

# From Feedback to Feedforward: A Theoretical Model of Artificial Intelligence Assessment in Business Management Education

Paula Martínez-Sanchis<sup>1</sup> , Joan Merín-Rodríguez<sup>1</sup> , Meysam Moayeri<sup>2</sup> 

<sup>1</sup>Department of Business Management “Juan José Renau Piqueras”, University of Valencia, Spain, <sup>2</sup>ISG Institut Supérieur de Gestion, France

How to cite: Martínez-Sanchis, P.; Merín-Rodríguez, J.; Moayeri, M. (2026). From Feedback to Feedforward: A Theoretical Model of Artificial Intelligence Assessment in Business Management Education. In: 12th International Conference on Higher Education Advances (HEAd'26). Valencia, 15-18 June 2026. <https://doi.org/10.4995/HEAd26.2026.21673>

## Abstract

*Focusing on business management education, this paper contends that much of existing Artificial Intelligence (AI) feedback remains retrospective and informational, offering limited support for the learning process. In doing so, it develops a conceptual model, which shifts the focus from literature dominant reactive feedback approach to a proactive one. Drawing on self-regulated learning theory and assessment research, the proposed model suggests that AI feedforward assessment holds the potential to enhance substantially learning performance, learner autonomy, and managerial competences, thereby increasing learning personalization, timeliness, and reflective learning processes. The paper closes by discussing implications for management educators and outlining future lines of research to guide empirical validation.*

**Keywords:** Artificial Intelligence; feedforward assessment; business management education; self-regulated learning; formative assessment.

## 1. Introduction

The integration of Artificial Intelligence (AI) into higher education life has renewed scholarly interest in feedback and assessment practices, at the core of student learning. Decades of research suggest that feedback plays a critical role in supporting learning, especially when it is timely, specific, and actionable, thereby enabling learners to move forward between current and desired performance (Hattie & Timperley, 2007; Sadler, 1989; Shute, 2008). In this regard, in management education, where pedagogical approaches such as experiential learning, case-based teaching, and simulations tend to rely on iterative cycles of action and critical reflection, feedback is particularly important for developing solid managerial competences (Biggs & Tang, 2011; Kolb, 1984).

Despite this recognition, research has consistently shown that feedback often fails to achieve its intended effects in higher education. Students frequently struggle to interpret instructor's feedback, to be aware of its relevance for future tasks, or even to use it for regulating purposes as part of their learning strategies (Carless, 2006; Evans, 2013; Nicol & Macfarlane-Dick, 2006). These challenges are especially latent in large and diverse cohorts, where instructors face structural constraints, thereby limiting individualized and timely feedback. As a result, feedback practices in management education have often remained retrospective in timing and post hoc in form (Boud & Falchikov, 2007).

In contrast, recent advances in AI emerge as a potential response to these long-standing limitations. In this regard, empirical studies suggest that AI systems generate rapid, detailed, and consistent feedback at scale, alleviating concerns related to instructors' workload and detailed feedback provision in bigger classes (Henderson et al., 2025; Venter et al., 2025). In management education, where students are expected to develop judgment and decision-making skills under conditions of uncertainty, receiving and incorporating this feedback appears particularly promising.

However, despite a burgeoning body of research on AI-based feedback, its pedagogical mechanisms remain insufficiently theorized. Much of the recent literature focuses on the technical capabilities of AI systems and on students' appraisal of AI-generated feedback, which limits insights into how such feedback shapes the learning processes over time (Tensen et al., 2025; Usher, 2025). Moreover, evidence indicates that a mere increase in the volume or speed of feedback does not yield automatically to an enhanced learning performance (Carless et al., 2011). As a consequence, students' engagement with AI-generated feedback remains inconsistent, and many learners report difficulties interpreting, trusting, and enacting automated comments (Henderson et al., 2025; Zhan & Yan, 2025). While these findings take on renewed significance of feedback in AI learning environments, a theory-driven understanding of how such feedback functions as part of the learning process is still missing.

This paper argues that the central limitation of current research lies not in the availability of AI-generated feedback (where feedback is abundant but not necessarily meaningful), but in the absence of a theory-driven understanding of how such feedback functions as part of the learning process. Specifically, existing studies rarely explain how AI-generated feedback can be designed and embedded as feedforward, that is, as a guiding to undertake future learning actions rather than simply executing retrospective evaluation.

Accordingly, the objective of this paper is to develop a theory-driven conceptual model of AI-driven feedforward assessment in business management education. Building on formative assessment theory, self-regulated learning, and recent empirical research on AI disruptive influence in feedback, this study develops a theoretical model explaining how AI-driven feedforward may contribute to student engagement, support self-regulated learning, and

ultimately contribute to managerial competence development in business management education.

The contribution of this paper is threefold. First, it reframes AI-generated feedback within a feedforward perspective aligned with the iterative nature of management education. Second, it integrates formative assessment and self-regulated learning theories to propose a mechanism-based understanding of how AI-supported assessment influences learning processes over time. Third, it offers a conceptual framework that can guide future empirical research and inform the pedagogical design of AI-enhanced assessment practices.

## **2. Theoretical Background**

### **2.1. Feedback and Assessment in Management Education: Dominant Approaches**

Management education has traditionally embraced experiential pedagogies, including (but not limited to) case-based teaching, simulations, and project-based learning. These approaches assume that learning solidifies through iterative cycles of action and reflection. Yet, as recent reviews acknowledge, assessment has remained summative in nature focusing mostly on the learning performance (Henderson et al., 2025).

In this line, traditional feedback research has established that feedback supports learning only if students actively engage with it, using it as a consequence to regulate future learning processes (Hattie & Timperley, 2007; Nicol & Macfarlane-Dick, 2006). Despite this, recent empirical studies continue to report low levels of feedback appraisal, particularly in higher education contexts characterized by large cohorts and limited instructor interaction (Zhan & Yan, 2025).

Additionally, recent AI-focused studies have begun to revisit this problem. In this regard, Venter et al. (2025) demonstrate that AI-assisted feedback has the ability to increase the volume and consistency of feedback in large classes, whilst Tensen et al. (2025) show that AI enables Socratic feedback practices. In this context, however, these studies tend to frame feedback as a response to completed tasks rather than as an integral component the ongoing learning cycle. Thus, while recent research acknowledges the importance of feedback engagement, it falls short when it comes to theorize on feedback as a forward-looking learning mechanism aligned with the iterative logic of management education.

### **2.2. Artificial Intelligence and the Scalability of Feedback in Management Education**

Interest in generative AI has intensified scholarly attention to feedback practices. Digging into the potential of AI, emerging studies examining large language models and AI-supported feedback systems highlight their potential in producing ad hoc feedback, consequently reducing instructor workload (Henderson et al., 2025; Usher, 2025). However, extant empirical evidence also reveals significant challenges.

First, recent studies show that in a context of AI-generated feedback, students' engagement is highly variable. Specifically, Zhan and Yan (2025) report that students struggle in evaluating the credibility of AI feedback, thus experiencing difficulties in translating it into concrete learning actions. Similarly, Henderson et al. (2025) caution that without critical pedagogical framing from the instructor, AI feedback risks becoming yet another layer of information rather than a trigger for learning. Second, much of the AI-feedback literature remains institution-centered. As a result, AI is primarily used to automate feedback delivery and to reinforce monitoring and prediction, rather than to empower learners' self-regulation (Tensen et al., 2025). In such a context, even if learner agency is acknowledged, the mechanisms through which AI feedback supports planning and learner's strategy adjustment remain under-theorized. Third, existing studies tend to focus on short-term perceptions and performance outcomes. There is limited theorization of how AI-generated feedback interacts with engagement and self-regulated learning over time, processes that are central to competence development in management education.

All this considered, recent research confirms that AI has indeed expanded the capacity to deliver tailored feedback but has not yet realized its pedagogical potential. What remains missing is a theory-driven framework explaining how AI-generated feedback can function as feedforward, that is, as personalized, timely, and actionable guidance embedded within learning activities. Addressing this gap requires integrating recent AI-feedback research with formative assessment and self-regulated learning theories, which this paper undertakes through the proposed conceptual model. Before unfolding the proposed model, Table 1 condenses key contrasting aspects of the two above-mentioned approaches.

**Table 1. Comparative table: Dominant vs. AI-based feedback approaches Source: Own elaboration.**

| <b>Dimension</b>                   | <b>Dominant Approaches in Management Education</b>                                                                  | <b>AI-Based Feedback Approaches in Management Education</b>                               |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Pedagogical foundation             | Experiential and competence-oriented pedagogies (cases, simulations, projects) grounded in action–reflection cycles | Technology-enhanced learning with a focus on automation, scalability, and personalization |
| Assessment orientation             | Largely summative and output-focused, despite experiential teaching methods                                         | Formative in intent, but often applied after task completion                              |
| Role of feedback                   | Feedback viewed as a post hoc response to completed tasks                                                           | Feedback framed as AI-generated responses to student outputs                              |
| Temporal focus                     | Retrospective, emphasizing past performance                                                                         | Mostly retrospective, with limited integration into the ongoing learning cycle            |
| Student engagement with feedback   | Often low, especially in large cohorts with limited instructor interaction                                          | Highly variable; students may struggle to assess credibility and apply feedback           |
| Scalability                        | Constrained by instructor time and class size                                                                       | High scalability through automation and consistent feedback delivery                      |
| Learner agency and self-regulation | Assumed but weakly supported through assessment design                                                              | Acknowledged but under-theorized; limited support for planning and strategy adjustment    |
| Pedagogical framing                | Feedback often detached from learning design and future tasks                                                       | Risk of becoming too informative without pedagogical integration                          |
| Focus of empirical research        | Feedback appraisal and effectiveness                                                                                | Short-term perceptions, productivity gains, and performance outcomes                      |

### 3. Conceptual Method and Model Development

This study adopts a theory building approach to develop a conceptual model of AI driven feedforward assessment in business management education (illustrated in Figure 1). The model is derived through an integrative synthesis of literature on formative assessment and AI supported feedback.

The model links AI driven feedforward, student engagement, self-efficacy, learning performance, and managerial competences. AI driven feedforward is conceptualized as a formative assessment mechanism characterized by personalization, immediacy, and actionability, and is operationalized through students' perceptions of usefulness, attention, reflection, and motivation, adapted from the AI feedback utility scale (Sichterman et al., 2025).

Student engagement, defined as cognitive, emotional, and behavioral involvement in learning, is measured using the scale by Schaufeli et al. (2002). Self-efficacy refers to students' beliefs in their capability to perform academic tasks effectively. Learning performance is operationalized as final course grades, and managerial competences are measured using Hernández Lara et al. (2019).

The model proposes that AI driven feedforward is associated with student engagement and self-efficacy, which in turn mediate its relationship with learning performance.

Proposition 1. AI driven feedforward is positively associated with student engagement.

Proposition 2. AI driven feedforward is positively associated with self-efficacy.

Proposition 3. Student engagement mediates the relationship between AI driven feedforward and learning performance.

Proposition 4. Self-efficacy mediates the relationship between AI driven feedforward and learning performance.

Proposition 5. Learning performance is positively associated with the development of managerial competences.

Overall, the model represents a framework in which AI driven feedforward influences learning outcomes through engagement and self-efficacy. Control variables including gender, age, and year of study are incorporated to account for heterogeneity in learning behaviours and outcomes.

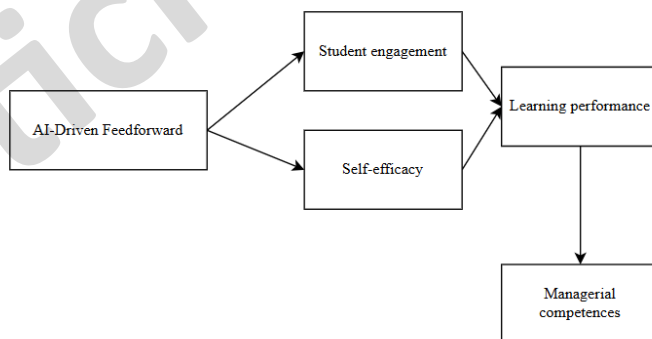


Figure 1. Conceptual Model on AI-Driven Feedforward Assessment. Source: Own elaboration.

## 4. Conclusions

The purpose of this study was to address a theoretical gap in management education research concerning the role of feedback in learning environments. As outlined in the theoretical background, prior research has recognized the value of innovative pedagogical approaches, such as case-based teaching, simulations, and project-based learning for developing managerial competences (Kolb, 1984). Yet, assessment and feedback practices have remained largely retrospective, as a consequence not aligned with the iterative nature of these pedagogies (Biggs & Tang, 2011; Boud & Falchikov, 2007). The present paper responds to this imbalance by theorizing AI-driven feedforward as a formative learning mechanism capable of aligning assessment practices with contemporary approaches to management education.

### 4.1. Implications for Educators, Institutions, and Ethical Safeguards

For educators, the model suggests that assessment activities should be designed to allow students to act on feedforward before final evaluation. Assignments should be structured as iterative learning processes rather than one-off tasks, enabling students to revise decisions and strategies in response to AI-generated guidance. In parallel, faculty development is essential, as instructors must acquire competencies related to the interpretation and pedagogical integration of AI outputs, fostering active engagement with feedforward.

At the institutional level, AI-driven assessment systems offer opportunities for scalability, consistency, and quality assurance in business education. When embedded within appropriate governance frameworks, such systems can support strategic objectives related to teaching innovation and learning outcomes. Institutions also play a key role in providing infrastructure, pedagogical support, and alignment between AI tools and curriculum design.

From an ethical perspective, the adoption of AI in assessment raises important ethical issues. Institutions must ensure that AI-driven feedforward systems are explainable, that student data are protected, and that automated recommendations do not reinforce existing inequalities. To this end, clear governance structures, ethical guidelines, and continuous monitoring are essential to ensure responsible and sustainable implementation.

### 4.2. Limitations and Future Research Directions

As a conceptual paper, this study does not provide empirical validation of the proposed relationships. The model is grounded in established theory and informed by an educational innovation context, which may limit its immediate generalizability. In particular, the focus on business management education may constrain the direct transferability of the model to other disciplinary contexts, where pedagogical dynamics and assessment practices may differ. Furthermore, part of the literature informing this study, especially research on AI driven feedback, remains emergent, which implies that some of the underlying assumptions may evolve

as the field matures. These limitations are inherent to theory building research and should be addressed through future empirical studies.

We propose that future research should empirically test the proposed propositions using experimental, quasi experimental, or longitudinal designs. Alternatively, mixed method approaches combining learning analytics with qualitative insights are particularly suitable for capturing the mechanisms underlying AI driven feedforward. Further studies could also examine boundary conditions related to course characteristics, student digital literacy, and cultural or institutional contexts.

## Acknowledgements

This work was supported by the University of Valencia (grant number: 3901165).

## Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used Grammarly and ChatGPT to revise the manuscript and improve language and readability. After using these tools, the authors reviewed and edited the content as needed and took full responsibility for the content of the publication.

## References

- Biggs, J., & Tang, C. (2011). *Teaching for quality learning at university* (4.<sup>a</sup> ed.). McGraw Hill.
- Boud, D., & Falchikov, N. (Eds.). (2007). *Rethinking assessment in higher education: Learning for the longer term*. Routledge. Taylor & Francis Group.
- Carless, D. (2006). Differing perceptions in the feedback process. *Studies in Higher Education*, 31(2), 219-233. <https://doi.org/10.1080/03075070600572132>
- Carless, D., Salter, D., Yang, M., & Lam, J. (2011). Developing sustainable feedback practices. *Studies in Higher Education*, 36(4), 395-407. <https://doi.org/10.1080/03075071003642449>
- Evans, C. (2013). Making Sense of Assessment Feedback in Higher Education. *Review of Educational Research*, 83(1), 70-120. <https://doi.org/10.3102/0034654312474350>
- Hattie, J., & Timperley, H. (2007). The Power of Feedback. *Review of Educational Research*, 77(1), 81-112. <https://doi.org/10.3102/003465430298487>
- Henderson, M., Bearman, M., Chung, J., Fawns, T., Buckingham Shum, S., Matthews, K. E., & de Mello Heredia, J. (2025). Comparing Generative AI and teacher feedback: Student perceptions of usefulness and trustworthiness. *Assessment & Evaluation in Higher Education*, 0(0), 1-16. <https://doi.org/10.1080/02602938.2025.2502582>
- Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall, Inc.

- Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in Higher Education*, 31(2), 199-218. <https://doi.org/10.1080/03075070600572090>
- Sadler, D. R. (1989). Formative assessment and the design of instructional systems. *Instructional Science*, 18(2), 119-144. <https://doi.org/10.1007/BF00117714>
- Schaufeli, W. B., Martinez, I. M., Pinto, A. M., Salanova, M., & Bakker, A. B. (2002). Burnout and engagement in university students: A cross-national study. *Journal of Cross-Cultural Psychology*, 33(5), 464-481.
- Shute, V. J. (2008). Focus on Formative Feedback. *Review of Educational Research*, 78(1), 153-189. <https://doi.org/10.3102/0034654307313795>
- Sichterman, B., Banihashem, S. K., Verstappen, M., Schipper, M., Waisvisz, P., Noroozi, O., & van Ginkel, S. (2025). Can AI feedback stand alone for fostering students' presentation performance? A comparison of AI-only versus teacher-supported AI feedback. *Interactive Learning Environments*, 1-18.
- Tensen, D., Grainger, P., & Graham, W. (2025). Using AI to generate formative feedback in doctoral education. *Assessment & Evaluation in Higher Education*, 0(0), 1-17. <https://doi.org/10.1080/02602938.2025.2536558>
- Usher, M. (2025). Generative AI vs. instructor vs. peer assessments: A comparison of grading and feedback in higher education. *Assessment & Evaluation in Higher Education*, 50(6), 912-927. <https://doi.org/10.1080/02602938.2025.2487495>
- Venter, J., Coetzee, S. A., & Schmulian, A. (2025). Exploring the use of artificial intelligence (AI) in the delivery of effective feedback. *Assessment & Evaluation in Higher Education*, 50(4), 516-536. <https://doi.org/10.1080/02602938.2024.2415649>
- Zhan, Y., & Yan, Z. (2025). Students' engagement with ChatGPT feedback: Implications for student feedback literacy in the context of generative artificial intelligence. *Assessment & Evaluation in Higher Education*, 0(0), 1-14. <https://doi.org/10.1080/02602938.2025.2471821>