education, 20(1), 56. https://doi.org/10.1186/s41239-023-00426-1

Lee, A. S., Baskerville, R. L. (2003). Generalizing generalizability in information systems research. Information Systems Research, 14(3), 221-243. https://doi.org/10.1287/isre.14.3.221.16560

Lee, J. H., Yang, H., Shin, D., & Kim, H. (2020). Chatbots. ELT Journal, 74(3), 338–344. https://doi.org/10.1093/elt/ccaa035

Li, J., Xue, E. (2023). Dynamic interaction between student learning behaviour and learning environment: Meta-analysis of student engagement and its influencing factors. Behavioural Sciences, 13(1), 59. https://doi.org/10.3390/bs13010059

Lin, M. P.-C., Chang, D. (2023). CHAT-ACTS: A pedagogical framework for personalized chatbot to enhance active learning and self-regulated learning. Computers and Education: Artificial Intelligence, 5, Article 100167. https://doi.org/10.1016/j.caeai.2023.100167

Lin, A., Silva, L. (2005). The social and political construction of technological frames. European Journal of Information Systems, 14(1), 49–59. https://doi.org/10.1057/palgrave.ejis.3000521

Lindebaum, D. (2024). Management learning and education as "big picture" social science. Academy of Management Learning & Education, 23(1), 1–7. https://doi.org/10.5465/amle.2023.0173

Liu, Y., Morard, S., Adinda, D., Sanchez, E., Trestini, M., Trestini, M. A., & Liu, Y.-D. (2023). A Systematic Review: Criteria and Dimensions of Learning Experience. https://hal.science/hal-04264325v1

Malik, R., Shrama, A., Trivedi, S., & Mishra, R. (2021). Adoption of chatbots for learning among university students: Role of perceived convenience and enhanced performance. *International* Journal of Emerging Technologies in Learning (IJET), 16(18), 200. https://doi.org/10.3991/ijet.v16i18.24315

Marell-Olsson, E., Jahnke, I. (2019). Wearable technology in a dentistry study program: Potential and challenges of smart glasses for learning at the workplace. In I. Buchem, R. Klamma, & F. Wild (Eds.), Perspectives on wearable enhanced learning (WELL) (pp. 433-451). Springer.

Norman, D. A. (1999). Affordance, conventions, and design. interactions, 6(3). https://doi.org/10.1145/301153.301168

Okonkwo, C. W., Ade-Ibijola, A. (2021). Chatbots applications in education: A systematic review. Computers and Education: Artificial Intelligence, 2, 100033. https://doi.org/10.1016/j.caeai.2021.100033

Oliver, M. (2011). Technological determinism in educational technology research: Some alternative ways of thinking about the relationship between learning and technology. Journal of Computer Assisted Learning, 27(5), 373–384. https://doi.org/10.1111/j.1365-2729.2011.00406.x

Oliver, M. (2013). Learning technology: Theorising the tools we study. *British Journal of Educational Technology*, *44*(1), 31–43. https://doi.org/10.1111/j.1467-8535.2011.01283.x

Orlikowski, W. J. & Gash, D. C. (1994). Technological frames: Making sense of information technology in organizations. ACM Transactions on Information Systems, 12(2), 174–207. https://doi.org/https://doi.org/10.1145/196734.196745

Papakostas, C., Troussas, C., Krouska, A., & Sgouropoulou, C. (2024). A rule-based chatbot offering personalized guidance in computer programming education. In A. Sifaleras & F. Lin (Eds.), Generative intelligence and intelligent tutoring systems. ITS 2024. Lecture Notes in

Computer Science (Vol. 14799). Springer, Cham. https://doi.org/10.1007/978-3-031-63031-6_22
Pesonen, J.A. (2021). 'Are you OK?' Students' trust in a chatbot providing support opportunities. In Zaphiris, P., Ioannou, A. (Eds.), Learning and collaboration technologies: Games and virtual environments for learning. HCII 2021. Lecture Notes in Computer Science vol 12785. Springer, Cham. https://doi.org/10.1007/978-3-030-77943-6_13
Polit, D. F., & Beck, C. T. (2010). Generalization in quantitative and qualitative research: Myths and strategies. International Journal of Nursing Studies, 47(11), 1451-1458. https://doi.org/10.1016/j.ijnurstu.2010.06.00
Salas, E., Shuffler, M. L., Thayer, A. L., Bedwell, W. L., & Lazzara, E. H. (2015). Understanding and improving teamwork in organizations: A scientifically based practical guide. Human Resource Management, 54(4), 599–622. https://doi.org/10.1002/hrm.21628
Scager, K., Boonstra, J., Peeters, T., Vulperhorst, J., & Wiegant, F. (2017). Collaborative learning in higher education: Evoking positive interdependence. CBE—Life Sciences Education, 15(4). https://doi.org/10.1187/cbe.16-07-0219
Schraw, G., Dennison, R. S. (1994). Assessing metacognitive awareness. Contemporary Educational Psychology, 19(4), 460–475. https://doi.org/10.1006/CEPS.1994.1033
Selwyn, N. (2012). Making sense of young people, education and digital technology: The role of sociological theory. Oxford Review of Education, 38(1), 81–96. https://doi.org/10.1080/03054985.2011.577949
Sharma, K., Nguyen, A., & Hong, Y. (2024). Self-regulation and shared regulation in collaborative learning in adaptive digital learning environments: A systematic review of empirical studies. British Journal of Educational Technology, 55(4), 1398–1436. https://doi.org/10.1111/bjet.13459
Shearer, R. L., Aldemir, T., Hitchcock, J., Resig, J., Driver, J., & Kohler, M. (2019). What students want: A vision of a future online learning experience grounded in distance education theory. American Journal of Distance Education. https://doi.org/10.1080/08923647.2019.1706019
Siewiorek, A., Saarinen, E., Lainema, T., & Lehtinen, E. (2012). Learning leadership skills in a simulated business environment. Computers and Education, 58(1), 121–135. https://doi.org/10.1016/j.compedu.2011.08.016
Silverstone, R. (2006). Domesticating domestication. Reflections on the life of a concept. In T. Berker, M. Hartmann, Y. Punie, & K. J. Ward (Eds.), Domestication of Media and Technology (pp. 229–248). Open University Press.
Spieth, P., Röth, T., Clauss, T., & Klos, C. (2021). Technological frames in the digital age: Theory, measurement instrument, and future research areas. Journal of Management Studies, *58*(7), 1962–1993. https://doi.org/10.1111/joms.12720
Squire, K., Dikkers, S. (2012). Amplifications of learning: Use of mobile media devices among youth. Convergence, 18(4), 445–464. https://doi.org/10.1177/1354856511429646
Stöhr, C., Ou, A. W., & Malmström, H. (2024). Perceptions and usage of AI chatbots among students in higher education across genders, academic levels and fields of study. Computers and Education: Artificial Intelligence, 7, 100259. https://doi.org/10.1016/j.caeai.2024.100259
Strzelecki, A. (2024). Students' acceptance of ChatGPT in higher education: An extended unified theory of acceptance and use of technology. Innovative Higher Education, 49(2), 223–245. https://doi.org/10.1007/s10755-023-09686-1
Tlili, A., Shehata, B., Adarkwah, M. A., Bozkurt, A., Hickey, D. T., Huang, R., & Agyemang, B. (2023). What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education. Smart Learning Environments, 10(1), 15. https://doi.org/10.1186/s40561-023-00237-x
Treem, J. W., Dailey, S. L., Pierce, C. S., & Leonardi, P. M. (2015). Bringing technological frames to work: How previous experience with social media shapes the technology's meaning in an

organization. Journal of Communication, 65(2), 396–422. https://doi.org/10.1111/jcom.12149

Vanichvasin, P. (2021). Chatbot development as a digital learning tool to increase students' research knowledge. International Education Studies, 14(2), 44–53. https://doi.org/10.5539/ies.v14n2p44

Van Osch, W., Mendelson, O. (2011). A. Typology of affordances: Untangling sociomaterial. interactions through video analysis. Proceedings of the International Conference on Infromation Systems (ICIS), Shanghai, China, December.

Williams, M. (2000). Interpretivism and generalisation. Sociology, 34(2), 209-224. https://doi.org/10.1177/S0038038500000146

Winkler, R., & Söllner, M. (2018). Unleashing the potential of chatbots in education: A state-of-the-art analysis. Academy of Management Proceedings, 2018(1). https://doi.org/10.5465/AMBPP.2018.15903abstract

Wollny, S., Schneider, J., Di Mitri, D., Weidlich, J., Rittberger, M., & Drachsler, H. (2021). Are we there yet? A systematic literature review on chatbots in education. Frontiers in Artificial Intelligence, 4, 654924. https://doi.org/10.25656/01:22886

Yin, J., Goh, T.-T., Yang, B., & Xiaobin, Y. (2020). Conversation Technology With Micro-Learning: The Impact of Chatbot-Based Learning on Students' Learning Motivation and Performance. Journal of Educational Computing Research, 59(1), 154-177.