From Reflection to Action: The Role of Retrieval Practice in Deepening Learning and Instruction

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Abstract

This article responds to the persistent disconnect between educational research and classroom practice by examining retrieval practice as a reflective and actionable pedagogy. Drawing on cognitive science, it explores how retrieval practice, defined as the act of recalling knowledge from memory, can strengthen learning by activating prior knowledge and promoting long-term retention. The article positions retrieval practice as a timely response to educational systems dominated by summative assessment and superficial engagement, offering an alternative grounded in evidence and cognitive theory. It outlines the theoretical principles underpinning retrieval practice, including cognitive load theory and the concept of desirable difficulties, while critically reflecting on their limitations, particularly in their application to complex learning and real-world settings. Drawing on recent critiques, it argues for a more situated and responsive use of cognitive science in education. The article considers why retrieval practice remains underused despite strong empirical support. Barriers identified include misconceptions about effort and learning, task complexity, student anxiety and a lack of reflective implementation. Policy interventions, such as those in England, can encourage action but risk superficial adoption if divorced from professional reflection. This tension underscores the need for teachers to interpret evidence critically, adapt it thoughtfully and embed it meaningfully into their practice. In response, the article proposes evidence-informed strategies to support reflective action, which includes using feedback to motivate students, teaching learning strategies directly and supporting teachers through dialogue and professional communities. These approaches position both teachers and students as active agents in shaping learning environments that are responsive to research. Retrieval practice exemplifies how educational practice can be transformed when research engagement moves beyond passive awareness to active interpretation and application. This article calls for continued collaboration among researchers, practitioners and policymakers to sustain reflective educational cultures that act on evidence while remaining attentive to context.

Keywords: retrieval practice; education; evidence-informed teaching

Introduction

Learning can be defined as a change in long-term memory, whereby new information is encoded from working memory with the ability to be

retrieved later (Kirschner *et al.*, 2006). Optimising learning and teaching have long been a primary focus for educators, researchers and policymakers. Recently, cognitive science principles such as elaboration, retrieval practice and spaced learning have received attention for their potential to enhance learning outcomes (Dunlosky *et al.*, 2013). This represents a broader shift towards reflecting not only on how learning happens but also on how such knowledge can inform more effective instructional design. This shift invites reflection on how learning happens and what to do with that knowledge.

Retrieval practice, which involves actively recalling information to strengthen memory (McDermott, 2021), is increasingly seen as a practical application of cognitive science in classrooms. It addresses challenges like overload, shallow learning and mental fatigue, particularly in systems focused on short-term performance and rote memorisation (Bjork and Bjork, 2020). Retrieval practice helps learners by encouraging effortful recall, which builds links between what they know and new ideas, and supports long-term memory (Carpenter, 2023).

Though retrieval practice dates back to early twentieth-century research (Gates, 1917; Spitzer, 1939), interest has resurged in recent decades, with growing empirical evidence across age groups and contexts (Agarwal and Bain, 2019; Dunlosky and Rawson, 2019). Nonetheless, classroom implementation lags behind research, due to misunderstandings or practical constraints (Rea *et al.*, 2022).

Policy responses have begun to emerge, albeit unevenly. England has formally embedded retrieval practice in teacher development and initial teacher education (Department for Education, 2022). Müller and Cook (2024, p. 1478) found that 90% of teachers in England use it confidently, but this is an exception. Most education systems have not formally adopted retrieval practice widely and it often stays within research circles.

This article explores retrieval and memory theory, the concept of desirable difficulties, applications of retrieval practice and implementation challenges. To affect transformative change in classroom practice, this article moves beyond laboratory findings to address the gap as to how teachers interpret and apply retrieval in varied classroom contexts. Compared to existing reviews, this article addresses the gap of applying retrieval practice in an Irish context and how teachers can develop their

own professional practice. Finally, it offers recommendations for future research and practice, positioning retrieval practice as a reflective and actionable response to the evolving demands of education.

How Learning Happens: Cognitive Architecture and Pedagogical Implications

Cognitive Science in Education and the Policy Landscape

Cognitive science principles, such as student quizzing, have been practised informally for decades but are now being systematically researched. Cognitive psychology studies behaviour and interpretation, while cognitive neuroscience investigates brain responses (Perry *et al.*, 2021). Sweller *et al.* (2011) argue that instructional design is blind without an understanding of human cognition. However, much of the conducted research is laboratory-based, raising concerns about its ecological validity and classroom transferability.

In England, education policy has mandated the use of cognitive science strategies, including retrieval practice, to improve student learning (Müller and Cook, 2024). While this has increased uptake, the absence of detailed implementation guidance has led to challenges. Bates and Shea (2024, p. 252) report that 52.3% of surveyed teachers used strategies solely due to policy pressure, potentially resulting in tokenistic application and limited impact (Burdett and O'Donnell, 2016). This highlights the importance of reflective understanding alongside policy action. Educators must not only adopt evidence-based methods but also understand how they align with established pedagogies and how best to apply them in practice (Perry, 2022).

Despite this policy-level action, English education reforms have also attracted criticism. Scholars argue that these reforms prioritise large-scale empirical studies at the expense of long-standing traditions in philosophy, sociology and curriculum theory (Hordern and Brooks, 2023). These fields have historically aimed to enrich and inform teaching and learning by approaching education from distinct disciplinary perspectives, providing a contrasting vision to the 'New Science' approach currently favoured in English education policy. This new policy focus is viewed as effectively marginalising the rich and diverse insights offered by philosophy, sociology

and curriculum theory that empowers teachers as critically reflective professionals (Tillin, 2023).

The English Early Career Framework, for example, has been criticised for reducing teaching to procedural knowledge, neglecting tacit and situated dimensions of professional expertise (Hordern *et al.*, 2024). Tillin (2023) further suggests that the emphasis on school-led teacher training has marginalised universities, raising concerns about the coherence and depth of research-informed education. These developments risk fragmenting teacher education and reinforce the need for policy to be critically examined to ensure it supports reflective, high-quality professional practice.

While England has formally integrated retrieval practice into policy, Ireland's policy landscape is still evolving in terms of explicit cognitive science recommendations. The Irish Department of Education's current strategy (Department of Education, 2023) emphasises evidence-informed practice in general but does not yet mention specific techniques like retrieval practice. This highlights a gap and an opportunity within the Irish context to bring research on retrieval into policy and practice dialogues.

The Role of Retrieval in Learning and Memory
Retrieval refers to the act of recalling information from memory, often with little to no support, and is one of the most fundamental aspects of human learning and remembering (Perry *et al.*, 2021). It can involve recall (producing information) or recognition (identifying familiarity). It plays a pivotal role in the successful learning and application of information. However, it is not a neutral process, as it influences and also partly changes what is remembered with the accurate retrieval of memories enhancing later retention and inaccurate retrieval cementing errors (Roediger and Abel, 2022). It remains unclear on how retrieval can be integrated in applied settings, such as secondary classrooms, and how to increase its utilisation among students as a learning strategy (Carpenter, 2023).
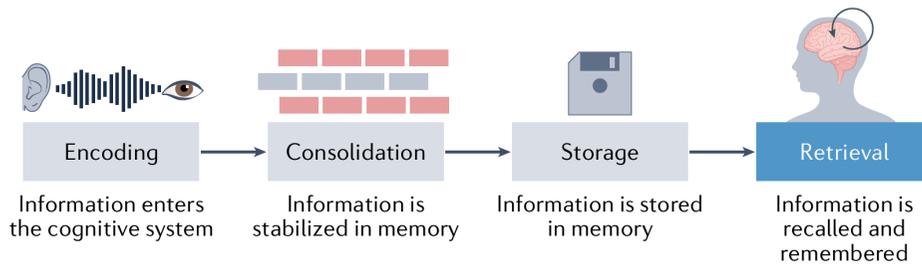
Figure 1: Four Stages of Memory (Roediger and Abel, 2022, p. 709)

Roediger and Abel (2022) describe four stages in the learning and memory process, illustrated in Figure 1, with the process beginning with encoding of information, together with the context in which it was encountered, through direct experience. The new information is then consolidated and stored in memory. Retrieval is the final stage, whereby memories are recalled into conscious awareness either overtly (saying or writing it) or covertly (thoughts only) (Roediger and Abel, 2022). Retrieval theory proposes that the learning benefits of recall arise from the cognitive effort expended during retrieval (Smith-Peirce and Butler, 2025), aligning with Willingham's (2021, p. 58) view that "memory is the residue of thought".

Retrieval benefits increase when students receive feedback on their failed retrieval attempts as it can potentiate subsequent learning of correct material (McDaniel *et al.*, 2011). Conversely, if there are errors in memory recall then a retrieval practice effect can also occur for erroneous information and the more the error is repeated then the more it becomes part of the memory (McDermott, 1996).

The forward-testing effect (test-potentiated learning) describes how engaging in a test prior to the learning of new information leads to improved learning of that new information (Pan *et al.*, 2024). Even unsuccessful retrieval attempts (pretesting on unknown material) can enhance subsequent learning (Rea *et al.*, 2022). This process involves activating relevant schema networks and directing attentional resources more efficiently during subsequent learning (Pan and Carpenter, 2023).

However, an issue that has not yet been examined is whether this effect decreases with repeated and maybe routine use in classrooms and other real-life contexts (Roediger and Abel, 2022). One key concept that helps explain its effectiveness is that of desirable difficulties.

Desirable Difficulties

Effortful retrieval is a desirable difficulty that supports learning (Carpenter, 2023). Bjork (1994) argues that the best way for learners to remember what they have learnt and transfer new learning to other contexts is to make the learning experience slightly more difficult in the short term. Desirable difficulties, pedagogical strategies that introduce manageable cognitive challenge, have been shown to enhance long-term learning by fostering deeper cognitive processing (Bjork and Bjork, 2020). This theory calls for a shift from short-term performance to long-term, meaningful learning through strategies like retrieval practice. It offers a response to the widespread issue of surface-level learning in education.

However, Bjork and Bjork (2020) state that not all difficulties are desirable as if the learner is not eventually successful then the task can be ineffective from a learning perspective. They claim that the optimal level of difficulty varies depending on the learner's prior knowledge and the key is that difficulties must be task-relevant, novel and potentially solvable by the learner. This aligns with Perry *et al.*'s (2021) claim that uncertainty remains about how much difficulty is desirable in retrieval practice or whether feedback always provides a solution for unsuccessful retrieval. This requires the need for measured teacher judgement, with reflection on prior knowledge essential to calibrating the level of difficulty.

Although there is much published research regarding the benefits of using desirable difficulties (Bjork and Bjork, 2020; Rovers *et al.*, 2018), its use is limited in practice due to many education systems' traditional focus on short-term performance. This results in superficial learning gains, which deliberate cognitive challenge seeks to counter (Kirschner *et al.*, 2022). However, Wenzel and Reinhard (2019) found that the benefits of desirable difficulties might not extend to lower-ability learners, requiring further research. This again shows that teachers must reflect on students' prior knowledge and abilities when introducing difficulties, to ensure positive results. This reinforces the need for reflective teacher judgement. Retrieval

practice offers a practical method to implement desirable difficulties, which will be explored next.

It is worth positioning retrieval practice within the broader spectrum of educational approaches. While retrieval is grounded in cognitive science and often associated with teacher-guided, knowledge-rich instruction (Kirschner *et al.*, 2006), it need not conflict with constructivist or sociocultural paradigms. Constructivist theories (Bruner, 1961; Dewey, 1938) and sociocultural perspectives (Vygotsky, 1978) emphasise meaning-making through interaction and enquiry. However, retrieval practice can be harmonised with these views, for example, through reflective questioning in project-based learning, or collaborative recall tasks that support shared construction of knowledge. Seen this way, retrieval is not rote but reconstructive: an active process through which students make sense of prior learning (Wittrock, 1989).

The Role of Teacher Professional Reflection

Teacher professional reflection is a multifaceted process crucial for educators' ongoing development and their ability to effectively implement new teaching strategies in the classroom (Mathew *et al.*, 2017). Kolb's (1984) experiential learning cycle further highlights this, situating reflection as a critical stage where experience is transformed into knowledge through active conceptualisation (Collin *et al.*, 2013). Reflective practice fosters not only skill acquisition but also the development of professional identity. Rodgers and Scott (2008) argue that the construction of teacher identity is shaped by socio-cultural, relational and emotional contexts.

Despite its widely acknowledged benefits, reflective practice in teacher education faces significant critiques. There is a persistent lack of clarity and consensus on what reflective practice truly means, with authors using various terms like 'reflexivity', 'reflection' and 'reflective analysis' interchangeably or with differing meanings, leading to confusion (Rodgers, 2002). Some conceptualisations propose hierarchical levels of reflection, with broader perspectives (e.g. social, ethical dimensions) being considered superior (Collin *et al.*, 2013). While reflection is a dynamic and essential process in teacher professional development, the field acknowledges the need for more nuanced approaches that account for the diverse developmental stages of teachers.

Having established the cognitive foundations, this article now turns to retrieval practice itself: its forms, effectiveness and why it matters as a reflective pedagogy.

Retrieval Practice as Reflective Pedagogy: Forms, Timing and Effectiveness

What is Retrieval Practice and Why Does It Matter?

Retrieval practice involves actively recalling information from long-term memory, which strengthens retention and reduces forgetting (Willingham, 2021). However, memory comprises two interacting strengths: storage strength (how well an item is learned and integrated) and retrieval strength (ease of access) (Bjork and Bjork, 2011). Crucially, high retrieval strength leads to smaller gains in storage strength from retrieval, while high storage strength facilitates greater improvements in access (Bjork and Bjork, 2020). Therefore, this means that forgetting can actually enable learning when retrieval practice is spaced or varied (De Bruin et al., 2023).

While tests are often seen as assessments of learning, retrieval practice serves as an assessment for learning, encouraging learners to reflect on and consolidate prior knowledge (Wiklund-Hörnqvist et al., 2022). However, this process essentially asks learners to reflect on what they have previously learnt as a means of solidifying knowledge for future application. The benefits of retrieval practice are substantial when compared to no activity (Hedge's effect size, g = 0.93) or to restudy (g = 0.51), demonstrating it as a powerful action in response to forgetting (Adesope et al., 2017, p. 683). A key finding proposed by Bertilsson et al. (2021) for teachers is that retrieval practice can benefit all students regardless of individual differences. It also has the advantage of providing formative feedback to identify gaps and inform future teaching (Roediger et al., 2011).

While more applied studies of retrieval practice's effects are recommended (Roediger and Abel, 2022), certain case studies provide insight into real classroom experiences. McDaniel et al. (2011) conducted controlled experiments in middle school science classes, demonstrating that low stakes quizzing with feedback was highly effective in improving performance on summative assessments of core curricular content. Jaeger et al.'s (2015) study demonstrated the benefits of retrieval practice for

eight- to ten-year-olds in elementary schools in Brazil, with positive results extended to children across a range of abilities. Evidence increasingly supports that retrieval practice is a broadly applicable learning strategy, effective across a spectrum of cognitive abilities and for learners acquiring new languages, contributing to its high utility in diverse educational settings (Wiklund-Hörnqvist *et al.*, 2022).

Critics argue that its benefits decline with complex learning (Van Gog and Sweller, 2015) and others suggest effects are limited to factual recall (Rohrer *et al.*, 2020). Such critiques highlight that educators must consider what kind of learning outcome they are targeting. This article acknowledges these critiques and proposes that retrieval practice is most powerful for foundational knowledge, whereas deeper learning may require retrieval to be combined with other strategies. In other words, retrieval practice is not a silver bullet for all learning outcomes, but it is a crucial component for securing core knowledge, a stance this article advocates. Despite strong evidence, classroom uptake remains limited, often due to misunderstanding or insufficient support (Yang *et al.*, 2021). Greater support is needed to help teachers and students reflect on its value and use it effectively.

Designing Retrieval Practice: Techniques and Considerations

Retrieval practice can take many forms and educators should choose those that best fit their teaching goals and classroom context. Common retrieval practice techniques include:

- **Free recall**: Students write or say everything they remember without cues.
- **Low-stakes quizzes**: Used at lesson openings or endings to encourage practice without fear (multiple choice questions, matching, short answer questions).
- **Flashcards**: Especially effective for vocabulary, definitions, or formulae.
- **Concept mapping**: Helps students connect and organise ideas.
- **Brain dumps**: Encourage open-ended reflection and schema activation.
- **Any activity** that encourages learners to bring information to mind from memory.

These strategies can be adapted by teachers in response to their students' needs. Quizzes prompt students to think actively about previously learned material, supporting long term retention, but their effectiveness depends on several factors including timing, format and feedback (Adesope *et al.*, 2017). Delayed feedback may promote transfer of knowledge (Agarwal *et al.*, 2021), while the absence of feedback may reduce their usefulness (Moreira *et al.*, 2019).

It is important that both teachers and students understand the purpose of quizzes. Some students may experience anxiety or fear of failure if they cannot recall answers (Jørgensen *et al.*, 2024). Educators must therefore be reflective about how they introduce retrieval tasks, framing them as opportunities for learning and normalising mistakes, so that the act of quizzing does not provoke negative responses. While quizzes can also serve as a form of formative assessment to inform teaching decisions (Moreira *et al.*, 2019), if misused as formal tests, their benefits to strengthening memory may be lost (Bates, 2025).

Free recall, which asks students to remember material without cues, requires the most cognitive effort but can help learners organise and integrate concepts (Carpenter *et al.*, 2022). Dobson and Linderholm (2015) studied 125 undergraduate science students and found those who used free recall outperformed those who relied on note taking or rereading. However, the strategy is demanding and may leave some learners feeling uncertain or demotivated, particularly those with lower prior knowledge (De Lima and Buratto, 2024).

Concept maps involve retrieving information and linking ideas, which can support deeper understanding and memory (Ruiz-Martín *et al.*, 2024). Yet, Perry *et al.* (2021) argue they may cause cognitive overload if students focus more on structure than recall. Therefore, retrieval tasks should be carefully aligned with learning goals and cognitive load (Yang *et al.*, 2021). For example, free recall may suit more experienced learners, while structured quizzes with cues may support novices in building retrieval confidence.

When to Retrieve: The Role of Spacing and Timing in Learning

The timing of retrieval practice connects with the spacing effect, whereby opportunities to revisit material is spread out over time and has been shown

to be more effective than massed practice (Carpenter *et al.*, 2022). When spaced and retrieval practices are combined, they yield durable learning gains (Yang *et al.*, 2021). While weekly retrieval is common, the optimal interval varies. Classroom studies show greater gains from shorter delays; lab studies favour longer ones, suggesting timing must be adapted to authentic settings (Agarwal *et al.*, 2021). Clearly, more research is needed on this aspect to gain more conclusive evidence.

The timing of retrieval practice also questions whether it is improving performance or learning (Bjork and Bjork, 2023). Immediate retrieval may boost short-term performance, while delayed retrieval strengthens long-term memory. These mixed results indicate that educators must be adaptive, reflecting on whether the goal is short-term performance or long-term. Scheduling retrieval practice becomes an intentional action informed by reflective consideration of context, what works in a controlled study may need adjustment in a real classroom.

Despite clear benefits, the mere existence of retrieval practice as a strategy does not guarantee that students and teachers will embrace it. However, even with strong evidence for retrieval practice, it remains underutilised. The barriers that impede its implementation in real classrooms are explored in detail below.

Barriers to Implementation: Why Retrieval Practice Remains Underused

Cognitive Barriers: Misconceptions About Learning

Building on the previous section's design considerations, this section examines real-world challenges affecting the adoption of retrieval practice. Despite strong evidence of its benefits, uptake remains limited. Carpenter (2023) emphasises that although there is substantial research-informed evidence that retrieval practice is beneficial, we know far less about whether learners actually choose to use it when free to do so. Tricio *et al.* (2023) found that very few students report choosing retrieval practice and in a study by Ruiz-Martín *et al.* (2024) of 3,414 Spanish secondary students, retrieval practice was one of the least used strategies despite its strongest positive correlations with academic achievement.

This aligns with Hartwig and Dunlosky's (2012) finding from a study involving 324 undergraduate American students that self-testing was positively and significantly associated with high-grade performance. However, consistent with previous studies, most students reported using self-testing as a metacognitive tool to monitor what they had learnt rather than as a means to enhance learning directly. Even when informed of its benefits, students often avoid retrieval practice unless required (Broeren *et al.*, 2021; Simone *et al.*, 2023).

A key reason is that many teachers and students are often unfamiliar with effective learning strategies, such as retrieval practice, with instruction on them being rare (Jørgensen *et al.*, 2024). This underuse, despite strong evidence, represents a known gap in education and a call to action is needed. Closing this gap is a collective responsibility, whereby researchers must disseminate findings in more accessible ways and institutions must support teachers and students in adopting these strategies. Reflective teachers are attuned to students' misconceptions about learning and can adapt their instruction to explicitly challenge passive strategies, for instance, by modelling retrieval as an effective approach to long-term retention (Brookfield, 1998).

Large-scale adoption also depends on national policy support. However, embedding specific methodologies in policy remains rare and challenging. A balanced approach is needed to avoid oversimplification, evolving evidence suggests that initial guidance reports may offer a more flexible entry point for educators. Improving uptake demands a coordinated response, policy direction from above and teacher-led action from below. These cognitive barriers reveal how both students and teachers can misjudge effective learning, undervaluing the long-term benefits of retrieval practice, despite strong evidence.

Motivational Barriers: Effort, Anxiety and Avoidance

Learners' avoidance of retrieval practice despite its proven benefits over less effective strategies, which may stem from the false perception that effort signals ineffective learning (Kirk-Johnson *et al.*, 2019). Such misperceptions indicate the need for reflective interventions: students and educators must reconsider what effective learning feels like. This is precisely the challenge that desirable difficulties (Bjork and Bjork, 2020)

seek to address: learners must understand that struggle can be beneficial rather than a sign of failure.

In studies by Hui *et al.* (2021; 2022) participants learnt Latin names for images, with one set studied using retrieval practice and another through restudy. After an immediate test, the students were shown that retrieval practice was significantly more effective than restudy, yet participants still only chose it approximately 50% of the time. This suggests a strong preference for comfort over efficacy (Tricio *et al.*, 2023), illustrating that discomfort, even when paired with success, can be a strong deterrent.

Learners may also avoid using retrieval practice because it can involve making errors, which can undermine confidence and motivation (De Bruin *et al.*, 2023). Avoidance persists even when students understand that errors are a productive part of learning (Pan *et al.*, 2020). This again connects to desirable difficulties, where the productive struggle enhances memory, yet students still tend to resist the associated discomfort. Thus, part of the response to this issue is educational: students (and teachers) need opportunities to reflect on the benefits of difficulty, to see that the short-term struggle of retrieval yields long-term mastery.

Tullis *et al.* (2018) demonstrated that perceived effort plays a critical role in students' strategy choices in their study of twenty-three American introductory-level psychology students. They found that when learning word pairs by retrieval practice and restudy, even when the participants received feedback during retrieval practice that allowed them to correct their errors, they still preferred to restudy because of the decreased effort involved. The perceived undesirable side effects of retrieval practice have a considerable impact on students' efficacy in choosing a strategy demonstrating a need for methodologies to overcome this. These studies reveal how deeply ingrained the preference for comfort is and therefore the response must be persistent and multi-faceted in the form of classroom demonstrations, explicit teaching about learning science and continuous feedback.

Technology may help reduce resistance to retrieval practice. Gamified tools such as *Kahoot!* and *Quizizz* can increase engagement and make the process more enjoyable. However, teachers must exercise caution as not all technology incorporates best practice and students remember what they think about, with resulting memories of a game possibly overpowering

intended learning (Willingham, 2021). These motivational barriers indicate that students may avoid retrieval practice despite recognising its value, due to discomfort or perceived effort. Addressing this requires more than information, it demands a reflective shift in learning beliefs.

Institutional Barriers: Transfer from Research to Classroom

A recurring critique of retrieval practice research is its low ecological validity; many studies occur in highly controlled settings rather than actual classrooms. Perry *et al.* (2021) note that most studies were designed and delivered by researchers in scripted laboratory settings. This questions the generalisability of the findings as to whether they cane be translated to the more complex classroom setting (Bates and Shea, 2024). Moreover, many studies employ standardised methodologies that do not accommodate the diverse pedagogies and experiences of classroom teachers (Jørgensen *et al.*, 2024). This lack of ecological validity limits the practical guidance available to teachers and contributes to a persistent research-practice gap.

Despite these concerns, there is growing evidence that retrieval practice can be successfully implemented in classrooms. Carpenter *et al.* (2022) report benefits across various education levels and subjects. Notably, a study by Churches *et al.* (2020) involved teachers themselves conducting trials in thirty-one schools, with 2,157 children from early years to Year six included, a rare instance of research fully embedded in practice. The findings showed positive effect sizes for sixteen out of twenty-one retrieval practice studies, with nine of these having statistically significant results. While these results are encouraging, the authors caution that confidence in replicability remains low. Several factors contribute to this implementation gap:

- The artificial nature of many experimental studies
- Limited opportunities for teacher adaptation during research
- Pressure to implement evidence-based strategies without sufficient time or support
- A disconnect between academic discourse and school-level priorities.

English teachers generally hold positive views about retrieval practice and use it regularly, whether mandated or self-initiated (Bates and Shea, 2024). However, much research has yet to influence teacher training or

school practices, partly due to the adaptation required from laboratory to classroom contexts (Perry *et al.*, 2021). Studies from Bates (2025) and Churches *et al.* (2020) show that when teachers embed retrieval into everyday teaching, positive outcomes follow. These findings underline the need for reflective collaboration between researchers and educators. Institutional barriers such as limited training, lack of time and insufficient policy guidance must be addressed through coordinated, classroom-ready support.

Pedagogical Barriers: Task Complexity and Prior Knowledge

Although retrieval practice consistently enhances learning (Yang *et al.*, 2021), its impact may decline with more complex learning tasks. According to Van Gog and Sweller (2015), this complexity is defined by 'element interactivity', how much information must be processed simultaneously. Tasks with low element interactivity, where components can be learned independently, typically benefit more from retrieval practice. In contrast, highly interdependent tasks may require different or additional strategies.

Leahy *et al.* (2015) investigated the effect of retrieval practice after a worked example study with thirty-three primary school students from two Sydney schools. They found no improvement on immediate or delayed problem-solving tests. Similarly, Hanham *et al.* (2017) reported that retrieval was less effective with high element interactivity and might even inhibit learning. However, the strategy may become more appropriate as learners gain experience, highlighting the role of prior knowledge. These studies suggest that the benefits of retrieval practice may not be ubiquitous with gains dependent on task complexity and educators should exercise caution when assuming its effectiveness.

On the other hand, Dobson *et al.* (2018, p. 522) found that retrieval enhanced higher-order skills. When students were asked to critically evaluate research articles, those using retrieval outperformed those who restudied (mean score 34.6% vs 20.5%). This suggests that retrieval can support both factual recall and complex reasoning. Fiechter and Benjamin (2018) further argue that retrieval practice is especially effective for higher-order tasks when paired with appropriate scaffolding.

These debates demonstrate how research is responding to its own contradictions in the form of academic 'reflection and action'. Pedagogical

complexity remains a challenge, especially for teachers aiming to use retrieval practice with higher-order learning. Reflective planning and scaffolding can help ensure its appropriate use depending on learners' prior knowledge and task difficulty. Table 1 summarises key barriers and recommended responses.

Identified Barrier	Recommended Response
Students prefer passive study strategies	Teach students about retrieval benefits; use motivating feedback; make retrieval engaging (e.g. gamified quizzes, peer challenges) (Carpenter, 2023).
Students experience anxiety or fear of failure	Keep stakes low; frame quizzes as learning tools; normalise mistakes; allow group or anonymous responses to build confidence (Perry *et* al., 2021).
Teachers lack time or curricular space	Embed short retrieval tasks into existing lessons; use 5-minute starters; automate via tech tools where feasible (Bates and Shea, 2024).
Teachers uncertain about how to implement retrieval practice	Offer professional development and peer support; present retrieval as an adaptable enhancement to existing routines (Perry *et al.*, 2021).
Policy or exam pressure prioritises coverage over consolidation	Show that retrieval improves long-term learning; advocate for depth over pace; highlight how retrieval reduces reteaching time (Agarwal and Bain, 2019).

Table 1: Barriers to Retrieval Practice and Corresponding Solutions

In summary, maximising the impact of retrieval practice requires more than awareness of its benefits. It demands thoughtful, context-sensitive implementation and ongoing reflection from all educational stakeholders.

## Applying Retrieval Practice in the Classroom

In light of the identified barriers, how can educators and institutions respond to ensure retrieval practice is effectively implemented? This section offers strategies for implementing retrieval practice reflectively: leveraging feedback, building student metacognitive awareness and integrating retrieval into classroom practice. Retrieval practice should be embedded into curriculum planning as a routine element, not treated as an add-on, with regular, spaced activities like weekly quizzes or daily starters aligned to key syllabus content. When integrated thoughtfully, it supports learning consolidation, strengthens retention and reduces the need for re-teaching, all without significantly affecting lesson pacing.

Feedback as a Catalyst for Action

As discussed previously, one of the biggest barriers in retrieval practice implementation is that students tend not to choose it due to the perceived effort costs. However, showing students the desirable outcomes associated with retrieval-based learning and how those benefits apply to them increases the likelihood of adoption (Carpenter, 2023). This was observed in a study that offered students optional practice quizzes that could be used as a study tool in a biology course (Carpenter *et al.*, 2017, p. 5). Less than 50% of students completed at least one quiz before the first two course exams. The instructor then shared a simple graph comparing exam scores of those who completed the quizzes versus those who did not. The result was dramatic: on the next exam, 80% of students chose to use the quizzes. In other words, presenting students with clear feedback served as a catalyst for reflection, which in turn prompted them to take action. This contrasts Hui *et al.* (2021) finding where students were reluctant to change their practice, demonstrating the need for further research and perhaps, the differences between laboratory and classroom studies.

Similarly, Hui *et al.* (2021, p. 1844) found that when students saw proof of their improved performance due to retrieval practice, they became 70% more likely to choose retrieval over other methods. McCabe *et al.* (2021) reported that students who had used retrieval practice later self-reported using it far more frequently than those who had not, once they experienced its benefits firsthand. These examples suggest a key principle: feedback can convert short-term reflection into long-term action. By seeing concrete

evidence that effortful strategies pay off, learners become more motivated to adopt them.
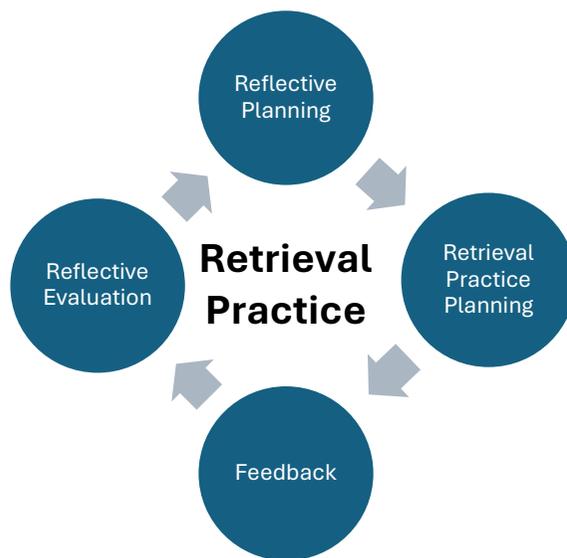
Figure 2: Reflective Retrieval Practice Model

Retrieval practice also has significant formative benefits, whereby it can provide feedback to both students and teachers to inform future learning and teaching. This feedback not only consolidates existing learning but also deepens and extends it, allowing teachers to address misconceptions and provide second learning opportunities for students (Bates and Shea, 2024). Since retrieval practice regularly involves errors, feedback helps students to address these errors and fill knowledge gaps (Moreira *et al.*, 2019).

While retrieval practice is powerful, it is not a one-size-fits-all strategy. Teachers should adapt tasks to suit diverse learners, using prompts or verbal retrieval for younger or less confident students, to ensure that difficulties remain desirable but not overwhelming (Bjork and Bjork, 2020). Figure 2 illustrates this article's conceptual framework: teachers reflect on learning

goals and student needs, then take action by implementing retrieval practice strategies. This produces evidence (student performance, feedback), which teachers reflect on to refine their practice further. This cyclical model situates retrieval practice not as an isolated technique but as part of an ongoing reflective teaching process.

From these studies it is clear that feedback plays an integral role in maximising benefits. Educators can respond to students' reluctance by incorporating regular low-stakes quizzes followed by reflective feedback sessions, where assessment results (anonymised if needed) are reviewed to show the benefits of retrieval practice. This not only reinforces content but also visibly demonstrates the value of the effort, encouraging continued engagement.

Empowering Students: Teaching for Metacognitive Awareness

While feedback can guide students after retrieval, empowering them before and during the process is equally crucial. Research suggests that many students are unaware of effective learning strategies, often relying on easier or more familiar methods (Ruiz-Martín *et al.*, 2024). Even when students have an understanding of effective methods, this does not always translate to consistent use (Rea *et al.*, 2022). As a result, interventions that aim to educate and promote greater awareness of more effective methods can significantly improve learning.

Research on self-regulated learning shows that students often need guidance to adopt effective strategies. Zimmerman (2002) outlines how self-reflection and monitoring are essential phases in the learning cycle. If students are taught why retrieval practice works (metacognitive knowledge) and how to do it, they are more likely to use it consistently. This aligns with Pintrich's (2000) argument that promoting metacognitive strategies can significantly improve academic performance.

Biwer *et al.* (2020) developed the 'Study Smart' programme, a series of training sessions to teach students about effective strategies, including desirable difficulties, and providing opportunities to practise them. The programme led to students having a more accurate awareness of retrieval practice, increased use of it and even higher exam performance (Biwer *et al.*, 2023). In addition to academic gains, such interventions may foster greater self-regulated learning and academic confidence, outcomes of

interest not just to educators but also to psychologists studying motivation. Notably, such programmes encourage students to reflect on their own study habits and then take informed action to adopt proven techniques like retrieval practice.

Although programmes like these have shown promising results (De Bruin *et al.*, 2023; McDaniel and Einstein, 2020), there is no record of similar programmes in Ireland. This gap in Ireland's educational policies represents an opportunity for a coordinated response: introducing national or regional initiatives to train students in effective learning strategies could significantly level the playing field. By embedding such reflective learning programmes into the education system, policymakers can take action informed by cognitive science to improve student outcomes.

Teacher Agency: Translating Evidence into Practice

Ultimately, teachers are the linchpin in whether retrieval practice becomes a regular part of learning. Without teacher buy-in, students are unlikely to engage in these strategies. Although the primary objective is for the increased use of effective strategies, like retrieval practice, it is unlikely to happen if teachers are not embedding it as a regular part of their classroom practice. Knowing that many students will not adopt retrieval practice independently (Simone *et al.*, 2023), teachers must proactively incorporate it into their teaching. They act as the crucial bridge between research and student behaviour.

To bridge the research-practice gap, teacher education and professional development should integrate training on retrieval practice, as part of wider cognitive science principles, and reflective pedagogy. For pre-service teachers, this might involve coursework on retrieval coupled with assignments to design and trial retrieval-based activities during teaching placements. Targeted professional development can help shift this mindset by demonstrating the learning benefits of retrieval practice, not just its assessment role (Wiklund-Hörnqvist *et al.*, 2022).

Schools or regions could establish professional learning communities to reflectively share experiences of implementation and even conduct action research projects to enhance best practice. When teachers understand *why* it works (the cognitive science behind it), they can implement it more purposefully. Bates and Shea (2024, p. 252) found that 83.6% of surveyed

teachers learnt about retrieval practice from professional conversations with fellow teachers demonstrating the importance of communities of practice for developing pedagogy (Wenger, 1998).

This highlights how collective reflection leads to action and reinforces that schools should encourage more professional learning communities where teachers regularly discuss and reflect on strategies like retrieval practice, share experiences and troubleshoot challenges. Crucially, understanding the "why" behind retrieval increases the likelihood of effective implementation (Jørgensen *et al.*, 2024).

It could be debated that mandating the use of retrieval practice through either national or school policy might lead to tokenism and poor implementation, but Bates and Shea (2024, p. 252) found that 72.5% of teachers reported using it when it was part of school policy compared to 52.1% when it was not. Yet, those forced by policy placed more emphasis on using it as an evaluative tool rather than as a technique to enhance student learning, diminishing the true objective of the strategy. This finding suggests that while policy can prompt action, it is the quality of that action, determined by teachers' reflective understanding, that matters for achieving the intended learning benefits. Therefore, the most effective response is likely a balanced approach: support and training to encourage action coupled with professional reflection to ensure the action is pedagogically sound.

It is important to note that overemphasis or a misunderstanding of its purpose could result in potential unintended consequences such as an overemphasis on testing culture and increased student stress. To mitigate these effects, this article stresses low-stakes and reflective use of retrieval, emphasising that retrieval practice is a tool for learning, not evaluating. Professional reflection also enables teachers to reframe retrieval practices, distinguishing them from high-stakes assessment and situating them instead as low-stakes, formative opportunities to enhance learning (Mathew *et al.*, 2017).

To understand the potential enactment of retrieval practice in the classroom, this article presents a hypothetical vignette: To illustrate the classroom enactment of retrieval practice, consider a hypothetical example from a secondary history lesson on the 1916 Rising. As part of reflective planning, the teacher anticipates common misconceptions and opens the

unit with a low-stakes quiz on prior learning about Irish nationalism. The retrieval task surfaces gaps in understanding, allowing the teacher to address key schema before introducing new material. A subsequent think–pair–share activity prompts students to reflect on what was difficult to recall and why. This feedback shapes the teacher's next instructional decisions. In this way, retrieval practice becomes embedded within a reflective cycle of planning, action and evaluation.

Collectively, these strategies of providing feedback, educating learners and empowering teachers, demonstrate how reflecting on the barriers can inform tangible actions that improve learning.

Conclusion: Bridging the Gap Through Reflection and Action

While retrieval practice offers significant benefits, an overemphasis on recall tasks risks reinforcing a performance-driven or test-oriented culture. It is therefore essential that retrieval be balanced with pedagogies that promote deeper enquiry, collaboration and meaning-making.

Despite strong empirical support, retrieval practice remains underutilised, due in part to motivational barriers, misconceptions about effective learning and challenges with classroom implementation. Future research should investigate how retrieval practice can be adapted to varied educational settings, with attention to optimal timing, feedback, individual learner differences and integration into broader pedagogical frameworks. A deeper understanding of these factors will help move the strategy from theory to sustainable practice.

To conclude, this article outlines calls-to-action steps various stakeholders can take to close the persistent research-practice gap in education, using retrieval practice as a model case:

- **Teachers** should start small by incorporating one retrieval activity per week and reflect on its impact on students' learning and how it connects with other methodologies. They can then share their experiences with colleagues and school leadership to promote bottom-up and top-down engagement.
- **School leaders** can encourage and support evidence-informed learning and teaching methods by providing professional development, relevant literature and celebrate these methods' impact. Allocating time to

teacher collaboration and reflection would significantly enhance implementation rates.

- **Policymakers** could integrate key principles of learning science into curricula and produce official guidelines of best practice. They could fund and disseminate pilot projects in schools to investigate its impact in applied settings.
- **Researchers** should work closely with schools to conduct action research on implementation and its effect on student learning. This would address barriers such as student motivation, test anxiety and misconceptions. Researchers could also communicate findings in accessible formats, such as infographics, workshops and open access summaries.

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