Learning and Instruction 40 (2015) 61–68

Contents lists available at ScienceDirect

Learning and Instruction

journal homepage: www.elsevier.com/locate/learninstruc

Further evidence that concept mapping is not better than repeated retrieval as a tool for learning from texts

M. Teresa Lechuga [a, *], Juana M. Ortega-Tudela [b], Carlos J. Gómez-Ariza [a]

[a] Universidad de Jaén, Departamento de Psicología, Campus Las Lagunillas, 23071, Jaén, Spain
[b] Universidad de Jaén, Departamento de Pedagogía, Campus Las Lagunillas, 23071, Jaén, Spain

ARTICLE INFO

Article history:
Received 15 October 2014
Received in revised form
30 July 2015
Accepted 7 August 2015
Available online xxx

Keywords:
Retrieval practice
Testing effect
Conceptual learning
Concept mapping

ABSTRACT

Karpicke and Blunt (2011) showed in college students that retrieval practice produced more learning from educational texts than concept mapping on a 1-week delayed test. This finding is surprising since concept mapping is thought to involve elaborative processing. Hence, the present study (N = 84; 76 females) aimed to examine whether the advantage of repeated retrieval remains when concept mapping is performed by *ad hoc* trained students or students who regularly utilise concept maps to prepare for exams. While the results essentially replicate Karpicke and Blunt's finding which shows that retrieval practice leads to better overall performance than concept mapping, this effect was less pronounced for people with experience using this technique than it was for trained participants. These findings point to the need to take retrieval-based learning into account in educational settings as well as to further investigate the conditions that may make retrieval activities more effective than concept mapping.

1. Introduction

A widely held view in academic contexts is that learning activities which involve the active elaboration of information lead to better results than passive and rote learning activities. Indeed, much psychological research carried out in the last forty years has shown that the way in which information is processed during episodes of studying determines its subsequent accessibility and storage in long-term memory (for a review, see Hunt, 2008). For example, there is evidence that students who are encouraged to come up with their own explanations of the facts learned are better able to later recall this information than those who had these explanations given to them (e.g., Pressley, McDaniel, Turnure, Wood, & Ahmad, 1987).

This emphasis on the role of encoding processes in learning can also be seen in the educational setting, where elaborative study techniques have been developed at length (see, for example, Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013). The use of concept maps, for example, which represent a hierarchical structure of concepts and relations, is considered an ideal strategy to enhance meaningful learning (Novak & Gowin, 1984). Of relevance here, from this encoding-based perspective retrieval processes from memory have only been taken into account insofar as they allow access to already stored information and, therefore, assessment of learning, without emphasising any roles of retrieval in learning experiences.

In contrast to a learning approach centred on processes that involve information entering the memory, the last ten years have seen a fruitful line of research arguing for retrieval-based learning. Although this is not a completely new proposal (Bacon, 1620; 2000), it is only until recently that experimental works, both basic and applied in nature, have begun to be published, highlighting the role that retrieval may play as a facilitative process of learning (for reviews, see Karpicke & Grimaldi, 2012; Roediger, Putnam, & Smith, 2011). Retrieval-based learning refers to the fact that engaging in retrieval activities, namely those requiring learners to set aside the learning material and actively access already encoded information in memory, enhances performance in a variety of learning tests (Nunes & Karpicke, 2015).

In an illustrative experiment on retrieval-based learning, Roediger and Karpicke (2006a; Exp. 2) asked college students to study prose passages under three experimental conditions. One group of participants spent four 5-min periods studying the passage (SSSS condition), whereas a second group was instructed to study the same passage during three 5-min periods and then spend a fourth period trying to remember the ideas from the text by

* Corresponding author.
E-mail addresses: mtlechuga@ujaen.es (M.T. Lechuga), jmortega@ujaen.es (J.M. Ortega-Tudela), cjgomez@ujaen.es (C.J. Gómez-Ariza).

http://dx.doi.org/10.1016/j.learninstruc.2015.08.002
0959-4752/

taking a free-recall test (SSST condition). The third group of participants studied the passage during one 5-min period and were then allowed to take three consecutive recall sessions, attempting to remember as many ideas as possible from the passage they had previously read (STTT condition). Thus, during the retrieval trials students were asked to recall as many ideas as they could from the text, but they did not reread or receive any feedback. Once these four initial periods of study and/or retrieval were completed, the participants carried out a memory test that would assess how many ideas they were able to recall from the passage. Half of the participants in each group took an immediate recall test (5 min after finishing the last reading/retrieval activity), and the other half a week later. The results were clear: in the immediate test, the number of study periods was the best predictor of the amount of recalled ideas (students in the SSSS condition performed best on this test). However, the delayed test yielded the opposite pattern, in that the number of retrieval events predicted the best performance a week later (those in the STTT condition fared best overall). To summarise, retrieval practice (by means of multiple recall tests) enhanced long-term learning more so than repeated study. Hence, repeated retrieval of previously encoded information in memory seemed to strengthen the participants' knowledge, and, as such, they were more able to efficiently use that knowledge in the 1-week delayed learning test than the other groups. Interestingly, this improved performance following retrieval practice (a phenomenon known as the testing effect) was not linked to the participants' judgments of their own learning. When asked to make predictions about their own memory performance in a learning test which would be administered a week later, the students in the repeated study condition (SSSS) predicted better performance than those who underwent retrieval practice (STTT).

Although accounts of the advantages of repeated retrieval over restudy are limited, it has recently been proposed that retrieval practice promotes elaborative processing (Carpenter, 2009; 2011). The idea is that retrieval cues (either provided to the person attempting to retrieve or present in the learning setting) activate information in long-term memory that is also encoded along with the memory traces of the target and the cues. Hence, it is thought that elaborated and integrated memories are created during the retrieval episodes that provide extra retrieval routes to access the target when needed in a future learning test (see Rawson, Vaughn, & Carpenter, 2015; for recent evidence supporting this elaborative retrieval hypothesis). Alternatively, from an episodic context account (Karpicke, Lehman, & Aue, 2014), it has been suggested that repeated retrieval allows people to encode unique context features that become associated with the previously retrieved items. Hence, when the context is reinstated during the learning test, it serves as a powerful cue to access those items in memory (Lehman, Smith, & Karpicke, 2014). Whatever the mechanisms of retrieval-based learning are, however, it now seems clear that retrieval processes are not neutral for learning. Instead, the act of retrieval from memory is thought to play a role as a knowledge modifier (i.e., by strengthening memory traces, Bjork, 1975), thus facilitating access to that knowledge in the future.

The notion that retrieval can enhance learning has recently given rise to an enormous amount of research aimed at linking cognitive research with educational practice. Thus, the beneficial effect of retrieval on learning has been replicated in different contexts and applied across a wide range of materials and populations (for reviews, see Karpicke & Grimaldi, 2012; Nunes & Karpicke, 2015; Roediger & Butler, 2011). Specifically, using educationally relevant materials, various studies have proven the efficacy of retrieval practice over other more popular techniques such as repeatedly studying the material (Roediger & Karpicke, 2006a), note-taking (McDaniel, Howard, & Einstein, 2009), verbally and visually elaborating the material (Karpicke & Smith, 2012), and using concept maps (Karpicke & Blunt, 2011), the latter being of particular relevance to the aim of this study. Karpicke and Blunt (2011) compared long-term learning in four groups of college students who were asked to carry out different activities using the same text. One group read the text during a single 5-min study period (S condition), whereas another group participated in a further three 5-min study periods (SSSS condition). The third group read the text for 5 min and was then given 25 min to construct a concept map, being allowed to consult the text (S + CM condition). The fourth and final group repeated a study protocol twice, which included a 5-min reading period plus a 10-min retrieval period in the form of a free-recall test (STST condition). The results demonstrated that participants in the retrieval practice group (STST condition) recalled more information than the remaining groups in a concept learning test administered a week later, and which covered both direct and inferential questions about the text. In a second experiment, Karpicke and Blunt (2011) found that the advantage in the retrieval practice group outweighed that of the group involved in creating concept maps, even when learning was measured by requesting that all participants construct a concept map about the text's content. Also, as was the case in the study by Roediger and Karpicke (2006a), the participants' expectations for success were not very accurate either; that is, the college students who used concept mapping predicted better performance in the learning test than those who engaged in repeated retrieval of ideas from the text. Based on the results from the two experiments, the authors concluded that practicing retrieval can be a more effective tool to promote conceptual learning than even traditional elaborative techniques such as concept mapping.

Far from being seen as a crucial step in enhancing learning in educational settings, Karpicke and Blunt (2011) study has faced strong criticism from some researchers in the field of education (Mintzes et al., 2011). For example, doubt has been cast about whether the participants truly mastered the technique behind creating concept maps before partaking in the experiment. In fact, Karpicke and Blunt found no benefit to creating concept maps over simply rereading the text, which would suggest that their concept map group may not have been good enough to demonstrate the effectiveness of this technique.

1.1. The present study and hypotheses

Given the theoretical and, especially, the practical implications of Karpicke and Blunt (2011) study, the present research aims to further explore the potential differences between repeated retrieval and concept mapping as learning tools, in an attempt to remedy, where possible, the shortcomings of the original study. As mentioned above, a salient criticism of Karpicke and Blunt's findings has to do with the level of performance reached by the group creating concept maps. Although the participants in this group were reminded about what a concept map is and how to create one using an example, it remains possible that these instructions and, in particular, the lack of practice in constructing concept maps contributed towards performance in this group being lower (at least compared with the repeated reading group). To address this, the present study includes two conditions for constructing concept maps, aimed at maximising the chances that this elaborative technique will be used properly. Thus, one group of students would receive brief training on the concept mapping technique before working on the experimental material (training group), and the other group would comprise students selected based on previous experience using concept maps (expert group). Having these two different groups included in our study would allow us to take experience in concept mapping into account and draw finer-