Received: 19 May. 2026 | Revised: 25 May. 2026 | Accepted: 05 Jun. 2026 | Published online: 18 Jun. 2026

REVIEW ARTICLE

Contemporary Education and Teaching Research
Student Learning in Higher Education: Curriculum, Teaching, and Learning Outcomes
2026, Vol 1, 1-11
DOI: 10.61360/BoniCETRHE262020150101

Structured Reflection for Durable Learning in Higher Education: An Integrative Review Building the SIRR Framework

Maria Navarro[1,*]
[1]*University of Georgia, USA*

Abstract: This integrative review reconceptualizes reflection as a designable process that can be systematically embedded in higher education. Drawing on classical and experiential accounts alongside evidence from the learning sciences, the review synthesizes research on retrieval practice, elaboration and self-explanation, interleaved discrimination, contextualization, and metacognitively supported self-regulation. The synthesis introduces SIRR (Spaced Interleaved Reflective Retrieval), a compact framework that translates these learning processes into brief, recurring reflective prompts integrated within ongoing instruction. Rather than treating reflection as an unstructured or purely introspective activity, SIRR positions reflection as a structured practice that engages memory, supports conceptual integration, and encourages the selection and application of knowledge across contexts. Evidence across domains supports the effectiveness of the individual learning processes incorporated in the framework. This review uses that evidence to inform and justify their coordination within a single instructional routine, while recognizing that this integration represents a design proposition rather than a directly validated intervention. The paper contributes a theoretically informed and designable account of reflection and offers a practical approach for structuring reflective activity in conceptually dense and interdisciplinary higher education contexts. It also identifies directions for future research to evaluate and refine the effectiveness of coordinated reflective routines in supporting learning and transfer.

Keywords: structured reflection, retrieval practice, interleaving, metacognition, higher education

1. Introduction: Why Reflection Now

Reflection is frequently addressed in higher education but often treated as a general invitation to "think deeply" rather than a process that can be designed, implemented, and assessed. This ambiguity limits its impact in conceptually dense domains, where learners must coordinate technical knowledge with social, contextual, and disciplinary dimensions. When reflection remains underspecified, it risks becoming a diffuse activity that does not reliably support learning outcomes. Classical scholarship frames reflection as disciplined inquiry that organizes experience for intelligent action, while experiential and professional perspectives emphasize how reflective analysis connects experience with abstraction and future practice (Kolb, 2014; Mann et al., 2009; Rodgers, 2002). Contemporary classroom research complements these traditions by identifying specific processes that, when activated during well-designed reflective activity, are associated with improvements in delayed performance and transfer, particularly retrieval practice, elaboration and self-explanation, interleaved discrimination, and metacognitively supported self-regulation (Agarwal et al., 2021; Chi et al., 1994; Nicol & Macfarlane-Dick, 2006; Rohrer et al., 2020; Taylor & Rohrer, 2010).

This paper offers an integrative review that reconceptualizes reflection as a generative meta-mechanism and presents SIRR (Spaced Interleaved Reflective Retrieval) as a compact, classroom-scale design. The goal is to propose a structured approach designed to support durable understanding, principled transfer, and coherent knowledge development in higher education, grounded in evidence on underlying learning processes. This is particularly relevant in contexts where learners must discriminate among closely related concepts and apply principles flexibly across situations.

Corresponding Author: Maria Navarro
University of Georgia, USA

2. Conceptual Framework: Reflection as a Generative Meta-Mechanism

The conceptual framework integrates multiple strands of reflection research to guide the design decisions that follow.

2.1 Classical roots: Dewey, experiential cycles, and professional cognition

Dewey's pragmatist account views reflection as a disciplined, inquiry-like process that organizes experience into a coherent continuity for intelligent action, supported by habits such as open-mindedness, responsibility, and wholeheartedness (Rodgers, 2002). This clarifies that reflection is more than description; it is a systematic search for meaning guided by criteria and consequences. Kolb's experiential learning framework positions reflection as the hinge between concrete experience and abstract conceptualization, preparing learners for active experimentation. Reflection in this cycle is where meaning is abstracted and readied for transfer to new contexts (Kolb, 2014). In professional education, reflection-in-action and reflection-on-action highlight both adaptive reasoning during practice and retrospective analysis that informs future performance, especially in ill-structured problem spaces (Mann et al., 2009).

2.2 Cognitive and learning-sciences anchors

Classroom-connected research identifies several processes that reflection can activate when it is deliberately designed: retrieval practice to strengthen long-term memory, elaboration and self-explanation to build coherence, interleaved discrimination to improve concept selection for novel cases, and metacognitively supported self-regulation to guide strategy choice (Agarwal et al., 2021; Chi et al., 1994; Nicol & Macfarlane-Dick, 2006; Taylor & Rohrer, 2010). In this paper, these are treated as evidence-supported design anchors rather than generic 'deep thinking' processes. Section 4 translates them into a weekly routine that coordinates memory, meaning, and monitoring in ordinary courses.

2.3 Transformative, epistemic, and identity perspectives

Beyond cognitive performance, reflection often supports reframing of assumptions and growth in how learners construe knowledge. The Reflective Judgment Model traces how epistemic assumptions develop from pre-reflective to quasi-reflective to reflective stages, and how these assumptions shape judgments about ill-structured problems typical of public policy and development contexts (King & Kitchener, 1994, 2004). Embedding reflection that targets justification of claims with evidence and warrants can therefore support the development of both disciplinary understanding and epistemic maturity (King & Kitchener, 1994, 2004).

2.4 Designable practices, levels, and assessment

Empirical reviews in professional education report widespread advocacy of reflection but note variability in design quality and measurement. Deeper reflection is more likely when educators provide structure, exemplars, and social supports, rather than rely solely on unstructured journaling (Mann et al., 2009). Levels frameworks offer practical footholds: Hatton and Smith's (1995) scheme distinguishes descriptive, dialogic, and critical reflection in teacher education; Kember et al. (2000) developed a validated questionnaire that measures habitual action, understanding, reflection, and critical reflection, with acceptable factor structure and reliability. These tools enable more consistent assessment and research on reflective outcomes. Formative assessment research adds complementary design guidance. Seven feedback principles for self-regulated learning emphasize making goals explicit, enabling self-assessment, and providing timely information that learners can use to plan next steps, all of which align closely with reflective activity design in large classes (Nicol & Macfarlane-Dick, 2006).

2.5 Relevance, context, and interest

Reflection also functions as a bridge between academic concepts and lived contexts. Situated and anchored perspectives show that learning is strengthened when ideas are tied to authentic settings, practices, and problems (Bransford et al., 1990; Brown et al., 1989). Short prompts that ask students to notice, interpret, or connect course ideas to local observations or current events can create semantic and episodic anchors that support retrieval and elaboration. Perceived relevance is also associated with the development of interest, which predicts persistence and deeper engagement over time (Hidi & Renninger, 2006).

2.6 Working definition for the paper

Synthesizing across traditions, reflection is a coordinating process that brings knowledge to mind, evaluates and reframes it in context, reorganizes mental models, and regulates future action. This definition is consistent with Dewey's inquiry, Kolb's cycle, and professional reflection-in-action, while explicitly naming cognitive, epistemic, and motivational processes that can be designed and assessed in ordinary courses (Kolb, 2014; Mann et al., 2009; Rodgers, 2002). In this paper, these processes

are treated as evidence-supported components whose coordination within instructional design is proposed as a theoretically grounded interpretation rather than a directly validated model.

3. Methods: Integrative Review Approach

This study employed an integrative review to synthesize conceptually dispersed scholarship and generate a designable framework (SIRR). In this study, the integrative review is theory-driven and design-oriented rather than exhaustive. The SIRR framework reflects iterative development within higher education classroom contexts over multiple years, with ongoing engagement with relevant scholarship used to explain, refine, and strengthen the design. The purpose of the review was therefore not to provide a comprehensive mapping of all literature on reflection, but to identify and synthesize streams of research that offer explanatory and empirical support for the mechanisms incorporated within SIRR (e.g., retrieval, spacing, interleaving, elaboration, and metacognition).

An integrative approach is appropriate when the aim is to combine diverse empirical and theoretical sources to produce new conceptual insight and design guidance, rather than to estimate a single effect size or to limit inclusion to one methodology (Toronto & Remington, 2020; Torraco, 2005, 2016; Whittemore & Knafl, 2005).

3.1 Review focus and guiding questions

The review examined three questions that guided the search strategy, appraisal, and thematic synthesis: (a) How has reflection been conceptualized across classical, experiential, professional, and cognitive traditions? (b) Which classroom-feasible mechanisms are most consistently associated with durable learning, discrimination, transfer, and self-regulation? and (c) How can these strands be coordinated into a compact, course-scale routine for higher education contexts, and how can existing evidence inform and justify this coordination as a design proposition?

3.2 Search and selection

Consistent with integrative review methodology, the search process followed an iterative, progressively focused strategy rather than a fixed systematic protocol (Torraco, 2005, 2016). Searches were conducted through the EBSCOHost research platform, drawing on core databases such as ERIC, PsycINFO, Academic Search Complete, and Education Research Complete.

The search process was purposive, theory-informed, and iterative. Rather than applying predefined inclusion and exclusion criteria, sources were selected based on their relevance to specific learning mechanisms and their applicability to higher education teaching and learning contexts. Priority was given to meta-analyses, systematic and narrative review papers, and foundational theoretical works that provided strong empirical support or conceptual clarity regarding mechanisms such as retrieval practice, distributed practice, interleaving, elaboration, and metacognitive regulation.

The search evolved as the SIRR framework was refined. As particular components (e.g., interleaving or spaced practice) became more central to the design, additional targeted searches were conducted to deepen understanding of those mechanisms and their instructional implications. This resulted in a progressively focused corpus rather than a fixed body of literature identified at a single point in time.

To identify additional domain-relevant and mechanism-specific sources, the authors used purposeful sampling and backward and forward citation tracing of foundational publications. Searches targeted: (a) reflection, reflective practice, and professional reasoning; (b) brief, scalable mechanisms such as retrieval practice, interleaved or comparative judgment, self-explanation and elaboration, and metacognitive monitoring; and (c) design work relevant to higher education teaching and learning. Across these domains, sources were prioritized for their explanatory contribution to the framework, including the strength of empirical support, conceptual clarity, and relevance to instructional design. The aim was to achieve conceptual coherence across well-established evidence bases rather than exhaustive coverage of all available literature.

3.3 Appraisal and synthesis

Following Whittemore and Knafl (2005), included sources were appraised for their explanatory contribution to the developing framework, including (a) strength and consistency of empirical evidence, (b) conceptual clarity regarding the mechanism under consideration, and (c) relevance to classroom implementation in higher education contexts, recognizing that integrative reviews incorporate diverse traditions and therefore do not rely on a single uniform appraisal tool. The goal, consistent with Torraco's (2016) guidance, was not to impose methodological homogeneity but to develop a coherent conceptual synthesis across varied evidence types.

The synthesis proceeded through iterative comparison across sources to identify convergent

learning mechanisms and to examine how these mechanisms could be meaningfully coordinated within a single instructional routine. This process involved moving between literature and emerging design, refining the framework as theoretical and empirical insights accumulated. Findings were then organized to (a) articulate a designable definition of reflection as a coordinating process; (b) align specific learning mechanisms with concise reflective prompts suitable for weekly use; and (c) elaborate SIRR as a theoretically grounded but design-oriented framework.

3.4 AI statement

Microsoft Copilot was used for language editing, clarity refinement, and word count reduction during manuscript preparation.

4. Results and Discussion: SIRR as the Product of the Integrative Synthesis

The integrative review yields a practical routine, SIRR (Spaced Interleaved Reflective Retrieval), that coordinates the mechanisms identified in the framework. This section explains what SIRR is for, how each mechanism is operationalized in brief spaced prompts, and how educators can anticipate and address common forms of resistance. The section closes with implications for practice, limitations of the approach, and a research agenda to guide future work.

4.1 What SIRR is for and why it matters

SIRR is a weekly, low-stakes, structured reflective routine designed for higher education course settings. Each week, students respond to a short reflection prompt, typically five to ten minutes, in class or as a brief homework entry. Across the term, SIRR coordinates distributed practice with retrieval, interleaved discrimination, brief generative explanation, and metacognitive calibration. Not every prompt must invoke every mechanism; spacing applies to the overall cadence, while individual prompts may focus on particular processes depending on instructional goals.

The purpose of this design is to create conditions that, based on existing evidence for these mechanisms, are likely to support durable retention, principled transfer, and course-level coherence in content-rich subjects. The design of SIRR translates well-established learning mechanisms into brief, recurring prompt structures that can be implemented within ordinary course constraints. Rather than representing an empirically validated intervention in itself, SIRR is best understood as a coordinated design informed by these mechanisms, whose combined implementation is proposed as a plausible approach to supporting learning.

Classroom-oriented syntheses consistently place practice testing and distributed practice among the most effective techniques for long-term learning; randomized and classroom trials show that interleaving improves delayed performance by strengthening learners' ability to select the right concept for a novel case (Donoghue & Hattie, 2021; Rohrer et al., 2020; Taylor & Rohrer, 2010). Applied retrieval routines have also been shown to be feasible and beneficial in ordinary courses (Agarwal et al., 2021). Taken individually, these findings provide strong support for the component mechanisms incorporated into SIRR. However, the coordination of these mechanisms within a single routine, as proposed here, remains a theoretically informed design proposition rather than a directly tested instructional model.

SIRR is particularly relevant for conceptually dense and interdisciplinary domains, where learners must discriminate among closely related concepts and apply principles flexibly across contexts. While developed for higher education contexts, the underlying principles reflect general features of effective learning and may be adaptable across instructional settings. In this sense, SIRR is positioned as a compact, research-aligned framework that connects evidence on learning processes with everyday instructional practice.

4.2 Mechanisms operationalized in SIRR

This section outlines the learning mechanisms coordinated within SIRR. Spacing defines the overall temporal rhythm of the routine, while the remaining mechanisms are enacted through rotating prompt types. The inclusion of these mechanisms is grounded in convergent empirical evidence across the learning sciences. The role of this section is not to demonstrate the effectiveness of SIRR as an integrated intervention, but to establish how each component is independently supported and how their coordination can be theoretically justified.

4.2.1 Spacing

Distributed practice (spacing learning over time) and practice testing (retrieval) consistently outperform rereading or massed study for long-term retention across domains (Bjork, 1994, 2011; Donoghue & Hattie, 2021; Lang, 2021; Roediger & Karpicke, 2006). Classroom syntheses further show that brief, recurring recall opportunities are effective and feasible in ordinary courses (Agarwal et al., 2021), and naturalistic studies link spaced engagement to improved academic outcomes

(Hartwig & Malain, 2022). In SIRR, spacing is achieved through a predictable weekly cadence of short reflective prompts that revisit prior material. By keeping entries brief and rotating topics, the routine ensures repeated encounters with key ideas across the term.

4.2.2 Retrieval and successive relearning

Retrieval practice requires learners to bring prior knowledge to mind, strengthening memory and improving long-term performance more effectively than restudy (Agarwal et al., 2021; Roediger & Karpicke, 2006). When retrieval opportunities are spaced and repeated, successive relearning produces durable retention while mitigating fluency illusions associated with massed study (Dunlosky & Rawson, 2015; Rawson & Dunlosky, 2013). In SIRR, cumulative prompts ask students to recall and re-engage prior ideas in light of new content. Selected high-value concepts are revisited across prompts, allowing learners to retrieve, justify, and re-explain them multiple times over the term.

4.2.3 Interleaved discrimination

Interleaving alternates among non-adjacent topics, requiring learners to select appropriate strategies and discriminate among similar concepts. Experimental and classroom studies show that interleaving improves conceptual selection and delayed performance, even when spacing is controlled (Rohrer et al., 2020; Taylor & Rohrer, 2010). In SIRR, prompts often ask students to 'choose and justify' which prior concept applies to a current case. This pairing of retrieval with principled comparison supports discrimination and helps learners connect ideas across topics that might otherwise remain compartmentalized.

4.2.4 Self-explanation and elaboration

Self-explanation and elaboration prompt learners to articulate reasoning, make causal connections, and integrate new information with prior knowledge, thereby strengthening understanding and transfer (Asterhan & Schwarz, 2007; Chi et al., 1994; Gershman et al., 2009; Hamilton, 2012; Sampson & Clark, 2008; Zheng et al., 2023). In SIRR, many prompts require short why or how explanations and, where appropriate, links to earlier concepts. These brief generative accounts externalize reasoning and support the development of more integrated conceptual structures.

4.2.5 Metacognition and calibration

Metacognitive prompts support self-regulated learning by encouraging learners to monitor understanding and adjust strategies (Agarwal et al., 2021; Dunlosky & Metcalfe, 2009). Calibration, a component of metacognition, involves judging the accuracy of one's knowledge and can be improved through confidence ratings and feedback (Pieschl, 2008; Tobler & Kapur, 2023). In SIRR, metacognitive cues are embedded as brief prompt elements that ask students to identify points of clarity or confusion and to plan subsequent study moves. Occasional confidence ratings and comparison with model responses support calibration, while class-level feedback structures (e.g., exemplars, exam wrappers) provide scalable guidance without substantial grading demands (Gezer-Templeton et al., 2017; Nicol & Macfarlane-Dick, 2006).

4.2.6 Contextual and personal relevance

Learning is strengthened when concepts are connected to meaningful contexts, as situated and anchored perspectives emphasize the role of authentic settings in supporting retention and transfer (Bransford et al., 1990; Brown et al., 1989). Perceived relevance also promotes motivation, persistence, and deeper processing (Hidi & Renninger, 2006). In SIRR, some prompts ask learners to identify and interpret concept-relevant phenomena in current events or everyday contexts. These connections create semantic and episodic anchors that support retrieval and elaboration while reinforcing the applicability of course ideas beyond the classroom.

4.3 Prompt families

Table 1 summarizes the core SIRR prompt families, their purposes, and illustrative examples adapted for use in higher education contexts. Each prompt type is designed to fit within a brief 5 to 10 minutes window and can be used at the beginning or end of class or as short out-of-class activities, maintaining a light and predictable cadence. Together, these prompt families operationalize the mechanisms outlined in Section 4.2 by offering flexible structures that can be adapted across disciplines and instructional formats.

Table 1 SIRR Prompt Families and Illustrative Examples

Prompt family	Purpose	Example
Retrieval (short recall)	Strengthen durable memory through effortful recall without notes.	List three key concepts introduced last week and briefly explain one of them.
Interleaved discrimination (choose and justify)	Develop discrimination by selecting and justifying the most appropriate concept for a new case.	Which concept best explains the situation discussed today? Justify your answer in 1-2 sentences.
Self-explanation and elaboration (why and how)	Deepen understanding by explaining mechanisms and linking ideas.	Explain how two concepts from the course relate to each other in this context.
Contextual relevance	Connect learning to broader contexts and applications.	Identify an example related to today's topic and explain how it illustrates a key concept.
Metacognition	Support self-regulated learning and strategy awareness.	Name one concept you understand more clearly and one question you still have.
Calibration	Improve accuracy of self-assessment.	Rate your confidence in your answer (0-10) and briefly explain your rating.

4.4 Anticipated opposition

Active learning approaches are consistently associated with improved learning outcomes, yet they often generate student resistance. Meta-analytic evidence shows that active learning increases performance and reduces failure rates relative to lecture (Freeman et al., 2014), and controlled studies demonstrate that brief, research-aligned interactive activities can significantly enhance learning without increasing total instructional time (Deslauriers et al., 2011). However, students do not always perceive these approaches as effective. Experimental research indicates that learners may report lower perceived learning under active conditions even when objective learning gains are higher, in part because increased cognitive effort is experienced as difficulty rather than improvement (Deslauriers et al., 2019).

This perception-learning gap is central to understanding responses to SIRR. The routine relies on effortful processes such as retrieval, interleaving, and explanation, which support durable learning but reduce immediate fluency. As a result, students may interpret these experiences as ineffective despite their alignment with well-established learning principles.

Three recurring forms of resistance reflect this mismatch between perception and evidence. First, distributed low-stakes tasks may be experienced as continuous workload rather than as a sequence of brief activities. Research shows that learners tend to prefer less effortful strategies such as rereading and often underestimate the value of retrieval and spacing (Agarwal et al., 2021; Dunlosky & Rawson, 2015). This suggests the need to frame recurring prompts as a learning structure rather than a series of evaluations and to maintain low-stakes grading policies that reduce perceived pressure.

Second, interleaving may be interpreted as disorganization. Because it mixes topics, it contrasts with the linear progression that students often associate with clarity. Empirical findings show that learners frequently prefer blocked practice even when interleaving leads to better delayed performance (Rohrer et al., 2020; Taylor & Rohrer, 2010). Clarifying the role of comparison in strengthening conceptual discrimination can help align perception with instructional intent.

Third, relevance-based prompts may be dismissed as peripheral to course requirements. However, research indicates that connecting ideas to meaningful contexts supports engagement and deeper processing (Hidi & Renninger, 2006; Bransford et al., 1990). Resistance in this case reflects differing assumptions about what counts as academic work rather than a lack of instructional value.

Across these patterns, students tend to judge learning based on immediate experience, including ease and familiarity, whereas processes that support long-term retention and transfer often introduce difficulty. This discrepancy helps explain why evidence-supported approaches may be undervalued during implementation.

From an instructional perspective, the implication is not to reduce effort, but to support interpretation. Brief explanations of prompt purposes, opportunities for self-assessment, and use of exemplars can help students recognize effort as a feature of effective learning. In this way, resistance can be addressed while preserving alignment with evidence-based mechanisms.

4.5 Why SIRR should be retained

The rationale for SIRR rests not on any single mechanism, but on the coordination of processes that are often implemented in isolation. As reviewed in Section 4.2, these mechanisms have a strong and converging empirical base when considered individually. SIRR brings these processes into a shared, recurring routine that is feasible in everyday instructional settings. The theoretical basis for this coordination follows from the observation that complex learning requires the interaction of multiple processes, including retention, discrimination, explanation, and monitoring. When these processes are supported separately or inconsistently, learning may remain fragmented.

By embedding these processes within a shared cadence of short reflective episodes, SIRR offers a design that aims to support cumulative learning and conceptual integration. Adopting SIRR does not introduce a single new technique, but rather reorganizes reflective activity to more directly align with processes known to influence learning. As a low-overhead routine, SIRR offers a structured approach to reflection grounded in existing research. However, empirical research is needed to evaluate the extent to which this coordinated design produces outcomes beyond those associated with its individual components.

4.6 Implications for higher education teaching and learning

Adopting SIRR means shifting from generic reflective writing to micro-prompts. Keeping entries brief, revisiting a small set of key ideas, and distributing engagement across weeks aligns classroom practice with distributed practice and retrieval-based learning, which are linked to improved delayed performance and transfer in ordinary courses (Agarwal et al., 2021; Rohrer et al., 2020; Taylor & Rohrer, 2010). SIRR emphasizes scalable feedback structures that support self-regulation without extensive grading. Visible criteria, self-assessment, and occasional exam-wrapper-style reflections provide actionable information that can improve monitoring and strategy use in large enrollments (Gezer-Templeton et al., 2017; Nicol & Macfarlane-Dick, 2006). Because prompts may connect ideas to observations and current events, the framework incorporates relevance as a design element that can support both memory and motivation (Bransford et al., 1990; Brown et al., 1989; Hidi & Renninger, 2006).

While its cadence reflects higher education course design, the underlying principles can be applied flexibly across instructional contexts. In practice, these principles translate into brief, recurring reflective activities that help students resurface prior knowledge, differentiate among closely related concepts, and articulate concise explanations.

More broadly, SIRR contributes to the development of coherent learning environments by linking curriculum design, instructional practice, and feedback processes. By embedding structured reflection within regular course rhythms, instructors can make learning processes more visible and support ongoing calibration without substantial increases in time or grading demand.

4.7 Theoretical implications

Conceptually, the integrative review reconceptualizes reflection as a coordinating meta-mechanism that brings together distributed memory processes (spacing and retrieval), discrimination among closely related concepts (interleaving and choose-and-justify), generative explanation (brief why and how accounts), contextualization, and light-touch metacognitive calibration. This formulation clarifies that reflection is not a singular activity but a structured coordination of processes that operate jointly to support learning. On this view, SIRR reframes reflection from a largely descriptive or introspective practice into a designable process that can be systematically embedded in instruction. Rather than relying on open-ended prompts or generalized appeals to ‘thinking deeply,’ SIRR defines reflection in terms of processes that are associated with memory, understanding, and self-regulation, thereby making it both theoretically explicit and pedagogically actionable. Importantly,

this formulation distinguishes between evidence-supported mechanisms and their proposed coordination, positioning SIRR as a framework that is conceptually grounded and open to empirical testing.

The integrative synthesis also contributes by linking traditions that are often treated separately in the literature. Classical and experiential accounts of reflection are connected to findings from the learning sciences, including meta-analytic support for practice testing and spacing, as well as classroom and experimental evidence on interleaving and generative explanation. This coordination provides a more precise account of how reflective activity may support delayed and transfer performance, even when learners experience it as effortful (Agarwal et al., 2021; Donoghue & Hattie, 2021; Rohrer et al., 2020; Taylor & Rohrer, 2010). These contributions position SIRR not merely as a context-bound technique, but as a compact, theoretically grounded framework that explains how structured reflection functions as an integrated learning process across higher education settings.

4.8 Limitations of SIRR

These findings should be interpreted with attention to several boundary conditions and constraints that shape both design and evaluation. Because SIRR integrates multiple mechanisms within brief episodes of practice, it is difficult in typical classroom settings to attribute observed effects to any single component when they co-occur. Effects also depend on instructional cadence. Very short courses, irregular calendars, or infrequent meetings may require adaptation to sustain spacing and cumulative revisits. For measurement, short entries that support cadence can invite overinterpretation of reflective depth. Rubric-based judgments should therefore be complemented with validated schemes or instruments when SIRR is used for high-stakes assessment or research purposes (Hatton & Smith, 1995; Kember et al., 2000). A perception-learning gap may also emerge during implementation, as students may interpret the cognitive effort required by retrieval, interleaving, and explanation as evidence of poorer learning. This misinterpretation can influence course evaluations and affect instructor adoption or persistence. Addressing this constraint requires explicit communication of instructional purpose and support for interpreting the role of effort in learning.

4.9 A research agenda for SIRR

Given that SIRR is proposed as a theoretically grounded but empirically testable framework, several lines of inquiry are needed to examine its effectiveness, efficiency, and contextual fit across higher education settings. One priority is to establish effective design parameters for weekly routines, including the number of re-encounters, rotation intervals, and overall cadence needed to support reliable successive relearning under classroom constraints, with an emphasis on delayed outcomes. A second line of work concerns variation within the coordinated routine, where designs that preserve cadence could compare retrieval-only prompts with retrieval-plus-explanation and blocked justification with interleaved choose-and-justify formats to estimate the contribution of specific components. A third area involves scalable feedback structures, where comparisons of class-wide keys, annotated exemplars, and exam wrappers could examine their effects on calibration, reported learning strategies, and achievement in large-enrollment contexts. A fourth direction focuses on relevance and interest development, examining which types of prompts, such as local observation, news analysis, or stakeholder perspective, most effectively support durable memory and interest development. Finally, future research should examine whether reflective routines contribute to epistemic development, particularly in relation to reasoning about ill-structured problems through sustained engagement in justification and comparison.

5. Conclusion

This integrative review reconceptualizes reflection as a designable, process-aligned approach and presents SIRR as a compact framework that coordinates evidence-supported learning principles within everyday instruction. By structuring reflection through brief activities, the framework specifies how reflection can be organized to support retention, transfer, and coherence in higher education. Conceptually, the paper advances a more precise account of reflection as a coordinating process that integrates cognitive, epistemic, and motivational dimensions. This moves beyond treating reflection as an open-ended or introspective practice and instead positions it as a structured component of learning environments. The synthesis of classical reflection traditions with findings from the learning sciences provides a

clearer theoretical account of how such structured approaches may support learning over time. Practically, SIRR offers a feasible way to embed reflective activity within regular course structures without increasing instructional time or grading demands. By relying on brief prompts and scalable feedback, the framework aligns instructional design with processes known to support learning while remaining adaptable to different teaching contexts. At the same time, the review is not exhaustive, and SIRR should be understood as a conceptually grounded and empirically testable framework. Further research is needed to examine its effectiveness, refine its design, and evaluate how coordinated reflective routines influence retention, transfer, and epistemic development. Within these limits, structured reflection represents a promising direction for connecting research on learning with everyday instructional practice.

Conflict of Interest

The author declares that she has no conflicts of interest to this work.

References

Agarwal, P. K., Nunes, L. D., & Blunt, J. R. (2021). Retrieval practice consistently benefits student learning: A systematic review of applied research in schools and classrooms. *Educational Psychology Review, 33*(4), 1409–1453. https://doi.org/10.1007/s10648-021-09595-9

Asterhan, C. S. C., & Schwarz, B. B. (2007). The effects of monological and dialogical argumentation on concept learning in evolutionary theory. *Journal of Educational Psychology, 99*(3), 626–639. https://doi.org/10.1037/0022-0663.99.3.626

Bjork, R. A. (1994). Memory and metamemory considerations in the training of human beings. In J. Metcalfe & A. P. Shimamura (Eds.), *Metacognition: Knowing about knowing* (pp. 185–205). MIT Press.

Bjork, R. A. (2011). On the symbiosis of remembering, forgetting, and learning. In A. S. Benjamin (Ed.), *Successful remembering and successful forgetting: A Festschrift in honor of Robert A. Bjork* (pp. 1–22). Psychology Press.

Bransford, J. D., Sherwood, R. D., Hasselbring, T. S., Kinzer, C. K., & Williams, S. M. (1990). Anchored instruction: Why we need it and how technology can help. In D. Nix & R. J. Spiro (Eds.), *Cognition, education, and multimedia: Exploring ideas in high technology* (pp. 115–141). Lawrence Erlbaum Associates.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32–42. https://doi.org/10.3102/0013189X018001032

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/10.1207/s15516709cog1803_3

Credé, M., Roch, S. G., & Kieszczynka, U. M. (2010). Class attendance in college: A meta-analytic review of the relationship of class attendance with grades and student characteristics. *Review of Educational Research, 80*(2), 272–295. https://doi.org/10.3102/0034654310362998

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, 116*(39), 19251–19257. https://doi.org/10.1073/pnas.1821936116

Deslauriers, L., Schelew, E., & Wieman, C. (2011). Improved learning in a large-enrollment physics class. *Science, 332*(6031), 862–864. https://doi.org/10.1126/science.1201783

Donoghue, G. M., & Hattie, J. A. C. (2021). A meta-analysis of ten learning techniques. *Frontiers in Education, 6*, 581216. https://doi.org/10.3389/feduc.2021.581216

Dunlosky, J., & Metcalfe, J. (2009). *Metacognition*. SAGE.

Dunlosky, J., & Rawson, K. A. (2015). Practice tests, spaced practice, and successive relearning: Tips for classroom use and for guiding students' learning. *Scholarship of Teaching and Learning in Psychology, 1*(1), 72–78. https://doi.org/10.1037/stl0000024

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences, 111*(23), 8410–8415. https://doi.org/10.1073/pnas.1319030111

Gershman, S., Hausmann, R. G. M., Nokes, T. J., & VanLehn, K. (2009). The design of self-explanation prompts: The fit hypothesis. In *Proceedings of the 31st Annual Conference*

of the Cognitive Science Society (pp. 2626–2631). Cognitive Science Society.

Gezer-Templeton, P. G., Mayhew, E. J., Korte, D. S., & Schmidt, S. J. (2017). Use of exam wrappers to enhance students' metacognitive skills in a large introductory food science and human nutrition course. *Journal of Food Science Education, 16*, 28–36. https://doi.org/10.1111/1541-4329.12103

Hamilton, R. (2012). Elaboration effects on learning. In N. M. Seel (Ed.), *Encyclopedia of the sciences of learning* (pp. 1103–1105). Springer. https://doi.org/10.1007/978-1-4419-1428-6_170

Hartwig, M. K., & Malain, E. D. (2022). Do students space their course study? Those who do earn higher grades. *Learning and Instruction, 77*, 101538. https://doi.org/10.1016/j.learninstruc.2021.101538

Hartwig, M. K., Rohrer, D., & Dedrick, R. F. (2022). Scheduling math practice: Students' underappreciation of spacing and interleaving. *Journal of Experimental Psychology: Applied, 28*(1), 100–113. https://doi.org/10.1037/xap0000391

Hatton, N., & Smith, D. (1995). Reflection in teacher education: Towards definition and implementation. *Teaching and Teacher Education, 11*(1), 33–49. https://doi.org/10.1016/0742-051X(94)00012-U

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist, 41*(2), 111–127. https://doi.org/10.1207/s15326985ep4102_4

Kember, D., Leung, D. Y. P., Jones, A., Loke, A. Y., McKay, J., Sinclair, K., Tse, H., Webb, C., Wong, F. K. Y., Wong, M., & Yeung, E. (2000). Development of a questionnaire to measure the level of reflective thinking. *Assessment & Evaluation in Higher Education, 25*(4), 381–395. https://doi.org/10.1080/713611442

King, P. M., & Kitchener, K. S. (1994). *Developing reflective judgment: Understanding and promoting intellectual growth and critical thinking in adolescents and adults*. Jossey-Bass.

King, P. M., & Kitchener, K. S. (2004). Reflective judgment: Theory and research on the development of epistemic assumptions through adulthood. *Educational Psychologist, 39*(1), 5–18. https://doi.org/10.1207/s15326985ep3901_2

Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning and development* (2nd ed.). Pearson.

Lang, J. M. (2021). *Small teaching: Everyday lessons from the science of learning*. Jossey-Bass.

Mann, K., Gordon, J., & MacLeod, A. (2009). Reflection and reflective practice in health professions education: A systematic review. *Advances in Health Sciences Education, 14*, 595–621. https://doi.org/10.1007/s10459-007-9090-2

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

Pieschl, S. (2008). Metacognitive calibration—An extended conceptualization and potential applications. *Metacognition and Learning, 4*(1), 3–31. https://doi.org/10.1007/s11409-008-9030-4

Rawson, K. A., & Dunlosky, J. (2013). Relearning attenuates the benefits and costs of spacing. *Journal of Experimental Psychology: General, 142*(4), 1113–1129. https://doi.org/10.1037/a0030498

Rodgers, C. (2002). Defining reflection: Another look at John Dewey and reflective thinking. *Teachers College Record, 104*(4), 842–866. https://doi.org/10.1111/1467-9620.00181

Roediger, H. L., III, & Karpicke, J. D. (2006). Test-enhanced learning: Taking memory tests improves long-term retention. *Psychological Science, 17*(3), 249–255. https://doi.org/10.1111/j.1467-9280.2006.01693.x

Rohrer, D., Dedrick, R. F., Hartwig, M. K., & Cheung, C.-N. (2020). A randomized controlled trial of interleaved mathematics practice. *Journal of Educational Psychology, 112*(1), 40–52. https://doi.org/10.1037/edu0000367

Sampson, V., & Clark, D. B. (2008). Assessment of the ways students generate arguments in science education: Current perspectives and recommendations for future directions. *Science Education, 92*(3), 447–472. https://doi.org/10.1002/sce.20276

Smith, A. M., Floerke, V. A., & Thomas, A. K. (2016). Retrieval practice protects memory against acute stress. *Science, 354*(6315), 1046–1048. https://doi.org/10.1126/science.aah5067

Taylor, K., & Rohrer, D. (2010). The effects of interleaved practice. *Applied Cognitive Psychology, 24*(6), 837–848. https://doi.org/10.1002/acp.1598

Tobler, S., & Kapur, M. (2023). Metacognitive calibration: A methodological expansion and empirical application. In *Proceedings of the 17th International Conference of the Learning Sciences (ICLS 2023)* (pp. 3–10). International Society of the Learning Sciences. https://doi.org/10.3929/ethz-b-000600979

Toronto, C. E., & Remington, R. (Eds.). (2020). *A step-by-step guide to conducting an integrative review*. Springer. https://doi.org/10.1007/978-3-030-37504-1

Torraco, R. J. (2005). Writing integrative literature reviews: Guidelines and examples. *Human Resource Development Review, 4*(3), 356–367. https://doi.org/10.1177/1534484305278283

Torraco, R. J. (2016). Writing integrative literature reviews: Using the past and present to explore the future. *Human Resource Development Review, 15*(4), 404–428. https://doi.org/10.1177/1534484316671606

Whittemore, R., & Knafl, K. (2005). The integrative review: Updated methodology. *Journal of Advanced Nursing, 52*(5), 546–553. https://doi.org/10.1111/j.1365-2648.2005.03621.x

Zheng, X., Ma, Y., Yue, T., & Yang, X. (2023). Effects of different types of cues and self-explanation prompts in instructional videos on deep learning: Evidence from multiple data analysis. *Educational Technology Research and Development, 71*, 807–831. https://doi.org/10.1007/s11423-023-10188-2

Zhu, L., Huang, E., Defazio, J., & Hook, S. A. (2019). Impact of the stringency of attendance policies on class attendance/participation and course grades. *Journal of the Scholarship of Teaching and Learning, 19*(2), 130–140. https://doi.org/10.14434/josotl.v19i1.23717

How to Cite: Navarro, M. (2026). Structured Reflection for Durable Learning in Higher Education: An Integrative Review Building the SIRR Framework. *Contemporary Education and Teaching Research, 1(Special Issue: Student Learning in Higher Education: Curriculum, Teaching, and Learning Outcomes),* 1−11. https://doi.org/10.61360/BoniCETRHE262020150101