



Empirical study

Textual and graphical refutations: Effects on conceptual change learning

Lucia Mason^{a,*}, Roberta Baldi^a, Sara Di Ronco^a, Sara Scrimin^a, Robert W. Danielson^b, Gale M. Sinatra^b^a Department of Developmental Psychology and Socialization, University of Padova, Italy^b Rossier School of Education, University of Southern California, United States

ARTICLE INFO

Article history:

Available online 18 March 2017

Keywords:

Refutation text
Refutation graphic
Conceptual change
Learning from text

ABSTRACT

Refutation text is potentially more effective than standard text for conceptual change. Learning from text and graphic is also potentially superior to learning from text alone. In two studies, we investigated the effectiveness of both a refutation text and a refutation graphic for promoting high school students' conceptual change learning about season change, as well as their metacognitive awareness of conceptual conflict and knowledge revision. In both studies, participants were randomly assigned to one of four conditions: (1) standard text with standard graphic, (2) standard text with refutation graphic, (3) refutation text with standard graphic, or (4) refutation text with refutation graphic. Both studies had a pretest, immediate post-test, and delayed post-test design and involved students with an initial common misconception about the causes of season change. In Study 2, explicit relevance instructions to observe the important illustration were given to the participants. In both studies, refutation text with refutation graphic was not more beneficial than other instructional materials, either at immediate or delayed post-test. In Study 1, more stable conceptual change learning emerged in readers of the refutation text with standard graphic compared to readers in the control condition. In Study 2, readers of the standard text with refutation graphic performed as well as readers of the refutation text with standard graphic. In addition, more readers of the refutation text with either graphic showed metacognitive awareness of their knowledge change compared to readers in the control condition. Educational implications underline the importance of relevance instructions for guiding readers toward the graphic and of the design of text-graphic pairing to sustain knowledge revision.

© 2017 Elsevier Inc. All rights reserved.

1. Introduction

Successful text reading is the basis of most disciplinary learning in school and academic contexts. Research has widely demonstrated that learning from science text is particularly difficult when readers have alternative conceptions about the text topic, which can impede deep text comprehension (Otero, León, & Graesser, 2002; Sinatra & Broughton, 2011; van den Broek, 2010). Thus, readers' prior knowledge must undergo conceptual change. Refutation text in particular has been shown to be effective in promoting knowledge revision (Guzzetti, Snyder, Glass, & Gamas, 1993; Sinatra & Broughton, 2011; Tippett, 2010). This type of text is designed to activate students' prior knowledge by directly stating their misconceptions about a topic, refuting those misconceptions, then presenting the scientific explanation as a plausible alternative.

Informational texts are often accompanied by illustrations. According to the multimedia principle, students learn better from texts and pictures, rather than text alone (Mayer, 2009). For multimedia learning to occur, however, information provided by texts should be integrated with information provided by pictures (Mayer, 2009; Schnotz, 2014).

To date, no studies have focused on the possible refutational characteristics of an instructional graphic that illustrates a science text. Like refutation text material, a refutation graphic should be designed to activate a misconception, refute it, and then present the correct conception. The combination of a refutation text and a refutation graphic may represent an optimal tool for knowledge revision. The present studies address this gap in current research on reading-induced conceptual change, comparing both refutation text and graphic with standard text and graphic.

1.1. Effectiveness of refutation text

Various models of text comprehension have been proposed (e.g., Israel & Duffy, 2009, for a review), and despite their divergences, all models share the view that the reader plays an active

* Corresponding author at: Department of Developmental Psychology and Socialization, University of Padova, via Venezia 8, 35131 Padova, Italy.

E-mail address: lucia.mason@unipd.it (L. Mason).

role in constructing meaning from text, and that she may comprehend a text at different levels. In learning from text, the propositional textbase and the situation model levels of comprehension are essential for the formation of a coherent representation of the text content. Comprehension at the propositional textbase level involves extracting semantic information, both locally and globally, which is organized into a coherent network of propositions. Comprehension at the situation model level involves integrating text information with the reader's prior knowledge (Kintsch, 1998). This integration, characterizing the deepest level of text comprehension, can be rather difficult to achieve when readers hold misconceptions about the text topic (Kendeou & O'Brien, 2014; Sinatra & Broughton, 2011).

Refutation texts have been shown to be effective tools to promote knowledge revision about science topics through reading (Guzzetti et al., 1993; Sinatra & Broughton, 2010; Tippett, 2010). For example, one common misconception is that seasonal change occurs because the distance between the Earth and the Sun varies, being closer in summer and farthest in winter. This misconception originates from the idea that the Earth orbits the Sun and this makes the Earth closer or further away from the Sun depending on the time of the year. Refutation text aims to overcome this misconception by first acknowledging it, then providing a viable explanation of why the elliptical orbit and the Earth's tilted axis are the real causes of the changing seasons (Broughton, Sinatra, & Reynolds, 2010).

Research has documented the superiority of refutation texts over standard texts, that is, traditional expository texts with a non-refutation structure, which introduce and explain science concepts. The superiority of refutation text has been demonstrated for conceptual change learning in many science domains including physics (Braasch, Goldman, & Wiley, 2013; Diakidoy, Mouskounti, Fella, & Ioannides, 2016; Kendeou, Muis, & Fulton, 2011), astronomy (Broughton et al., 2010; Cordova, Sinatra, Jones, Taasobshirazi, & Lombardi, 2014) and biology (Mason & Gava, 2007; Mikkilä-Erdmann, 2001). Refutation texts have been used successfully for different populations including students from elementary school through college (Ariasi & Mason, 2011; Braasch et al., 2013; Broughton et al., 2010; Diakidoy, Kendeou, & Ioannides, 2003; Diakidoy, Mouskounti, & Ioannides, 2011; Mason, Gava, & Boldrin, 2008).

Recent research has also indicated that after reading refutation texts, students more often correct high-confidence misconceptions than after reading standard texts. In contrast, low-confidence misconceptions did not benefit from reading refutation vs. standard texts (van Loon, Dunlosky, van Gog, Merriënboer, & de Bruin, 2015). Relatedly, Cordova et al. (2014) showed that confidence in prior knowledge interacts with other key constructs such as self-efficacy and interest. In their study, they identified different profiles that had differential outcomes. The mixed profile (high confidence, self-efficacy, and interest, but low prior scientific understanding and high prior misconceptions), gained the most by reading refutation text about seasonal change; they also maintained this advantage over time compared to the group with a lower level of motivational beliefs.

Moreover, theoretical accounts have posited that refutation text may also improve learners' metacognition (Hynd, 2003; Tippett, 2010). However, there is scant research on this issue. Of note is that metacognition is a general umbrella term referring to various aspects of cognition about cognition (Flavell, 1979), including metacognitive knowledge, experiences, and skills (Efklides, 2006; Reber & Greifeneder, 2016). Focusing on experiences, the term metacognition is intended here to refer to students' awareness of their own conceptions and scientific conceptions. More specifically, this type of metaconceptual competence involves learners' awareness of the differences between their own alternative repre-

sentation of a phenomenon and the scientific representation. In addition, evidence of metaconceptual awareness is seen when learners recognize the difference between their current and previous representation of the phenomenon once their knowledge has been revised (Vosniadou, 1994, 2003).

This type of awareness is a manifestation of reflective thinking and underlies intentional conceptual change, that is, a self-initiated, goal-directed, and learner-controlled deliberative process of knowledge revision (Sinatra & Pintrich, 2003). The first step in the conceptual change process, as identified by Strike and Posner (1992), was an increase in learners' dissatisfaction with their current understanding. We suggest that measuring metacognitive awareness may tap into this important construct. That is, metacognitive awareness may be a precursor to increasing dissatisfaction, as learners recognizes the widening gap between their existing conception and the new, more scientifically correct conception.

In this regard, it should be pointed out that conceptual change may also occur implicitly or incidentally, without awareness and deliberate effort, when learners do not plan to modify their representations. However, the kind of change that leads to understanding complex science concepts more often requires learners to be purposeful and able to metacognitively monitor and regulate their learning. A process of intentional conceptual change necessarily starts from learners' metaconceptual awareness of what they already know and what they need to know to advance their understanding, so that they are planful and regulated in their pursuit of learning (Hennessey, 2003; Vosniadou, 2003).

Refutation text has the potential to sustain readers' intentional conceptual change by promoting metaconceptual awareness (Hynd, 2003). By directly stating and challenging their alternative conceptions, the refutation text, more than a standard text, supports students' reflection on what they know and what they need to know to truly understand. Measuring metacognitive awareness, therefore, is both theoretically and practically important for understanding conceptual change. Documenting individual characteristics involved in intentional learning processes aimed at knowledge revision has theoretical importance; and practically educational interventions should promote the ability to make one's thoughts the object of cognition, by fostering awareness of one's knowledge representations and knowledge needs to advance in understanding.

Despite the efficacy of refutation texts in promoting conceptual change, and the theoretical connection between metacognitive awareness and classical conceptual change, very few studies have examined the relation between refutation text and metacognitive awareness. In a study with undergraduates, Broughton et al. (2010) found that refutation-text readers were to some extent aware post reading that the read text contained information that contradicted their prior knowledge. The authors did not use the term metacognitive awareness when referring to the performance of students who were able to identify text information that contradicted their prior knowledge. Despite their terminology, their evidence indicates that refutation-text readers were metacognitively aware that their knowledge was in conflict with the scientific knowledge provided in the text. This outcome corroborated the findings of the quantitative analysis showing a larger decrease in misconceptions among the refutation-text readers (Broughton et al., 2010).

Similarly, in a study with eight graders, Mason and Gava (2007) revealed that refutation-text readers showed greater metaconceptual awareness of the changes in their conceptual structures compared to non-refutation text readers. The former were more able to think about their prior and current conception. After perceiving the distinction between their own explanation and the scientific one, and recognizing the former as limited and the latter as having more value, readers of a refutation text build a more correct repre-

Download English Version:

<https://daneshyari.com/en/article/4937909>

Download Persian Version:

<https://daneshyari.com/article/4937909>

[Daneshyari.com](https://daneshyari.com)