LINHAS CRÍTICAS

Article

Retrieval practice at school: a narrative review of test formats

Prática de lembrar em ambiente escolar: revisão narrativa sobre formatos de testes

Práctica de recuperación en escuelas: revisión narrativa sobre formatos de las pruebas

Anne Caroline Borba da Silva[i]
Universidade Estadual do Norte do Paraná. Jacarezinho, PR, Brazil
annecarolsap@gmail.com
https://orcid.org/0000-0002-0689-1196

Lisandra Tamires Mendonça[ii]
Universidade Estadual do Norte do Paraná. Jacarezinho, PR, Brazil
lisandratamiresm@gmail.com
https://orcid.org/0000-0002-7880-5955

José Cláudio de Sene Miguel[iii]
Universidade Estadual do Norte do Paraná. Jacarezinho, PR, Brazil
joseclaudiosm@gmail.com
https://orcid.org/0000-0001-6097-2950

Roberta Ekuni[iv]
Universidade Estadual do Norte do Paraná. Jacarezinho, PR, Brazil
robertaekuni@uenp.edu.br
https://orcid.org/0000-0003-1490-0184

The authors contributed equally to the elaboration of the manuscript.

Received: 04/21/2022
Accepted: 07/28/2022
Published: 08/16/2022

Linhas Críticas | Journal edited by the Faculty of Education of the University of Brasília, Brazil
ISSN: 1516-4896 | e-ISSN: 1981-0431
Volume 28, 2022 (jan-dec).
http://periodicos.unb.br/index.php/linhascriticas

Full reference (APA):
Silva, A. C. B. da, Mendonça, L. T., Miguel, J. C. de S., & Ekuni, R. (2022). Retrieval practice at school: a narrative review of test formats. *Linhas Críticas*, *28*, e43014. https://doi.org/10.26512/lc28202243014

Alternative link:
https://periodicos.unb.br/index.php/linhascriticas/article/view/43014

Abstract: Retrieval practice, which consists of trying to remember content already seen, is considered as one of the most effective strategies to generate long-term learning. In order to promote its effective use, this narrative review focuses on suggesting guidelines for the application of different test formats, often used to practice retrieval, and pointing out advantages and disadvantages of each. As a result, the reviewed research encompassed students from kindergarten through undergraduation. Overall, retrieval practice can benefit the learning of different content, providing test formats are suitable to the learner's age, regardless of the materials used.
Keywords: Education. Test format. Learning.

Resumo: A prática de lembrar, que consiste em tentar recordar conteúdo já visto, é tida como uma das estratégias mais eficazes para gerar aprendizado de longa duração. A fim de promover seu uso eficaz, a presente revisão narrativa tem por foco sugerir diretrizes a respeito da aplicação de diferentes formatos de testes, com frequência empregados para praticar lembrar, e apontar vantagens e desvantagens de cada um. Como resultado, os estudos revisados envolveram alunos desde a educação infantil até a graduação. No geral, a prática de lembrar pode beneficiar a aprendizagem de diferentes conteúdos contanto que os formatos de teste se adaptem à idade do aprendiz, independentemente dos materiais usados.
Palavras-chave: Educação. Formato de teste. Aprendizagem.

Resumen: La práctica de recuperación, es decir, intentar recordar contenido ya visto, es considerada una de las estrategias más efectivas para generar aprendizaje de larga duración. Para promover su uso eficaz, esta revisión narrativa se enfoca en sugerir pautas sobre la aplicación de diferentes formatos de pruebas, a menudo usados para practicar recordar, y señalar sus ventajas y desventajas. Los estudios revisados involucraron a alumnos desde el jardín de infantes hasta la graduación. En general, la práctica de recuperación puede beneficiar el aprendizaje de diferentes contenidos siempre que los formatos de prueba se adapten a la edad del alumno, independientemente de los materiales utilizados.
Palabras clave: Educación. Formato de prueba. Aprendizaje.

[i] Master Student at Graduate Program in Education - Universidade Estadual do Norte do Paraná.
[ii] Master in Basic Education (Graduate Program in Education) at Universidade Estadual do Norte do Paraná (2021).
[iii] Master Student at Graduate Program in Education - Universidade Estadual do Norte do Paraná.
[iv] Adjunct Professor at Graduate Program in Education at Universidade Estadual do Norte do Paraná.

Introduction

One of the goals of education is for learning to persist over time. However, it is common for students to complain about not being able to remember the content they have studied. One of the reasons is that they do not prefer to use the best strategies to learn (Karpicke et al., 2009; Dunlosky et al., 2013; Karpicke et al., 2014; Ekuni et al., 2020). Given that, several research in the field of Cognitive Psychology, both in laboratories and educational settings, point to strategies that promote long-lasting learning, such as retrieval practice (Dunlosky et al., 2013).

Retrieval practice is a learning strategy that aims to try to remember content previously seen, either through tests (multiple-choice, fill-in-the-blanks, short-answer, etc.) or through exercises that stimulate retrieval (Roediger & Karpicke, 2006a). During the encoding of information (which occurs, for example, when attending a class, reading a text, etc.), information is put *in* our head. When trying to remember, however, we search for this information, trying to put it *out* of our head (Agarwal & Bain, 2019). In this attempt, our brain elaborates and relates available routes (pathways) to identify information we have previously accessed (Bjork, 1975) and activates semantically related content (Carpenter, 2011). This means that when we find the content we are looking for in our mind, information is reconsolidated, its access is facilitated, and the memory trace is strengthened, making it more lasting (Van den Broek et al., 2016).

Historically, experiments testing the effects of retrieval practice date back more than a century. The papers reviewed converge on an experiment conducted by Abbott (1909), which is indicated as the initial milestone of studies in this field (Yang et al., 2021). Abbott's finding, later replicated by numerous researchers, is that testing learned knowledge alters its retention in memory (Abbott, 1909; Roediger & Karpicke, 2011). The heyday of research on remembering practice, however, would only come up in the 1960s and 1970s from the publication of other relevant papers regarding topics pertinent to the Cognitive Psychology of Memory (Roediger & Karpicke, 2011). Despite a century of research in the field, Agarwal and Bain (2019) state that pedagogical “fads" are shown in teacher education courses and end up leaving evidence-based teaching strategies out of it. Perhaps this explains why retrieval practice is not widely seen as a teaching strategy in everyday school life.

Among its benefits, retrieval practice improves metacognition (McDermott, 2021), decreases anxiety on later tests (Agarwal et al., 2014), provides feedback on what one knows and what one does not know, thereby making room for future studies (Roediger & Karpicke, 2006b). Another advantage is that it involves no additional financial investment (Roediger & Pyc, 2012) and can be adapted to a variety of educational materials and teaching methods (Agarwal et al., 2018).

As stated, one of the ways to practice retrieve can be through tests, for when a student sees a certain question, he must try to extract the answer from his head. However, in educational practice, tests are usually used as a form of assessment (i.e., school exams), not as a learning strategy (Yang et al., 2021). Implementing retrieval practice in education is important in the sense of promoting long- lasting learning and encouraging students to engage in their own cognitive processes through effective study strategies (Ekuni et al., 2020).

Education needs scientifically proven methods that enable concrete effects in the school environment (Slavin, 2020). Therefore, the use of more effective learning strategies can benefit students. In view of the above, the present study aimed to conduct a narrative review, a style of review that does not require following a systematic protocol, so that it is not necessary to inform the search methodology of the references (Rother, 2007). This review can be done by the author himself, without having to explain the criteria for the search and selection of sources (Collins & Fauser, 2005). However, one should ensure academic eloquence from the author's critical analysis of the published literature (Rother, 2007). Likewise, care must be taken so that the sources selected are based on scientific studies that have proven to be effective (Slavin, 2020). Following these guidelines, it is possible to establish a relationship between productions on previously defined topics, consolidate concepts and provide practical guidance (Elias et al., 2012). Thus, in narrative reviews, the bibliographic productions are analyzed in such a way that they result in a state-of-the-art on the topic in which the researcher intends to delve (Elias et al., 2012).

To analyze the use of different test formats as learning strategies, as explained above, we used the narrative review method. As inclusion criteria we used papers that focused on tests as a learning strategy, and not as an assessment tool. In fact, the purpose of using these strategies is not to evaluate the student, but to encourage him to try to remember the content learned. In this sense, the literature knows this phenomenon as *testing-effect*, *test-enhanced learning*, *retrieval-based learning, retrieval practice*, terms we used in the searches we did in databases through a non-systematic way. Finally, we provide recommendations and tips to teachers and students to implement retrieval practice in the teaching and learning process.

True or false

True or false (T/F) questions are answer selection questions, meaning that the respondent must recognize the answer to be selected by deciding whether a statement is false or true (Santrock, 2009). For example: *Castle Geyser is the oldest geyser in Yellowstone Park: (T) / (F).*

From the point of view of their advantages, questions of this type are commonly used in the classroom and are pedagogically practical to administer because they are objective in measuring results (score is based on right answers) and require less prep time (Uner et al., 2022). Furthermore, this type of test allows a large number of questions to be covered in a common testing period (Santrock, 2009). If there are situations where it is difficult to create several lures, i.e., plausible alternatives to multiple choice questions, this type of test is also useful (Uner et al., 2022).

T/F tests result in benefits also for children. For example, research involving students (eleven years-old on average) in a classroom setting found positive effects on cognitive (correctness of answers) and metacognitive (level of confidence in answers) performance from experiments involving T/F questions on History, Politics, and Geography content (Barenberg & Dutke, 2019). As indicated by experiments conducted with nearly five hundred university participants

employing Biology content in virtual learning environments, T/F questions can also be beneficial in e-learning or b-learning scenarios, especially when feedback is present (Enders et al., 2021).

Conversely, the pedagogical effectiveness of T/F tests may not be as powerful compared to other test formats, as indicated by experiments conducted with undergraduates in a laboratory setting using texts (Brabec et al., 2021). Thus, among the possible disadvantages of applying this type of test are blind guesses (i.e., attempts to get it right at random) and negative suggestions. In the latter case, by reading the lure (false information) the student may learn it and recognize it in other tests in the future, taking it for granted (Uner et al., 2022). In this vein, in experiments conducted with undergraduates, Brabec et al. (2021) found evidence of negative suggestion when participants had to choose the true alternative compared to not being tested with T/F questions (control condition). According to the authors, this negative effect may be lessened with the presence of feedback (Brabec et al., 2021).

To try to minimize this catch, as well as to avoid blind guesses, an experiment conducted with Psychology students, demanded participants to provide a justification for each selected answer (Schaap et al., 2014). As can be seen, this is a slightly modified T/F test. However, this strategy did not generate significant benefit compared to participants who had not had to justify their choices (Schaap et al., 2014). In attention to this, other modified experiments have required undergraduates not to justify choices, but to correct false alternatives (Uner et al., 2022).

Other modifications experimented involved inserting competitive clauses into the statements, a strategy that may make the tested information last longer in memory (Brabec et al., 2021). For example, instead of the statement standing alone, there is another statement inserted into it, in parentheses: *Castle* geyser (not *Stemboat*) is the tallest geyser (example taken from the aforementioned paper).

It is relevant to note that when students are prompted to correct alternatives which they think are false, the presentation of feedback improves retention of correct items on a subsequent short-answer test compared to a regular T/F procedure (Uner et al., 2022). There are three types of feedback: the first, the *right/wrong feedback* type; the second one, called *corrective feedback*, which provides the student the correct answer; and the third one, called *elaborate feedback*, which explains why a certain answer is true or false (Enders et al., 2021).

Corrective feedback can improve retention of tested items in T/F questions. Likewise, simple modifications (such as inserting competitive clauses and requesting correction of the wrong alternative or justification of the choice) in the way the test is administered appear to be more effective and promising for classroom implementation (Uner et al., 2022).

Regarding to suggestions for writing T/F questions, here is what we recommend to teachers: keep only one main idea in each alternative, and do not insert several of them at the same time; make statements short and with understandable vocabulary; avoid absolute terms (*always, never, no one,* etc.), circumstantial modal words (*can, maybe, sometimes,* etc.), and double negatives (Santrock, 2009).

Multiple-choice

Multiple-choice (MC) questions also involve answer selection. In terms of form, this type of question is composed of two parts: the base (statement) and its set of possible answers, of which only one is correct, and the others are lures (Santrock, 2009). MC tests are often used by educators because, like T/F, they allow easier scoring and are perceived as more objective (Butler et al., 2006). In fact, it is the most used type of objective test (Marsh et al., 2007). In addition, MC quizzes can be used throughout the school year to benefit student learning and performance on final tests, whether they are MC (composed of recognition questions) or short-answer (composed of elaboration questions) (McDermott et al., 2014).

MC questions should be worded so that lures are plausible (Little et al., 2012). However, as already mentioned in the excerpt about T/F type questions, there is the inconvenient effect of negative suggestion. Lures (incorrect answers) can be learned and reproduced on a later test, so that the MC test can be counterproductive if there are too many of them, as their interference can lead to the assimilation of erroneous knowledge (e.g., Marsh et al., 2012a). Indeed, an experiment conducted with undergraduates points out that the greater the number of alternatives offered in the MC test, the less beneficial the test is (Roediger & Marsh, 2005). In addition to the interference caused by too many lures, insufficient study of the content prior to the test contributes to the learning of misinformation (Butler & Roediger, 2008).

To avoid negative suggestion and leverage the benefits of MC tests, it is important to provide feedback (Marsh et al., 2012a). Feedback, particularly corrective feedback (in which the correct answer is given), is useful for correcting misinformation that students have learned from lures, as well as for maintaining long-term retention of correct answers (Butler, 2018).

MC tests were employed in various research studies with different age, setting, and materials employed. Experiments conducted with children (eight years-old on average) show that they benefit from MC tests on general knowledge, coupled with feedback (Marsh et al., 2012b). Other experiments with teenagers (thirteen years-old on average) point out that classroom science quizzes accompanied by feedback, even if they are brief, increase students' performance on later summative assessments, whether MC or short-answer (McDermott et al., 2014).

As for suggestions on how to design MC questions, some general and some specific to this type of test can be listed (Santrock, 2009; Butler, 2018). In general, MC questions should not contain grammatical improprieties, should be understandable, are best written as interrogative sentences, and should not contain tricky alternatives. Specifically, they should have answers of similar length and alternate the position of the correct alternatives between questions. It should be noted again that the greater the number of alternatives, the lower the hit rate tends to be (Butler et al., 2006). Moreover, MC tests should be appropriately challenging, because if too easy or too difficult, they are useless for both assessment and promotion of learning (Butler, 2018). A pertinent suggestion is to affix the "I don't know" option, in order to avoid blind guessing (Marsh et al., 2007). Again, the purpose of applying tests is learning, not grading.

As stated earlier, among its main disadvantages are the elaboration of the alternatives (both in terms of number, format, and degree of difficulty) and the possibility of negative suggestion (Butler, 2018). On the other hand, this test format has the advantage of being easily verifiable. Thus, it decreases the correction time and increases its objectivity (Butler et al., 2006; Marsh et al., 2012a). Indeed, it can be applied throughout the school year to boost learning (McDermott et al., 2014). Finally, marginal knowledge — that is, the knowledge which, even though stored in memory, is not accessible at any given time — can be easily reactivated through MC testing (Cantor et al., 2015).

MC questions have, therefore, important pedagogical implications, either in quizzes or in final tests, as they are practical and economical, but require care in their preparation. The recommendation to teachers, therefore, is to be careful with the number of alternatives and try to elaborate clear questions and plausible alternatives, with an adequate level of difficulty for the students.

Short-answer

The short-answer (SA) test format is widely used in the classroom. As can be inferred from its name, it is the same as to answering questions with a short answer. It is a test that imposes on the student to produce an answer (Larsen et al., 2008). This type of test is similar to tests with cues. In this case, however, the question is a cue that directs the respondent to the content to remember (Moreira et al., 2019). For example, after studying key-term definitions, 5th graders were asked to type in answers [e.g., What is *sound*? ____ (*form of energy that you can hear and that travels through matter as waves)]* (Lipko-Speeda et al., 2014).

This test format, like the free-recall test, requires more effort to remember and is more difficult than the multiple-choice test format, which involves recognition (Rowland, 2014). Effectively, research points out that SA tests are more efficient at retaining content than multiple-choice tests (e.g., Kang et al., 2007; Stenlund et al., 2016). However, there are studies that differ on this point (see Little et al., 2012). Regarding this disagreement, it is important to consider the age range of the students and the way the tests are formulated. Tests should be designed so that students try to remember rather than just identify answers (Little et al., 2012).

Several studies with different educational levels have been conducted with the SA test format, from elementary school (e.g., Goossens et al., 2016), through high school (Dirkx et al., 2014), to undergraduation (e.g., Endres et al., 2020). These researches used as materials: book chapters (e.g., Carpenter et al., 2009), word lists (Goossens et al., 2016), key-concept definition pairs (e.g., Lipko-Speeda et al, 2014), expository texts (e.g., Dirkx et al., 2014), key-concepts of studied topics (Wiklund-Hörnqvist et al., 2014), expository lectures (Foss & Pirozzolo, 2017), and lectures (Lyle & Crawford, 2011). Apart from the study by Goossens et al. (2016), in all of the aforementioned studies there were benefits of the short-answer test for learning.

Lipko-Speeda et al. (2014) analyzed the effect of performing SA test with and without feedback, employing rereading as a control condition. The target audience was 5th grade children, and the questions consisted of definitions of key-concepts from Science and Geography content. Positive effects were seen only in the test condition with feedback. In their study conducted with children, Goossens et al. (2016) found that this test format without feedback was no better than copying the studied material. Similarly, research conducted with high school students revealed that the SA test with feedback, compared to rereading and administered after studying a text on probability, increased retention of content from the text and improved application of the principles covered in the text (Dirkx et al., 2014).

Research with undergraduates has pointed out that, compared to rereading, SA tests were beneficial for long-term learning and retention (Larsen et al., 2009; Wiklund-Hörnqvist et al., 2014; Greving & Richter, 2018). A study by Carpenter et al. (2016) showed that SA tests generated better results with respect to recall of term definitions made by high-performing students. However, for medium and low-performing students, copying term definitions was better. In all these studies, feedback was offered after the initial SA test, except for Greving and Richter's (2018) study. The latter evidenced that, even without feedback, the short-answer test generated positive effects on introductory Cognitive Psychology content.

SA tests with feedback generate more learning outcomes (Kang et al., 2007). In this sense, because this format involves more retrieval effort, one of the most important precautions by teachers is to provide feedback with the correct answers. Therefore, students can correct their mistakes instead of just knowing what is right or wrong.

The research cited earlier showed that CR tests with older students were more efficient (e.g., Greving & Richter, 2018) than with younger students (e.g., Lipko-Speeda et al., 2014). It is therefore recommended that to younger learners, cues are provided (see section below – cued-recall) to facilitate recall. Another way out is to provide students with more learning opportunities and tests until they can integrate and retain the content (Lipko-Speeda et al., 2014).

One of the benefits of SA questions is that they favor retention of specific points of a content previously studied. Consequently, they facilitate the recall of more difficult or inaccessible points. As an indirect effect, they allow metacognitive accuracy, that is, the regulation of students' confidence in the certainty of their answers and the proportion of answers given that they would remember in a week. In this way, students' judgments regarding their learning are more calibrated (accurate) in the SA format compared to the free-recall test format (Endres et al., 2020). Another advantage is that conducting review at the end of each class via SA questions encourages students to engage in study and increases their performance on later tests (Greving & Richter, 2018).

One of the disadvantages of SA quizzes are that, in practice, this format is not very attractive to students. In addition, it can take teachers up to twice as long to correct and apply it in class because the format requires more complex answers (McDermott et al., 2014). However, it is not

necessary to correct individually, as the feedback can be collective (Butler & Roediger, 2007), since the goal is learning, not grading based on student's performance. Another disadvantage concerns the fact that without feedback, or without further study opportunities, such a format may not be as effective for retention of information.

In summary, SA tests are considered important for learning and recall, since through this format, students can remember facts, definitions of key-concepts, and specific content studied. Here is what we recommend to teachers: whenever possible, provide feedback to make the integration of content more effective.

Free-recall

Tests that encourage free recall (FR) can significantly boost new learning. Such a test format aims to search or information and content that students have previously had access to in their mind, without providing them with cues to get the correct answer (Brojde & Wise, 2008). An example is to ask students what they remember about the topic "solar system".

FR tests have shown beneficial results across different grade levels and age groups, with children from two and a half years-old (Cornell et al., 1988), to youngsters and adults (Tulving, 1967). However, in the final test of the research conducted by Aslan and Bäuml (2016), it was identified that younger children (six years-old on average) make more mistakes when using FR to practice remembering. Older children (eight years-old on average), on the other hand, benefit more from using FR testing (Aslan & Bäuml, 2016).

As for the settings of research on retrieval practice, considering only tests in FR format, studies conducted in the participants' homes (Cornell et al., 1988), in the laboratory (e.g., Lipowski et al., 2014), and at school in a classroom setting (e.g., Jones et al., 2016) were observed.

Research shows that, compared to rereading the same content, FR influences and enhances processing in retrieving individual (Tulving, 1967) and specific items (Lipowski et al., 2014). When comparing the effects of FR (retrieval practice) with no test (Brojde & Wise, 2008; Roediger et al., 2011b) or with commonly used study strategies such as copying (rewriting) (Jones et al, 2016; Rowley & McCrudden, 2020) and rereading (Cornell et al., 1988; Aslan & Bäuml, 2016), it is observed that retrieval practice is one of the most effective learning strategies that provides longer-lasting learning (Roediger et al., 2011a). Thus, the advantages of using this type of test are that it enables memory to be strengthened (Cornell et al., 1988), promotes understanding of the content presented (Brojde & Wise, 2008), improves spelling accuracy (Jones et al., 2016), and, as identified by Rohrer et al. (2010), stimulates the transfer of information to new contexts, benefiting learning in a robust manner.

In this sense, FR tests show a direct testing-effect by pushing students to recall information without cues being provided, thus stimulating desirable difficulty. This especially benefits the

learning of older children. Here is what we recommend to teachers: provide opportunities for students to freely recall content (e.g., ask students to write down or comment on what they remember about the content studied in the previous lesson, without checking any note) for students starting in elementary school.

Fill-in-the-blank

Fill-in-the-blank test is a type of test that makes it possible to recall one or certain keywords (Hinze & Wiley, 2011). For example, in Jaeger et al.'s (2015) study, students completed sentences after studying a text about the Sun [e.g., *The word* Sun *is derived from the Latin word* _____ (*solis*)].

This test format is numerically the least explored in the literature. However, existing studies have pointed out that this task makes it possible to retrieve items of previously studied information. According to some studies, fill-in-the-blanks can aid the retrieval of keywords from an encyclopedic text with 3rd graders (Jaeger et al., 2015), English language vocabulary learning with 9th graders (Barenberg et al., 2021), and item information about development, these presented via *PowerPoint* to Psychology undergraduates (Vojdanoska et al., 2010).

In Jaeger et al.'s (2015) research, students who initially recalled with fill-in-the-blank [e.g., *The surface layer of the Sun is called* _____ (*photosphere*)] - performed better on the final multiple-choice test after seven days compared to students who reread the complete sentences. The authors also argue that the practice of remembering through fill-in-the-blanks can benefit children who perform differently in IQ (intellectual quotient) and reading ability.

Barenberg et al. (2021) conducted experiments with German and English word pairs. At first, they administered the following fill-in-the-blank: a cue (German word) and the target word (English word). After one week, students who underwent such a test showed better results relative to those who underwent rereading, either when they performed final test identical to the initial one, or when they did it in reverse format (from target language to base language).

Feedback was present in the research of Barenberg et al. (2021) and Vojdanoska et al. (2010). The latter's results revealed that when feedback was provided, the advantages of the test were magnified compared to testing without feedback and without any activity.

One of the positives of fill-in-the-blanks is that it is simple to apply in the classroom, easy to correct, and not very time-consuming (Moreira et al., 2019). However, there are indications that this format may not show high retrieval practice effects. For example, in the experiment conducted by de Jonge et al. (2015), undergraduates studied a text [coherent and noncoherent (isolated sentences)] and performed a fill-in-the-blanks. As a control condition, rereading the sentences was used. The authors concluded that the fill-in-the-blanks was more beneficial for the noncoherent text format than for the coherent one. Thus, this result may have stemmed

from the fact that this type of task does not require content integration and construction (Karpicke & Aue, 2015). In other words, this type of task does not enable the student to meaningfully process and develop more ideas, because its goal is to retrieve/retain one or a few keywords.

Although there are few studies investigating the application of this test format, it can be observed, however, that fill-in-the-blanks presents a simple form of retrieval, enabling learning to last longer. This format has also proven beneficial at different levels of education, from elementary school to higher education (Vojdanoska et al., 2010).

Therefore, it is suggested that fill-in-the-blank tests be applied with content aimed at stimulating the recall of one or a few keywords, terms, or vocabularies, so that they remain longer in memory. Here is what we recommend to teachers: provide fill-in-the-blanks with the aim of word retrieval, without the need to integrate the whole content.

Cued-recall

Cued-recall (CR) is a test format in which cues are provided to try to recall answers (Lima & Jaeger, 2020). For example, given a fill-in-the-blank question, the first letter is provided to facilitate recall [e.g., *The word Sun derives from the Latin word s_____* (*solis*)] (Lima & Jaeger, 2020). Other examples can be seen in the studies of Aslan and Bäuml (2016), who used CR tests by presenting two to four initial letters of words for students to complete noun lists. In turn, Kliegl et al. (2018) presented blurry (unclear) versions of photos as a cue for students to associate them with photos they initially studied.

Since it provides cue to the response, CR facilitates retrieval of previously studied information and increases the likelihood of retrieving information from memory (Fazio & Agarwal, 2020). One possible explanation for this advantage is that the benefits of retrieval practice are more robust when initial recall is greater than 50% (Rowland, 2014).

CR tests have been used as a teaching strategy with children as young as two-years-and-ten-months-old (Fritz et al., 2007). As for settings, research using cued-recall tests with has been conducted in school, in a classroom setting (e.g., Ritchie et al., 2013), and individually, in a separate room with the experimenter (imitating the laboratory setting) (e.g., Fritz et al., 2007).

The benefits of CR have already been demonstrated using everything from simple materials — such as proper names (Fritz et al., 2007), names of sets of taxonomic categories (i.e., categories that define groups of biological organisms) and items, photos (with little *pixel* distortion) (Kliegl et al., 2018), fictional maps (Ritchie et al., 2013), phrases and word lists with their synonyms (Goossens et al., 2014a) — to more complex materials — such as sets of concept definition word-pairs (Lipko-Speeda et al., 2014) and encyclopedic texts (Lima & Jaeger, 2020).

Ritchie et al. (2013) identified that CR tests — taken based upon fictional maps that featured the location of some cities as cues and asked students to try to remember the name and its corresponding location on the maps — driven long-term learning. On the downside, CR tests, when compared to multiple-choice tests, resulted in lower recall. Still, both test formats generate better performance compared to the content rereading condition (Lima & Jaeger, 2020).

The benefits of CR testing are most robust when immediate feedback is provided for preschool children (Kliegl et al., 2018). Regarding undergraduates, CR tests followed by feedback comparing the easy practice condition (in which the first two letters of the target word are presented) to the hard practice condition (in which only the first letter of the target word is presented) showed that mean retrieval performance was significantly higher in the easy practice condition and in the short term. However, one week later, performance in the hard practice condition was shown to be superior (Kliegl et al., 2018). Thus, CR tests allow variation in difficulty level and therefore adaptation of retrieval practice strategies according to students' age group and prior knowledge (Fazio & Agarwal, 2020).

In short, the act of presenting cues while performing retrieval practice can serve as an aid, thus increasing the likelihood that students will arrive at the answers. Here is what we recommend to teachers: when providing CR tests, vary the level of difficulty according to students' prior knowledge, taking care not to make it too easy, but at the same time pushing students to retrieve information.

Guidelines for educators

The adaptability and applicability of retrieval practice via different test formats allow educators and students to use different teaching (teacher-driven) and study (student-driven) strategies (Roediger et al., 2011b; Agarwal et al., 2018). There are a variety of question types and test formats that can be used in real classroom settings (McDaniel et al., 2013) in order to benefit learning in flexible ways (McDaniel et al., 2013; Agarwal et al., 2018).

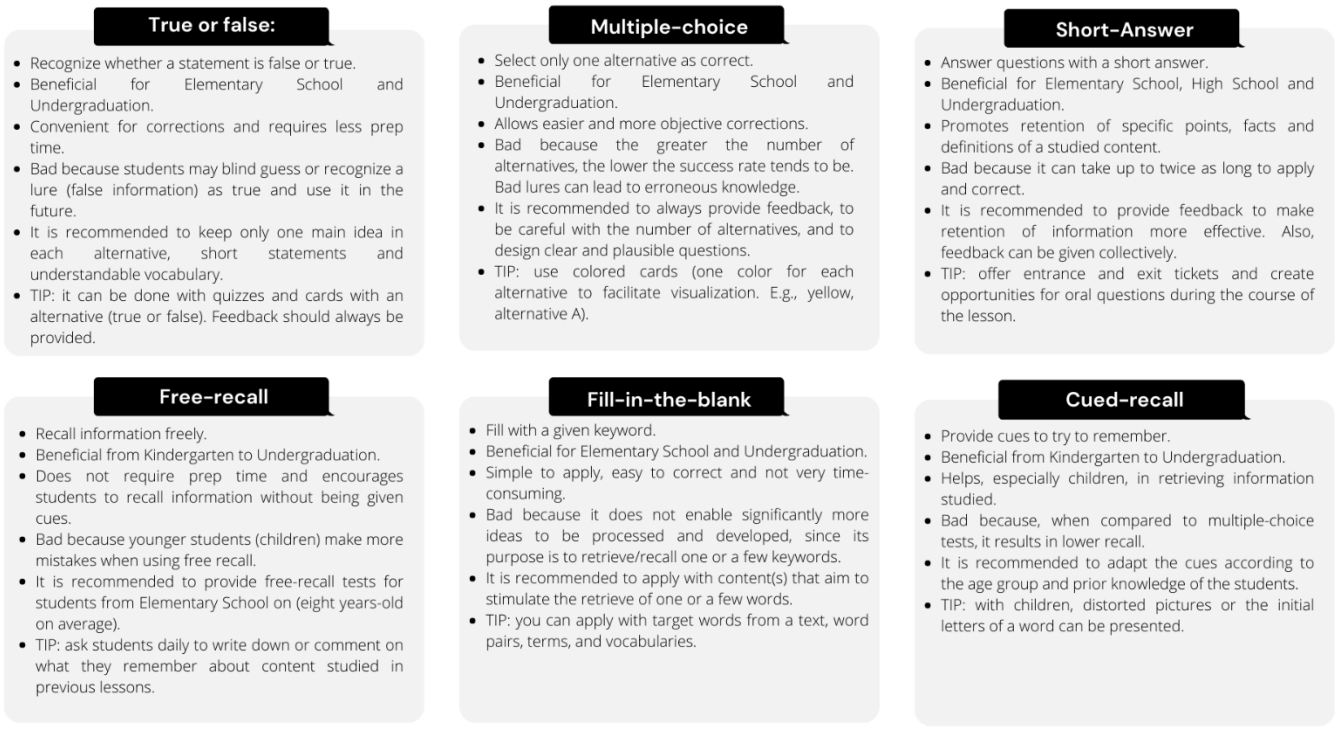
To facilitate the use of retrieval practice, a "retrieval practice guide" (Agarwal et al., 2018) and numerous research (e.g., Ekuni & Pompeia, 2020) present suggestions as well as guidelines for educators to use and encourage the performance of retrieval practice in the course of the teaching and learning process. From the research findings presented in this review, we will provide a summary with the main guidelines (see Image 1).

When using retrieval practice, students need to be guided that during testing, they should not consult materials, notes, or even their peers (Agarwal et al., 2018). They should be honest, searching their minds for information they have previously accessed (Agarwal et al., 2018). One way to encourage the whole class to practice retrieval is to be cautious when directing

questions. The teacher might, for example, ask an oral question, give students some time to think about the answer, and only then draw names of students to answer aloud.

Image 1

Comparison chart of the studies presented with test formats and recommendations to educators.



Source: made by the authors.

True-false and multiple-choice tests can be addressed in real time from quizzes (Agarwal et al., 2013). One idea is to use colored cards (like little signs) for students to raise their answer at the teacher's command. It is even better if the cards have standardized colors, so as to maintain the correspondence between colors and alternatives (Agarwal et al., 2013; Ekuni & Pompeia, 2020) (e.g., the card with the TRUE alternative can be white, and with the FALSE alternative, red; with respect to alternatives from A to D, the guidance is to use different colored cards as well, such as yellow for alternative A, blue for B, and so on). This way it is easy to visualize the alternatives most chosen by the students. When asking a question (by voice, by projection on screen, or by writing on the blackboard), you should give the students time to think about the answer before asking them to raise their cards. To further increase the benefit, feedback should be provided (e.g., Agarwal et al., 2018; Ekuni & Pompeia, 2020).

Strategies related to short-answer and free-recall tests can be put into practice with entrance and exit tickets (McDermott et al., 2014; Agarwal et al., 2018). This strategy can be accomplished using pieces of notebook paper, or bond paper. As students enter the classroom, the teacher can hand out the pieces of paper and ask, for example, for students to write down what they remember from the previous lesson. With exit tickets, it is possible to ask that, before the end of the lesson, students write down, for example, what they found most interesting about the topic covered (Agarwal et al., 2018).

Still considering free-recall tests, it is possible for the teacher to ask the students to make an oral or written summary of the content previously presented (Brojde & Wise, 2008). The teacher can also perform dictations with the goal of having students recall the spelling of words, meanings, and definitions. Free-recall tests can also be stimulated through interventions during readings in which the child is asked to point to pictures in the book (Cornell et al., 1988). Students can also be required to write a list of previously presented words in a dictation (Jones et al., 2016), or to write down everything they remember about a previously studied text (Rowley & McCrudden, 2020).

Regarding fill-in-the-blanks tests, it is possible to use them based on target words highlighted in a text. At the time of the test, you can present the definition so that students try to remember and fill in with the target word (Goossens et al., 2014b). In fill-in-the-blanks tests, one can practice retrieval using pairs of associated words, matching terms with words, etc. (e.g., *suburb* and *outskirts - suburb* and _____).

In cued-recall tests, one can present somewhat distorted images as cues and then ask students to name them (Kliegl et al., 2018). One can study phrases or lists of associated words and, at test time, provide one or two letters of the target word for students to try to remember and write the whole word (Kliegl et al., 2019).

There are, therefore, numerous possibilities to diversify the choice of test format when practicing retrieving. It is important to consider that different test formats benefit learning (McDermott et al., 2014; Agarwal et al., 2018). Furthermore, offering feedback after practice can help students correct errors and encourage retention of correct information (Marsh et al., 2012b). It is important to provide testing not only for the purpose of assessment or grading, but as a teaching strategy.

Conclusion

In view of an education based on scientific evidence, the present review points out different ways and test formats for implementing retrieval practice in a classroom setting. This makes it possible to contribute significantly to long-lasting and flexible learning. The results of the studies generally show that each format can contribute effectively to different content, materials, and grade levels. However, the present review, by being narrative, has limitations regarding the selection of papers. Future studies may conduct a systematic review on the theme, by conducting systematic searches.

From this research, it is also observed that the age of the students and the level of education seem to play an important role in the choice and implementation of the test format. With younger students, providing cues during retrieve may be more effective for learning. With older students, on the other hand, tests with a higher desirable difficulty can be provided. Another point concerns feedback. When given, whatever the test format is, it improves retention and corrects errors. Therefore, the effects of retrieval practice in an educational setting are robust.

For these and other reasons, retrieval practice is a promising strategy for teaching and learning for students of different age groups.

References

Abbott, E. E. (1909). On the analysis of the factor of recall in the learning process. *Psychological Review: Monograph Supplements, 11*(1), 159-177. https://doi.org/10.1037/h0093018

Agarwal, P. K., & Bain, P. M. (2019). *Powerful Teaching: unleash the science of learning*. Jossey-Bass.

Agarwal, P. K., D'Antonio, L., Roediger, H. L., McDermott, K. B., & McDaniel, M. A. (2014). Classroom-based programs of retrieval practice reduce middle schooland high school students' test anxiety. *Journal of Applied Research in Memory and Cognition*, *3*(3), 131-139. https://doi.org/10.1016/j.jarmac.2014.07.002

Agarwal, P. K., Roediger, H. L., McDaniel, M. A., & McDermott, K. B. (2013). *How to use retrieval practice to improve learning* [E-book]. Washington University in St. Louis. https://www.retrievalpractice.org/library

Agarwal, P. K., Roediger, H. L., McDaniel, M. A., & McDermott, K. B. (2018). *Como a Prática de Lembrar pode ser utilizada para melhorar a aprendizagem* [E-book]. Washington University in St. Louis. https://www.retrievalpractice.org/library

Aslan, A., & Bäuml, K. H. T. (2016). Testing enhances subsequent learning in older but not in younger elementary school children. *Developmental Science*, *19*(6), 992–998. https://doi.org/10.1111/desc.12340

Barenberg, J., & Dutke, S. (2019). Testing and metacognition: retrieval practise effects on metacognitive monitoring in learning from text. *Memory*, *27*(3), 269-279. https://doi.org/10.1080/09658211.2018.1506481

Barenberg, J., Berse, T., Reimann, L., & Dutke, S. (2021). Testing and transfer: Retrieval practice effects across test formats in English vocabulary learning in school. *Applied Cognitive Psychology*, *35*(3), 700-710. https://doi.org/10.1002/acp.3796

Bjork, R. A. (1975). Retrieval as a Memory Modifier: an interpretation of negative recency and related phenomena. Em R. L. Solso (Ed.). *Information processing and cognition: The Loyola Symposium* (pp. 123-144). Lawrence Erlbaum Associates.

Brabec, J. A., Pan, S. C., Bjork, E. L., & Bjork, R. A. (2021). True-False Testing on Trial: Guilty as Charged or Falsely Accused? *Educational Psychology Review*, *33*(2), 667-692. https://doi.org/10.1007/s10648-020-09546-w

Brojde, C. L., & Wise, B. W. (2008). An Evaluation of the Testing Effect with Third Grade Students. *Proceedings of the 3-Th Annual Meeting of the Cognitive Science Society*, 1362-1367.

Butler, A. C. (2018). Multiple-Choice Testing in Education: Are the Best Practices for Assessment Also Good for Learning? *Journal of Applied Research in Memory and Cognition*, *7*(3), 323-331. https://doi.org/10.1016/j.jarmac.2018.07.002

Butler, A. C., & Roediger, H. L. (2007). Testing improves long-term retention in a simulated classroom setting. *European Journal of Cognitive Psychology*, *19*(4-5), 514-527. https://doi.org/10.1080/09541440701326097

Butler, A. C., & Roediger, H. L. (2008). Feedback enhances the positive effects and reduces the negative effects of multiple-choice testing. *Memory and Cognition*, *36*(3), 604-616. https://doi.org/10.3758/MC.36.3.604

Butler, A. C., Marsh, E. J., Goode, M. K., & Roediger, H. L. (2006). When additional multiple-choice

lures aid versus hinder later memory. *Applied Cognitive Psychology*, *20*(7), 941-956. https://doi.org/10.1002/acp.1239

Cantor, A. D., Eslick, A. N., Marsh, E. J., Bjork, R. A., & Bjork, E. L. (2015). Multiple-choice tests stabilize access to marginal knowledge. *Memory & Cognition*, *43*(2), 193-205. https://doi.org/10.3758/s13421-014-0462-6

Carpenter, S. K. (2011). Semantic Information Activated During Retrieval Contributes to Later Retention: Support for the Mediator Effectiveness Hypothesis of the Testing Effect. *Journal of Experimental Psychology: Learning Memory and Cognition*, *37*(6), 1547-1552. https://doi.org/10.1037/a0024140

Carpenter, S. K., Lund, T. J. S., Coffman, C. R., Armstrong, P. I., Lamm, M. H., & Reason, R. D. (2016). A Classroom Study on the Relationship Between Student Achievement and Retrieval-Enhanced Learning. *Educational Psychology Review*, *28*(2), 353-375. https://doi.org/10.1007/s10648-015-9311-9

Carpenter, S. K., Pashler, H., & Cepeda, N. J. (2009). Using tests to enhance 8th grade students' retention of U.S. history facts. *Applied Cognitive Psychology, 23*(6), 760-771. https://doi.org/10.1002/acp.1507

Collins, A. J., & Fauser, C. J. M. B. (2005). Balancing the strengths of systematic and narrative reviews. *Human Reproduction Update*, 11 (2),103-104. https://doi.org/10.1093/humupd/dmh058

Cornell, E. H., Sénéchll, M., & Broda, L. S. (1988). Recall of Picture Books by 3-Year-Old Children: Testing and Repetition Effects in Joint Reading Activities. *Journal of Educational Psychology*, *80*(4), 537-542. https://doi.org/10.1037/0022-0663.80.4.537

de Jonge, M., Tabbers, H. K., & Rikers, R. M. J. P. (2015). The Effect of Testing on the Retention of Coherent and Incoherent Text Material. *Educational Psychology Review, 27*(2), 305-315. https://doi.org/10.1007/s10648-015-9300-z

Dirkx, K. J. H., Kester, L., & Kirschner, P. A. (2014). The testing effect for learning principles and procedures from texts. *Journal of Educational Research*, *107*(5), 357-364. https://doi.org/10.1080/00220671.2013.823370

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest, Supplement*, *14*(1), 4-58. https://doi.org/10.1177/1529100612453266

Ekuni, R., & Pompeia, S. (2020). Prática De Lembrar: a Quais Fatores Os Educadores Devem Se Atentar? *Psicologia Escolar e Educacional, 24,* e220284. https://doi.org/10.1590/2175-35392020220284

Ekuni, R., Souza, B. M. N., Agarwal, P. K., & Pompeia, S. (2020). A conceptual replication of survey research on study strategies in a diverse, non- WEIRD student population. *Scholarship of Teaching and Learning in Psychology*, Advance online publication, *8*(1), 1–14. https://doi.org/10.1037/stl0000191

Elias, C. D. S. R., da Silva, L. A., Martins, M. T. D. S. L., Ramos, N. A. P., de Souza, M. D. G. G., & Hipólito, R. L. (2012). Quando chega o fim? Uma revisão narrativa sobre terminalidade do período escolar para alunos deficientes mentais. *SMAD, Revista Electrónica en Salud Mental, Alcohol y Drogas*, *8*(1), 48-53. https://doi.org/10.11606/issn.1806-6976.v8i1p48-53

Enders, N., Gaschler, R., & Kubik, V. (2021). Online Quizzes with Closed Questions in Formal Assessment: How Elaborate Feedback can Promote Learning. *Psychology Learning and Teaching*, *20*(1), 91-106. https://doi.org/10.1177/1475725720971205

Endres, T., Kranzdorf, L., Schneider, V., & Renkl, A. (2020). It matters how to recall – task differences in retrieval practice. *Instructional Science*, *48*(6), 699-728. https://doi.org/10.1007/s11251-020-09526-1

Fazio, L. K., & Agarwal, P. K. (2020). *How To Implement Retrieval-Based Learning in Early Childhood* [E-book]. Washington University in St. Louis. https://www.retrievalpractice.org/library

Foss, D. J., & Pirozzolo, J. W. (2017). Four semesters investigating frequency of testing, the testing effect, and transfer of training. *Journal of Educational Psychology*, *109*(8), 1067-1083. https://doi.org/10.1037/edu0000197

Fritz, C. O., Morris, P. E., Nolan, D., & Singleton, J. (2007). Expanding retrieval practice: An effective aid to preschool children's learning. *Quarterly Journal of Experimental Psychology*, *60*(7), 991-1004. https://doi.org/10.1080/17470210600823595

Goossens, N. A. M. C., Camp, G., Verkoeijen, P. P. J. L., & Tabbers, H. K. (2014a). The effect of retrieval practice in primary school vocabulary learning. *Applied Cognitive Psychology*, *28*(1), 135-142. https://doi.org/10.1002/acp.2956

Goossens, N. A. M. C., Camp, G., Verkoeijen, P. P. J. L., Tabbers, H. K., & Zwaan, R. A. (2014b). The benefit of retrieval practice over elaborative restudy in primary school vocabulary learning. *Journal of Applied Research in Memory and Cognition*, *3*(3), 177-182. https://doi.org/10.1016/j.jarmac.2014.05.003

Goossens, N. A. M. C., Camp, G., Verkoeijen, P. P. J. L., Tabbers, H. K., Bouwmeester, S., & Zwaan, R. A. (2016). Distributed Practice and Retrieval Practice in Primary School Vocabulary Learning: A Multi-classroom Study. *Applied Cognitive Psychology*, *30*(5), 700-712. https://doi.org/10.1002/acp.3245

Greving, S., & Richter, T. (2018). Examining the testing effect in university teaching: Retrievability and question format matter. *Frontiers in Psychology*, *9*, 02412. https://doi.org/10.3389/fpsyg.2018.02412

Hinze, S. R., & Wiley, J. (2011). Testing the limits of testing effects using completion tests. *Memory*, *19*(3), 290-304. https://doi.org/10.1080/09658211.2011.560121

Jaeger, A., Eisenkraemer, R. E., & Stein, L. M. (2015). Test-enhanced learning in third-grade children. *Educational Psychology*, *35*(4), 513-521. https://doi.org/10.1080/01443410.2014.963030

Jones, A. C., Wardlow, L., Pan, S. C., Zepeda, C., Heyman, G. D., Dunlosky, J., & Rickard, T. C. (2016). Beyond the Rainbow: Retrieval Practice Leads to Better Spelling than does Rainbow Writing. *Educational Psychology Review*, *28*(2), 385-400. https://doi.org/10.1007/s10648-015-9330-6

Kang, S. H. K., McDermott, K. B., & Roediger, H. L. (2007). Test format and corrective feedback modify the effect of testing on long-term retention. *European Journal of Cognitive Psychology*, *19*(4-5), 528-558. https://doi.org/10.1080/09541440601056620

Karpicke, J. D., & Aue, W. R. (2015). The Testing Effect Is Alive and Well with Complex Materials. *Educational Psychology Review*, *27*(2), 317-326. https://doi.org/10.1007/s10648-015-9309-3

Karpicke, J. D., Blunt, J. R., Smith, M. A., & Karpicke, S. S. (2014). Retrieval-based learning: The need for guided retrieval in elementary school children. *Journal of Applied Research in Memory and Cognition, 3*(3), 198-206. https://doi.org/10.1016/j.jarmac.2014.07.008

Karpicke, J. D., Butler, A. C., & Roediger, H. L. (2009). Metacognitive strategies in student learning: Do students practise retrieval when they study on their own? *Memory, 17*(4), 471-479. https://doi.org/10.1080/09658210802647009

Kliegl, O., Abel, M., & Bäuml, K. H. T. (2018). A (preliminary) recipe for obtaining a testing effect in preschool children: Two critical ingredients. *Frontiers in Psychology*, *9*, 01446. https://doi.org/10.3389/fpsyg.2018.01446

Kliegl, O., Bjork, R. A., & Bäuml, K. H. T. (2019). Feedback at test can reverse the retrieval-effort effect. *Frontiers in Psychology*, *10*, 1863. https://doi.org/10.3389/fpsyg.2019.01863

Larsen, D. P., Butler, A. C., & Roediger, H. L. (2008). Test-enhanced learning in medical

education. *Medical Education*, *42*(10), 959-966. https://doi.org/10.1111/j.1365-2923.2008.03124.x

Larsen, D. P., Butler, A. C., & Roediger, H. L. (2009). Repeated testing improves long-term retention relative to repeated study: A randomised controlled trial. *Medical Education, 43*(12), 1174-1181. https://doi.org/10.1111/j.1365-2923.2009.03518.x

Lima, N. K. de, & Jaeger, A. (2020). The Effects of Prequestions versus Postquestions on Memory Retention in Children. *Journal of Applied Research in Memory and Cognition*, *9*(4), 555-563. https://doi.org/10.1016/j.jarmac.2020.08.005

Lipko-Speeda, A., Dunlosky, J., & Rawson, K. A. (2014). Does testing with feedback help grade-school children learn key concepts in science? *Journal of Applied Research in Memory and Cognition*, *3*(3), 171-176. https://doi.org/10.1016/j.jarmac.2014.04.002

Lipowski, S. L., Pyc, M. A., Dunlosky, J., & Rawson, K. A. (2014). Establishing and explaining the testing effect in free recall for young children. *Developmental Psychology*, *50*(4), 994-1000. https://doi.org/10.1037/a0035202

Little, J. L., Bjork, E. L., Bjork, R. A., & Angello, G. (2012). Multiple-Choice Tests Exonerated, at Least of Some Charges: Fostering Test-Induced Learning and Avoiding Test-Induced Forgetting. *Psychological Science*, *23*(11), 1337-1344. https://doi.org/10.1177/0956797612443370

Lyle, K. B., & Crawford, N. A. (2011). Retrieving Essential Material at the End of Lectures Improves Performance on Statistics Exams. *Teaching of Psychology*, *38*(2), 94-97. https://doi.org/10.1177/0098628311401587

Marsh, E. J., Fazio, L. K., & Goswick, A. E. (2012b). Memorial consequences of testing school-aged children. *Memory*, *20*(8), 899-906. https://doi.org/10.1080/09658211.2012.708757

Marsh, E. J., Lozito, J. P., Umanath, S., Bjork, E. L., & Bjork, R. A. (2012a). Using verification feedback to correct errors made on a multiple-choice test. *Memory*, *20*(6), 645-653. https://doi.org/10.1080/09658211.2012.684882

Marsh, E. J., Roediger, H. L., Bjork, R. A., & Bjork, E. L. (2007). The memorial consequences of multiple-choice testing. *Psychonomic Bulletin & Review*, *14*(2), 194-199. https://doi.org/10.3758/BF03194051

McDaniel, M. A., Thomas, R. C., Agarwal, P. K., McDermott, K. B., & Roediger, H. L. (2013). Quizzing in Middle-School Science: Successful Transfer Performance on Classroom Exams. *Applied Cognitive Psychology*, *27*(3), 360-372. https://doi.org/10.1002/acp.2914

McDermott, K. B. (2021). Practicing Retrieval Facilitates Learning. *Annual Review of Psychology*, *72*, 609-633. https://doi.org/10.1146/annurev-psych-010419-051019

McDermott, K. B., Agarwal, P. K., D'Antonio, L., Roediger, H. L. I., & McDaniel, M. A. (2014). Both multiple-choice and short-answer quizzes enhance later exam performance in middle and high school classes. *Journal of Experimental Psychology: Applied*, *20*(1), 3-21. https://doi.org/10.1037/xap0000004

Moreira, B. F. T., Pinto, T. S. da S., Justi, F. R. R., & Jaeger, A. (2019). Retrieval practice improves learning in children with diverse visual word recognition skills. *Memory*, *27*(10), 1423-1437. https://doi.org/10.1080/09658211.2019.1668017

Ritchie, S. J., Della Sala, S., & McIntosh, R. D. (2013). Retrieval practice, with or without mind mapping, boosts fact learning in primary school children. *PLoS ONE*, *8*(11), e78976. https://doi.org/10.1371/journal.pone.0078976

Roediger, H. L., & Karpicke, J. D. (2006a). 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

Roediger, H. L., & Karpicke, J. D. (2006b). The Power of Testing Memory: Basic Research and Implications for Educational Practice. *Perspectives on Psychological Science*, *1*(3), 181-210.

https://doi.org/10.1111/j.1745-6916.2006.00012.x
Roediger, H. L., & Karpicke, J. D. (2011). Intricacies of Spaced Retrieval: A resolution. Em A. S. Benjamin (Ed.). *Successful Remembering and Successful Forgetting: a festschrift in honor of Robert A. Bjork*. (pp. 70-115). Taylor and Francis Group.
Roediger, H. L., & Marsh, E. J. (2005). The Positive and Negative Consequences of Multiple-Choice Testing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *31*(5), 1155-1159. https://doi.org/10.1037/0278-7393.31.5.1155
Roediger, H. L., & Pyc, M. A. (2012). Inexpensive techniques to improve education: Applying cognitive psychology to enhance educational practice. *Journal of Applied Research in Memory and Cognition*, *1*(4), 242-248. https://doi.org/10.1016/j.jarmac.2012.09.002
Roediger, H. L., Agarwal, P. K., McDaniel, M. A., & McDermott, K. B. (2011b). Test-Enhanced Learning in the Classroom: Long-Term Improvements From Quizzing. *Journal of Experimental Psychology: Applied*, *17*(4), 382-395 https://doi.org/10.1037/a0026252
Roediger, H. L., Putnam, A. L., & Smith, M. A. (2011a). Ten benefits of testing and their applications to educational practice. Em J. P. Mestre & B. R. Ross. *The psychology of learning and motivation: Cognition in education* (pp. 1-36). Elsevier Academic Press.
Rohrer, D., Taylor, K., & Sholar, B. (2010). Tests Enhance the Transfer of Learning. *Journal of Experimental Psychology: Learning Memory and Cognition*, *36*(1), 233-239. https:/doi.org/10.1037/a0017678
Rother, E. T. (2007). Revisión sistemática X Revisión narrativa. *Acta paulista de enfermagem*, *20*, v-vi. https://doi.org/10.1590/S0103-21002007000200001
Rowland, C. A. (2014). The effect of testing versus restudy on retention: a meta-analytic review of the testing effect. *Psychological Bulletin*, *140*(6), 1432-1463. https://doi.org/10.1037/a0037559
Rowley, T., & McCrudden, M. T. (2020). Retrieval practice and retention of course content in a middle school science classroom. *Applied Cognitive Psychology*, *34*(6), 1510-1515. https://doi.org/10.1002/acp.3710
Santrock, J. W. (2009). *Psicologia Educacional*. McGraw-Hill.
Schaap, L., Verkoeijen, P., & Schmidt, H. (2014). Effects of different types of true-false questions on memory awareness and long-term retention. *Assessment and Evaluation in Higher Education*, *39*(5), 625-640. https://doi.org/10.1080/02602938.2013.860422
Slavin, R. E. (2020). How evidence-based reform will transform research and practice in education. *Educational Psychologist*, *55*(1), 21-31. https://doi.org/10.1080/00461520.2019.1611432
Stenlund, T., Sundström, A., & Jonsson, B. (2016). Effects of repeated testing on short- and long-term memory performance across different test formats. *Educational Psychology*, *36*(10), 1710-1727. https://doi.org/10.1080/01443410.2014.953037
Tulving, E. (1967). The effects of presentation and recall of material in free-recall learning. *Journal of Verbal Learning and Verbal Behavior*, *6*(2), 175-184. https://doi.org/10.1016/S0022-5371(67)80092-6
Uner, O., Tekin, E., Roediger, H. L. (2022). True–false tests enhance retention relative to rereading. *Journal of Experimental Psychology*: *Applied*, *28*(1), 114-129. https://doi.org/10.1037/xap0000363
Van den Broek, G., Takashima, A., Wiklund-Hörnqvist, C., Wirebring, L. K., Segers, E., Verhoeven, L., & Nyberg, L. (2016). Neurocognitive mechanisms of the “testing effect:" A review. *Trends in Neuroscience and Education*, *5*(2), 52-66. https://doi.org/10.1016/j.tine.2016.05.001
Vojdanoska, M., Cranney, J., & Newell, B. R. (2010). The testing effect: The role of feedback and collaboration in a tertiary classroom setting. *Applied Cognitive Psychology*, *24*(8), 1183-1195. https://doi.org/10.1002/acp.1630

Wiklund-Hörnqvist, C., Jonsson, B., & Nyberg, L. (2014). Strengthening concept learning by repeated testing. *Scandinavian Journal of Psychology*, *55*(1), 10-16. https://doi.org/10.1111/sjop.12093

Yang, C., Luo, L., Vadillo, M. A., Yu, R., & Shanks, D. R. (2021). Testing (quizzing) boosts classroom learning: A systematic and meta-analytic review. *Psychological Bulletin, 147(*4), 399-435. https://doi.org/10.1037/bul0000309