EDUCATIONAL INNOVATION: TOOLS AND PRACTICES FOR EFFECTIVE LEARNING

Cristóbal Torres Fernández (Dir.)
Marcos García-Vidal (Coord.)
José Ramón Márquez Díaz (Coord.)
Virginia Villegas José (Coord.)
Miguel Puig Cabrera (Coord.)

Dykinson, S.L.

El presente libro ha contado con el asesoramiento de profesionales en el tema objeto de estudio y ha seguido un proceso de revisión por pares ciegos antes de su publicación.

Editorial DYKINSON, S.L.

Meléndez Valdés, 61 - 28015 Madrid

Teléfono (+34) 915442846 - (+34) 915442869

e-mail: info@dykinson.com

http://www.dykinson.es

http://www.dykinson.com

ISBN: 979-13-7006-070-1

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Chapter 6. Towards Deep Learning using Immediate Response Systems (IRS) in online university environments

Dr. Guiomar Garrido Álvarez-Coto
Universidad Internacional de La Rioja

I. Introduction

Digitization and technological advancements have opened a vast range of possibilities in education over the past decades, expanding the availability, methods, and opportunities for learning. While the transition to online studies accelerated due to the COVID-19 pandemic, its exponential growth suggests that this modality is here to stay, as evidenced by the current high demand (Toro-Dupouy, 2022).

Distance higher education offers numerous advantages over traditional in-person classes, including flexible schedules, accessibility from any location and physical condition, a wide variety of available programs, personalized learning opportunities, cost and time savings in transportation, the development of digital skills, and the promotion of self-regulation and metacognition, among others. These benefits make online education an attractive and viable option for many students seeking a university degree. Consequently, distance education has gained popularity in recent years as a viable alternative to traditional in-person education, attracting an increasing number of university students. According to the latest study published by OBS Business School (Toro-Dupouy, 2023), 84.3% of respondents would recommend online education, considering it a highly efficient model (69.2%) that contributes to academic performance (67.3%) and increases student motivation (55.6%).

At first glance, online education might seem less interactive than face-to-face learning. However, this educational model offers numerous opportunities for interaction and engagement, though these have been less explored so far. Online learning platforms are typically equipped with various tools that foster collaboration, such as discussion forums, live chats, and group work functions. Students can share ideas, collaborate on projects, and actively participate in virtual discussions. Communication with instructors often takes place via email, forums, or video conferencing, allowing for direct and personalized interaction. Ultimately, the quality of this interaction depends not on the communication channel but on the involved participants.

Moreover, online universities provide students with the opportunity to attend real-time online sessions, offering live interaction with instructors comparable to the in-person experience. Additionally, students often have the added benefit of accessing recorded lectures, which they can review at any time. This flexibility allows students to adapt to different schedules and learning paces while ensuring access to all content as often as needed. As a result, online university education fosters autonomy and self-discipline, essential skills for the academic and professional success of future graduates.

In summary, supporting students in their university studies requires a methodology that understands and adapts to their priorities, diverse learning rhythms, and needs. The online university environment offers numerous possibilities to achieve this goal.

II. Deep Learning

The so-called Deep Learning was described in 1976 by Marton & Säljö in contrast to surface learning. As part of their research on the learning process, these authors concluded that deep learning generates transfer, that is, it provides students with the ability to apply the knowledge acquired in different contexts and situations. This approach recognizes the importance of adapting education to the individual needs and preferences of students, as well as providing them with learning opportunities that are relevant to their context and experience. Furthermore, it seeks to foster students' active engagement in their learning process by involving them in practical and meaningful activities that enable them to develop skills applicable to various areas of their lives. Thus, according to Furman (2021), we can say that a student has deeply learned about a topic if they can explain it in their own words, give examples, and apply that knowledge to solve problems or create something new. Additionally, they should be able to relate a new concept to prior knowledge or their personal reality, pose their own questions, represent it with images or metaphors, explain its importance and establish connections, teach it to others, and feel confident about that new knowledge.

Fullan et al. (2017) go a step further by asserting that deep learning represents a new educational paradigm, whose goal is for students to acquire a profound and meaningful understanding of learning content and develop critical skills to face the challenges of the modern world. According to these authors, deep learning would revitalize students' enthusiasm for learning across all age groups, promoting a new educational culture for all stakeholders (students, teachers, school leadership teams, and families).

Deep learning therefore entails a significant emotional dimension. Students feel comfortable with the knowledge they have acquired, perceiving it as an integral part of their identity and abilities (Furman, 2021). This helps improve students' self-concept and expectations for achieving their learning goals.

It is evident that this approach requires a renewal of educational practices and the development of new competencies at all levels, from teachers to entire educational systems. The four key elements of deep learning that should be addressed in a coordinated manner are as follows (Quinn et al., 2021):

- Learning Partners: This involves collaboration between students, teachers, and others, both within and outside the school environment, including families, experts, and the broader community. These partnerships expand learning opportunities and connect students with authentic experiences at local, national, and global levels.

- Learning Environments: This refers to the learning environment, which encompasses two fundamental aspects: creating a learning culture that motivates both teachers and students and designing physical and virtual spaces that optimize skill acquisition.

- Leveraging Digital Resources: This element emphasizes the importance of effectively using technological resources to enhance deep learning. It is less about the digital tools themselves and more about the role that interaction with them can play in facilitating meaningful partnerships and enabling students to take control of their own learning.

- Pedagogical Practices: Teachers face a wide variety of options regarding the methodological strategies of their educational practices. There is no single way to design deep learning, but it is essential for teachers to start from students' prior knowledge and remain open to identifying and adopting new practices that enhance learning. This includes both proven effective practices and innovative practices that are being collaboratively developed and shared. These new models focus on the student and strive to offer individualized, relevant, and engaging educational experiences aimed at generating meaningful and lasting learning and skills.

The goal of deep learning, according to Fullan et al. (2017), consists of six Global Competencies: Citizenship, Creativity, Collaboration, Character, Critical Thinking, and Communication, which encompass a range of areas, from cognitive skills to socio-emotional abilities, and are considered essential for adapting to an increasingly complex and globalized world.

As mentioned at the beginning of this article, online higher education is evolving towards more authentic and meaningful learning models centred on the student, which aim not only to impart knowledge but also to cultivate relevant and useful skills and competencies for life. This objective aligns perfectly with the pursuit of deep learning.

III. Immediate Response Systems (IRS)

Immediate Response Systems (IRS) in educational settings, also known as Student Response Systems (SRS), are technological tools that facilitate interaction and feedback, enabling instructors to collect and analyse data in real time during live sessions or at any time afterward. They integrate flexibly into face-to-face, hybrid, or fully online learning environments, both synchronous and asynchronous. These tools allow for quick and accurate responses to questions or prompts posed by the instructor. Additionally, they offer the possibility of gathering responses from students who choose to watch the class later, after the live session has ended.

These tools originally emerged as wireless voting systems for in-person sessions. Initially, they required the installation of specific software and the use of physical devices such as cases or clickers. After 20 years of research and practice in face-to-face classes incorporating student participation through clickers, IRS have proven effective in maintaining engagement and focus, improving student participation, fostering collaboration, and providing instant feedback (Goldstein & Wallis, 2015).

Today, IRS are cloud-based software tools (SaaS) that are easy to use, with user-friendly interfaces accessible from any internet-connected device (mobile phone, tablet, or computer). Most IRS offer a freemium version, providing basic services for free, with the option to integrate more advanced features in a paid version. Examples of IRS include digital platforms such as Wooclap, Vevox, Mentimeter, PearDeck, Socrative, and Nearpod, among others. Students can choose to respond from the same device they are using to view the live session or use a different device, such as a mobile phone, easily accessing the IRS by scanning a QR code, with the only requirement being an internet connection.

These systems can accommodate a variety of question-and-answer formats, including multiple-choice options, open-ended questions, numerical approximations, opinion polls, locating points on an image, labelling a figure, and more. Participants receive immediate feedback on the validity of their responses and those of their peers, enabling a bidirectional interaction between users and the system in real time. This not only greatly facilitates student participation and engagement but also offers significant advantages for the teaching and learning process itself. Instructors can choose to configure IRS participation anonymously or with identified users, allowing them to tailor the interaction dynamics in the virtual classroom according to specific needs, preferences, and activity objectives.

The data collected through the system is instantly analysed by the instructor, providing detailed information about participant responses in real time. This information can be shared with students if deemed appropriate or analysed later to assess progress and better understand the group's learning needs.

Therefore, immediate response systems can be highly valuable tools for various purposes, such as promoting student interaction with the content, increasing participation during classes, or reinforcing student engagement with the subject. Additionally, the data collected can be used by instructors to make informed decisions and adjust their teaching strategies as needed.

Research has shown that incorporating these participatory elements, which involve students as active agents in the learning process, significantly enhances educational practice (Deslauriers et al., 2019), resulting in improved academic performance. Thus, we can affirm that Immediate Response Systems (IRS) could play a key role in providing a more enriching and student-centred educational experience, making them a valuable tool for facilitating deep learning in online university environments.

IV. Advantages of IRS from cognitive psychology

4.1. Learning principles

Over the past 50 years, numerous experts in educational psychology have extensively studied how the learning process works and how educators can apply cognitive science principles in the classroom (an excellent synthesis of these advancements is provided in Kischner & Hendrick, 2020). Table 1 summarizes the three basic principles of the learning process and some strategies to facilitate it.

Table 1.
Learning principles.

		Principle of Learning	Teaching Strategy
A1	**ATTENTION**	The capacity for conscious attention is limited; we can only attend to a small number of stimuli simultaneously.	Direct students' attention toward the content to be learned.
A2	**WORKING MEMORY**	Working memory, the centre of conscious thought, has a limited capacity.	Ensure that students focus on small chunks of information.
A3	**LONG-TERM MEMORY**	Long-term memory is formed because of the thinking process. Thus, students consolidate information into long-term memory when they reflect deeply on its meaning.	Encourage students to reflect individually on the meaning of what they are learning.

Source: own elaboration based on Fletcher-Wood et al., (2019).

4.2. Advantages of IRS based on cognitive learning principles

4.2.1. Focusing attention (A1)

In a digital world filled with distractions, attention becomes the most valuable resource to preserve. In virtual educational environments, university students face an additional attentional challenge due to the ease of multitasking, such as attending a class while checking emails, accessing social media, or engaging in unrelated activities. This challenge not only involves managing multiple tasks simultaneously—thereby reducing working memory performance and causing relevant information to compete with irrelevant stimuli (Uncapher et al., 2016)—but the mere presence of digital noise threatens to disperse students' focus. In this context, maintaining students' attention becomes a significant challenge for educators. The use of IRS tools in synchronous virtual classes demands student participation. When students know in advance that their participation will be required at any moment during a session, they tend to pay more attention (Ruiz Martín, 2020). However, the effectiveness of IRS largely depends on how they are integrated into the educational process. If used superficially or merely as a complement, they risk becoming another distraction. On the other hand, when strategically employed to stimulate interaction, foster reflection, and assess comprehension, IRS can enhance attention and enrich the virtual classroom learning experience. Ultimately, the key to maintaining attention lies in how educators manage this tool to balance student participation and focus on the session's core content.

4.2.2. Managing working memory (A2)

Working memory capacity is limited, and processing information requires careful use of cognitive resources (Sweller, 1988). Reflecting on and applying new knowledge helps students store it in long-term memory, reducing the constant reliance on working memory. Effective cognitive processing—coherent, relevant, organized, and integrated with prior knowledge—is essential for meaningful learning (Wittrock, 1989).

When we can efficiently retrieve information from long-term memory, we free up working memory to focus on applying that information. Conversely, difficulties in recalling previously learned content can compromise our ability to understand new information and solve problems. In this sense, one of the most interesting applications of IRS is their ability to assess students' prior knowledge. This enables educators to activate relevant concepts in students before introducing new information and evaluate where to begin with the content.

As will be discussed later, anonymity plays a crucial role in providing a more realistic assessment of the class's prior knowledge, not just from those willing to respond orally. Additionally, IRS allows for the analysis of responses from many students within minutes—something impossible through individual questioning and listening.

4.2.3. Promoting Meaningful Learning (A3)

Prior knowledge plays a crucial role in our ability to learn new information, as we can only understand new concepts if we can relate them to something we already know. According to David Ausubel's theory of learning (1976), meaningful learning occurs when new concepts or ideas are related to what the student already knows. This can happen through linking new information with prior concepts, organizing information into new meaningful structures, or applying information to different situations.

Meaningful learning, therefore, refers to the process by which new knowledge is incorporated into the individual's existing cognitive structure, making it meaningful and relevant.

Questions are an excellent strategy as they allow students to recall learned content, structure concepts for explanation, and make connections with prior knowledge (Chi et al., 1994). IRS significantly facilitates the design and posing of questions during sessions, whether open-ended, multiple-choice, procedural ordering, matching, or even questionnaires on students' perceptions of their understanding of a specific content.

Properly designed interactive experiences with IRS tools provide students with opportunities to compare, contrast, and categorize information—fundamental actions for meaningful learning (Shimamura, 2018). These tools contribute agility to such practices and ensure anonymity in responses, a critical factor that encourages many students to participate without direct questioning

4.3. Teaching Principles

The fundamental principles of instruction that have proven most effective, according to scientific evidence provided by cognitive psychology and educational practices, were described in detail in 2010 by educational psychologist Barak Rosenshine. These ten principles, known as Rosenshine's Principles of Instruction and summarized in Table 2, aim to guide educators on the types of teaching practices that can help achieve better outcomes with their students.

Table 2.
Principles of instruction.

THE 10 PRINCIPLES OF ROSENSHEIN'S TEACHING		
E1	**INITIAL REVIEW**	Begin the class with a brief review of previously taught material to activate prior knowledge in working memory and effectively establish connections with new information.
E2	**PERIODIC REVIEW**	Plan periodic reviews of the material taught to strengthen information retrieval and ensure continuity in the construction of long-term memory. Provide specific and constructive feedback to improve learning and correct misunderstandings.
E3	**ASKING**	It's beneficial to ask more questions, involving more students and with greater depth.
E4	**CHECKING UNDERSTANDING**	Asking questions provides feedback on the effectiveness of our teaching and allows us to check comprehension, ensuring we address and correct concepts that may have been misunderstood.
E5	**STEP BY STEP**	Break down concepts and processes into small steps to practice each one separately, dedicating time to practice each phase.
E6	**PRESENTING MODELS**	Clearly present the new concepts or required skills, providing numerous concrete examples and clear explanations.
E7	**PROVIDING SCAFFOLDING**	Scaffolding is essential for skill development as it provides a system of cognitive support that will gradually be removed.
E8	**GUIDED PRACTICE**	Provide opportunities for students to actively practice the new material with the guidance and support of the teacher, ensuring they understand the steps and processes involved. Encourage the transfer of learning to new or different situations through activities that require applying the learned concepts in diverse contexts. This guided practice requires close and detailed supervision and feedback
E9	**SUCCESS RATE**	It is crucial to achieve a high success rate both in answering questions and in the development of practice (around 80%).
E10	**INDEPENDENT PRACTICE**	Allow students to practice the new material on their own, providing feedback and additional support as needed.

Source: own elaboration based on Sherrington (2020).

4.4. Advantages of SRIs according to the principles of teaching

Below, a series of advantages that SRIs may offer in relation to some of the teaching principles mentioned in Table 2 are outlined.

4.4.1. Initial review (E1)

It is widely recognized that dedicating the first few minutes of a session to actively reviewing with students the content from previous sessions leads to better results in final assessments (Good & Grouws, 1979). SRIs facilitate this initial review practice by allowing the swift retrieval of information from past sessions through review activities. These activities may include multiple-choice questions, relationship tests, image identification, diagram labelling, or reflection on answers to open-ended questions, among others.

4.4.2. Periodic review (E2)

We naturally forget information that is not stored in a prior schema or that is not frequently retrieved. Therefore, practicing information retrieval more frequently and deeply improves the ability to remember it, as retention increases when opportunities for review are increased. Spaced retrieval practice is one of the strategies that offers the greatest benefits for long-term learning, highlighting that review activities from previous lessons lead to better long-term results (Roediger & Karpicke, 2006). Deliberate practice is based on the creation and use of mental models and representations that guide students' possible decisions in different situations. These models, in turn, allow students to observe their own performance to improve it, which is advantageous in relation to metacognition.

SRI systems facilitate periodic review processes of past tasks, allow for the incorporation of standardized tests that prompt students to analyse their performance, reflect on it individually or collectively, review common mistakes, and thus leverage the full potential of retrieval practices.

4.4.3. Asking (E3)

Asking questions should be part of a highly interactive, dynamic, and responsive process (Nuthall, 2007; Wiliam, 2011). The most effective teachers are those who ask more questions, involve more students, explore more deeply, and dedicate more time to explaining, clarifying, and verifying understanding (Rosenshine, 2010). Asking questions during sessions allows, among other things, for periodic reviews, as already mentioned, but they can also be extremely useful for activating prior knowledge in students, thus preparing them for new learning. Additionally, teachers can assess students' understanding of the content in real-time and gather information about the strategies to adopt. It is important to remember that questions also help identify misconceptions, extract them, and try to address them using appropriate models.

To assess students' progress and understand how the group is evolving, it is essential to gather a wide range of responses. This will allow for the planning of the next steps in the instructional process. Since learning may not be immediately evident, active evidence of it should be sought during sessions, which constitutes a practice of "receptive teaching" (Wiliam, 2011). As mentioned, SRIs are designed to easily incorporate various types of questions in real-time to encourage students to practice what they have learned, thereby stimulating reflection and fostering active learning. It is very important to consider the form and quality of these questions, as only relevant questions will lead to relevant answers (Lemov, 2021).

4.4.4. Checking Understanding (E4)

Many authors assert that checking students' understanding is a key process in all teaching. The most effective methods for assessing understanding include asking varied questions, having students explain what they have learned, reviewing all students' answers, and providing feedback and corrections systematically (Sherrington, 2020). These methods are facilitated in virtual environments by SRIs, both during live sessions and afterward, also ensuring students' anonymity when deemed appropriate. Conducting periodic tests or quizzes through SRIs also allows us to check students' understanding, requesting personal identification when necessary for grading purposes. Furthermore, we can check understanding through the SRI using exit tickets at the end of each session. When designing multiple-choice questions in an SRI to assess understanding, it may be useful to include an option such as "I don't know," "I'm not sure," or "I don't remember" as a possible answer, in order to avoid random guessing and assess students' knowledge more objectively. Students should be explicitly encouraged to choose this option if they do not know the answer. Additionally, the option to click an "I'm lost" or similar button anonymously, offered by some SRIs, allows teachers to receive immediate feedback during class and return to content when necessary.

4.4.5. Step-by-step (E5)

Although this principle is not directly related to the main functions of SRIs, spacing out content through rounds of questions offered by these systems can benefit long-term learning, also providing opportunities for feedback and reflection after a delay, as previously mentioned (E2 principle).

4.4.6. Providing models (E6)

The better the models are illustrated, the more likely students are to assimilate the ideas and build an appropriate mental framework (Rosenshine, 2010). Although SRIs were not designed for this purpose, they can help teachers provide models, such as partially solved problems during virtual sessions, as well as graphic representations for labelling, incomplete texts, diagrams for linking with connectors, comparisons, etc.

4.4.7. Providing scaffolds (E7)

SRIs were not designed to provide scaffolds, although they can be used in different types of support activities. For example, a beneficial way to offer support to students through SRIs could be reviewing answers to certain questions provided by students from previous courses, anticipating common comprehension difficulties, and explicitly addressing frequent errors.

4.4.8. Guided practice (E8)

Various studies on guided learning suggest that increased time spent on guided practice leads to higher success rates and greater student engagement with individual work (Kischner et al., 2006). The use of SRIs allows teachers to design guided learning experiences in which content is temporally sequenced, including a practice period for each section, thereby guiding students through their learning process according to their needs.

One of the most important practices in any learning process is feedback, which involves providing students with information on their performance level and offering suggestions on how to improve. Feedback is one of the factors that most effectively contribute to achieving learning objectives (Hattie & Timperley, 2007). SRIs facilitate two types of feedback:

- Instant Feedback: Provided by the system itself based on the student's correct/incorrect responses, which may also include comments on the correct answer or guidance on how to improve performance. This type of immediate feedback can be particularly beneficial for university students, who typically exhibit higher levels of self-regulation. Additionally, receiving feedback from the system can reduce emotional tension for students compared to receiving feedback from the teacher (Wiliam, 2011).
- In-Depth Feedback: Provided by the teacher, not only correcting mistakes but also offering insights into the process, generalizing to other cases, and even providing self-regulation and metacognitive strategies for students. To facilitate the learning process, it is highly effective to provide feedback through repeated low-risk assessments. When these assessments are abundant and regular, anxiety is minimized, and the feedback can be used more productively (Ruiz Martín, 2020), potentially even increasing students' extrinsic motivation through gamification strategies. SRIs enable efficient and agile low-risk assessments, either anonymously or with student identification, and can even be useful for crafting final evaluation tests.

4.4.9. Success Rate (E9)

It is crucial for the teacher to be able to halt instruction when difficulties arise in order to revisit problematic content. Instruction should not continue until a sufficient success rate (around 80% correct answers) is achieved, ensuring mastery of the content (Rosenshine, 2010). SRIs are very useful in this regard, providing checkpoints that are quick and easy for teachers to assess whether it's necessary to review the material again or if they can proceed to the next content section.

4.4.10. Independent practice (E10)

The independent practice facilitated by SRIs at a personalized pace allows students to engage in low-stakes individual routine tests, which can serve as formative assessments and/or spaced practice. This action involves providing tasks on past content to reinforce recall (spaced curriculum) and analyse the learning process, thus fostering the metacognitive aspect of instruction. Additionally, as mentioned earlier, frequent quizzes via SRIs reduce their significance and familiarize students with tests, helping to reduce anxiety in more consequential exams.

4.5. Other advantages of SRI

In addition to the previously mentioned possibilities related to learning and teaching principles, SRIs can offer a range of additional advantages that are particularly relevant in online university settings.

4.5.1. Ensuring student anonymity

Despite the limitations in building interpersonal relationships, interacting with anonymous students can have certain benefits. Unlike direct verbal interventions, anonymity can provide a more accurate approach to understanding students' real knowledge. Students often feel embarrassed to publicly share an idea or respond to a question about a session's content,

which can lead them to avoid engaging directly in group discussions. Furthermore, students may feel self-conscious when freely expressing ideas in open-ended questions, as they often perceive these as evaluations of their knowledge. Therefore, using systems that do not require registration, or identification can prevent students from feeling judged while allowing for more authentic individual reflection. This approach can help preserve the feeling of belonging to the class group and foster mutual knowledge from the safety of anonymity. The ease with which these systems allow instructors to switch between different identification options when gathering personalized or anonymous responses can be valuable in analysing the group's behaviour in real-time and deciding whether certain content needs to be revisited based on the results obtained.

4.5.2. Participation

As previously mentioned, asking questions during sessions allows instructors to assess the level of comprehension among their students and gather valuable information for designing effective educational strategies. However, it is common for questions addressed to the entire class to be answered by the same few students, while questions directed at an individual student may lead to unwanted anxiety, hindering deeper learning. SRIs facilitate greater participation from large groups of students, both synchronously and asynchronously, which would be unfeasible through direct questioning. This allows for more realistic assessments of students' general knowledge, gathering relevant information about the learning process, preferences, and impressions, while enabling sufficiently large sample sizes to apply statistical treatments to the collected data.

4.5.3. Motivation

Increasing student participation can lead to greater intrinsic motivation. In a well-designed instructional setting using SRIs, participation can encourage students to engage more fully, seeing themselves as co-creators of the session. This active and responsible role in the development of the session can help improve intrinsic motivation for both students and instructors.

4.5.4. Attention to Diversity

As discussed, the use of SRIs ensures that all student voices are heard and valued, contributing to a more inclusive learning environment. By providing immediate feedback on students' comprehension levels, SRIs allow instructors to tailor instruction to meet individual learning needs. This is especially beneficial for students with different learning speeds or skill levels, as instructors can identify difficulties in real-time and provide additional support as needed.

Furthermore, in their asynchronous options, SRIs enable students to progress at their own pace, making it easier to track their achievements or identify difficulties. Some platforms also offer advanced accessibility options, such as the use of adaptive devices or integration of features within the platform itself. This supports the participation of students with sensory disabilities or special needs in their learning activities.

V. Final reflections

In traditional teaching models, technology is often used in a one-way direction, primarily to enhance the transmission of content from the teacher to the student. Immediate Response Systems (IRS) enable a two-way interaction, allowing students to engage with the content. Planning moments for this interaction, considering the principles of teaching and learning as well as recent educational research, can significantly enrich online instruction and improve the performance of university students.

It is essential that new proposals are grounded in solid theoretical frameworks. However, in the field of teaching, the empirical experience gained holds irreplaceable value. As discussed throughout this article regarding Immediate Response Systems, while they do not constitute a definitive solution to the pending educational challenges, their intelligent application, supported by evidence from cognitive sciences, can significantly enhance teaching processes aimed at fostering deep learning among university students. Each instructor's individual practice in using these tools, combined with conscious reflection on their implementation possibilities, could enrich progress toward deep learning in this time of educational transformation in higher education.

Rosenshine's principles can serve as an excellent guide for analysing teaching practices, improving them continuously, and focusing attention on the specific areas that may have the greatest room for improvement. As Sherrington (2019) states, Rosenshine never made a distinction between good and bad teachers but between those who are more effective and those who are less effective. This distinction invites us to adopt a growth mindset and consider that improvement in instructional processes is always achievable. When used efficiently, technology can facilitate the journey for educators to improve their practice and meet the unique needs of each student, thus promoting true lifelong learning.

Ultimately, and following the line of authors such as Fullan et al. (2017), it is crucial to change the culture of learning to adapt to a changing world, where distance learning is progressively consolidating. In this process of evolution in educational practices, we believe it is preferable to adopt individual commitments to facilitate new learning processes rather than waiting for this transformation to be imposed bydecree. This involves creating an environment that encourages curiosity, experimentation, and continuous learning for all the stakeholders involved. Adopting an open mindset to change and innovation, where learning is viewed as a dynamic process, supported by scientific evidence and enhanced by technological tools, is necessary to forge the path toward an adaptive learning culture, which will allow us to intelligently face some of the most significant challenges presented by the future of higher education.

VI. References

Ausubel, D. P. (1976). *Educational psychology: A cognitive perspective*. Ed. Trillas.

Chi, M.T.H., De Leeuw, N., Chiu, M.H., & Lavancher, C. (1994). Eliciting self-explanations improves understanding. *Cognitive Science, 18*(3), 439-477. https://doi.org/10.1016/0364-0213(94)90016-7.

Deslauriers, L., McCarty, L.S., Miller, K., Callaghan, K., & Kestin, G. (2019). Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom.

Proceedings of the National Academy of Sciences of the United States of America, 116, 19251–19257. https://www.pnas.org/doi/epdf/10.1073/pnas.1821936116

Fletcher-Wood, H., Bignall, B., Calvert, J., Goodrich, J., & McCrea, E. (2019). *The Learning Curriculum Version 2.0: Explaining the science of learning to teachers: A handbook for teacher educators*. Ambition Institute. https://s3.eu-west-2.amazonaws.com/ambition-institute/documents/Learning_Curriculum_2.0.pdf

Fullan, M., Quinn, J., & McEachen, J. (2017). *Deep learning: Engage the world change the world*. Corwin Press.

Furman, M. (2021). *Teaching Differently: A Guide to Innovating Without Getting Lost Along the Way*. Siglo XXI.

Goldstein, D.S. & Wallis, P.D. (Eds.). (2016). *Clickers in the Classroom: Using Classroom Response Systems to Increase Student Learning*. Routledge.

Good, T. L., & Grouws, D. A. (1979). The Missouri Mathematics Effectiveness Project: An Experimental Study in Fourth-Grade Classrooms. *Journal of Educational Psychology, 71*, 355-362. http://dx.doi.org/10.1037/0022-0663.71.3.355

Hattie, J. & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*(1), 81-112.

Kirschner, P. A., & Hendrick, C. (2020). *How Learning Happens: Seminal Works in Educational Psychology and what They Mean in Practice*. Routledge.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching. *Educational Psychologist, 41*(2), 75–86. https://doi.org/10.1207/s15326985ep4102_1

Lemov, D. (2021). *Teach Like a Champion 3.0*. Wiley.

Marton, F. & Säljö, R. (1976). On qualitative differences in learning: I. Outcome and process. *British Journal of Educational Psychology, 46*(1), 4-11.

Nuthall, G. (2007). *The Hidden Lives of Learners*. NZCER Press.

Quinn, J., McEachen, J., Fullan, M., Gardner, M., & Drummy, M. (2021). *Diving into Deep Learning: Engaging Tools*. Morata.

Roediger, H.L., & Karpicke, J.D. (2006). The Power of Testing Memory: Basic Research and Implications for Educational Practice. *Perspectives on Psychological Science, 1*(3), 181-210. https://doi.org/10.1111/j.1745-6916.2006.00012.x.

Rosenshine, B. (2010). *Principles of Instruction*. Educational Practices Series-21. UNESCO International Bureau of Education. https://unesdoc.unesco.org/ark:/48223/pf0000190652

Ruiz Martín, H. (2020). *How Do We Learn? A Scientific Approach to Learning and Teaching*. Grao.

Sherrington, T. (2020). *Rosenshine's Principles in Practice*. Aptus.

Shimamura, A. (2018). *MARGE: A whole-brain learning approach for students and teachers*. https://shimamurapubs.files.wordpress.com/2018/09/marge_shimamura.pdf

Sweller, J. (1988). Cognitive Load During Problem Solving: Effects on Learning. *Cognitive Science, 12*(2), 257-285. https://doi.org/10.1207/s15516709cog1202_4

Toro-Dupouy, L. (2022). *E-learning 2022. The Online University Student: Trends and Perspectives*. OBS Business School. https://marketing.onlinebschool.es/Prensa/Informes/Informe%20OBS%20E-learning%202022.pdf?no_link=1

Toro-Dupouy, L. (2023). *E-learning 2023: Tendencias y Percepciones sobre la Educación en Línea y la Adopción de Tecnologías Educativas*. OBS Business School. https://www.obsbusiness.school/sites/obsbusiness.school/files/media_files/Informe%20OBS%20E-Learning%202023.pdf?no_link=1

Uncapher, M.R., Thieu, M.K., & Wagner, A.D. (2016). Media multitasking and memory: Differences in working memory and long-term memory. *Psychonomic Bulletin & Review, 23*, 483–490. https://doi.org/10.3758/s13423-015-0907-3

Wiliam, D. (2011). *Embedded formative assessment*. Solution Tree Press.

Wittrock, M.C. (1989). Generative processes of comprehension. *Educational Psychologist, 24*(4), 345–376. https://doi.org/10.1207/s15326985ep2404_2