How to Foster Active Processing of Instructional Explanations

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Abstract. Instructional explanations can address learners' misunderstandings and contribute to repair them. Despite this, they are usually ineffective. We evaluated a strategy to make instructional explanations effective considering both learning process and learning outcomes. We asked 21 undergraduate students to learn about plate tectonics from a multimedia presentation while they thought-aloud. In addition to the presentation, we provided participants with instructional explanations revising typical misunderstandings. The participants in the responsive explanation condition received the explanations in combination with warning messages, which were devices pointing out the misunderstandings before revising them; the participants in the rough explanation condition received the explanations alone. The results showed that the participants in the responsive condition were more able to detect and repair flaws in their ongoing understanding, as revealed by thinking-aloud protocols, and performed better in transfer, as compared with those in the rough condition.

Keywords: instructional explanations; monitoring; regulation; thinking-aloud.

Introduction

According to Wittwer and Renkl (2008), there are at least two kinds of instructional explanations. Conventional explanations are those introducing new concepts to learners in order to give them a basic understanding of a topic. Other explanations are those used to specifically address learners' misunderstandings. We are interested in this second kind of instructional explanations, which are prevalent in instruction and have the advantage of providing learners with correct and complete information when they have problems of understanding but cannot do anything to solve them. However, these instructional explanations often have no impact on learning (Wittwer & Renkl, 2008).

In a prior study (Sánchez, García Rodicio, & Acuña, 2009) we assessed a strategy aimed at making instructional explanations effective. We asked undergraduate students to learn about plate tectonics from a multimedia presentation including animation with concurrent narration. At some points, we interjected instructional explanations reinstating key ideas of the presentation with the goal of revising learners' typical misunderstandings (these misunderstandings were identified in pilot studies). We provided the explanations either in combination with warning messages (*responsive explanation condition*), which were devices making the misunderstandings explicit before the explanations, or in isolation (*rough explanation condition*). In two experiments, participants receiving responsive explanations outperformed those receiving rough explanations in retention and transfer.

We used the *mental model repair view* (Chi, 2000) to interpret the results. This view suggests that learning from expository prose requires (a) monitoring our ongoing understanding to *detect* gaps and flaws and (b) generating explanations to *repair* the gaps and flaws. Based on this view, we interpreted the results of our experiment as follows. Since rough explanations do not help learners in identifying flaws in their emerging understanding, participants in this condition are not able to detect the flaws that the explanations are intended to revise; because of that, they treat explanations as ancillary (instead of supporting) information, thus making no use of the explanations as a basis for repairing their misunderstandings. Conversely, participants in the responsive explanation condition are assisted in identifying flaws in their understanding, which make these participants able to detect misunderstandings; because of that, they consider explanations as supporting information, thus using them as a basis for repairing their flawed understanding.

The problem is that this interpretation remains speculative until learning process (instead of learning outcomes) is examined. If the interpretation is true, participants receiving rough explanations should exhibit less processes of detection and repair than participants in the responsive explanation condition. The goal of the experiment presented here was to explore the processes that each form of support elicit during learning. To this end, we used a thinking-aloud methodology.

Method

Participants, materials and procedure

The participants were 21 undergraduate students. They were tested individually. They were randomly assigned to one of two conditions: responsive explanation condition (n = 10) and rough explanation condition (n = 11). First, the participant solved the *prior knowledge test*. This was a paper-and-pencil test comprising eight open-ended questions (e.g., “What is a tectonic plate?”). Total scores ranged from 0 to 24. Then, the participant started viewing the computer-based *multimedia presentation*. The presentation consisted of seven modules comprising animation with concurrent narration. The modules described several events concerning plate tectonics such as the convection currents, the collision between continental plates, or the destruction of crust in the subduction. The presentation also included *instructional explanations*, which were interjected in between the modules. The explanations were designed to revise typical learners' misunderstandings (based on pilot studies). For instance, based on prior studies, we expected many participants to mix up the specific features of two kinds of plate collision, i.e., the collision between two continental plates and the collision between one continental and one oceanic plate; consequently, the explanation stressed the differences between both collisions (“In the Himalaya range two continental plates are crashing, that is, plates with identical weight and size. Therefore, the collision is head on. Conversely, when one of the plates is oceanic, as in the Andes range, plates have different weight and size... ”). Participants in the *responsive explanation condition* received the explanations in combination with warning messages (“What you probably see is that both in the Andes and the Himalaya ranges two plates collide forming mountains. However, you probably did not realized that collisions in the Andes and the Himalaya ranges have big differences... ”). Participants in the *rough explanation condition* were provided with the explanations in isolation. After viewing the presentation, the participant solved the *retention test*, consisting of eight open-ended questions (e.g., “Why do tectonic plates move?”). Total scores ranged from 0 to 24. Finally, the participant solved the *transfer test*, which included ten open-ended questions (e.g., “If volcano eruptions stop, how would you explain it?”). Total scores ranged from 0 to 30.

Participants were asked to *think-aloud* while learning from the presentation. We used a coding scheme with four categories in order to identify the processes learners engaged in during learning. Categories included *paraphrasing* (expressing in your own words an idea presented in the materials; e.g., “Magma surfaces through the ridges making crust bigger”), *elaborating* (comments that go beyond the information being presented in the materials; e.g., “The resulting cracks allow magma to reach the surface in the form of volcanoes”), *distorting* (expressing in a twisted manner an idea presented in the materials; e.g., “There are two continental plates involved in the Andes plate collision”) and *detecting and repairing* (the learner generates inferences to revise a misunderstanding which he/she has previously identified; e.g., “I thought that magma from volcanoes could compensate for the loss of crust in the subduction; now I see that this is not possible because existing volcanoes are insufficient to generate new crust”).

Results

Performances are shown in Table 1. A MANCOVA with condition as the between-subjects factor and prior knowledge as a covariate revealed that there were no significant differences in the retention test, $F(1, 18) = 0.60$, $MSE = 9.35$, $p = .45$. This indicates that participants receiving responsive explanations and those receiving rough explanations were equally able to recall the key concepts covered in the presentation. With regard to the transfer test, the MANCOVA indicated that there were significant differences between the conditions, $F(1, 18) = 6.79$, $MSE = 17.28$, $p < .05$. This means that participants in the responsive explanation condition were more able to apply the knowledge they had acquired, with respect to their counterparts.

Table 1. Means and standard deviations of all conditions in all variables.

	Prior Knowledge		Retention		Transfer		Paraphrasing		Elaborating		Distorting		Detecting & Repairing	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Rough E	2.18	2.05	8.64	3.17	8.41	3.80	4.36	2.25	1.18	1.47	0.55	0.69	0.09	0.30
Responsive E	1.65	1.93	9.20	3.79	12.7	4.92	4.70	1.64	0.80	1.32	0.20	0.42	1.00	1.15

There were no significant differences between the conditions in any of the thinking-aloud categories (p's $> .05$) except for detecting and repairing, $F(1, 18) = 6.00$, $MSE = 0.72$, $p < .05$. This indicates that responsive explanations made participants produce more inferences to revise the flaws that they identified in their understanding, as compared with the participants in the rough condition.

Discussion

The results revealed that participants in the responsive explanation condition outperformed those in the rough explanation condition in transfer. This replicates prior findings (Sánchez et al., 2009) and indicates that pointing out the flaws in learners' ongoing understanding before providing revising explanations is an effective strategy in fostering the active processing of the explanations.

The thinking-aloud methodology made it possible to explore why this happens, since it explored the processes elicited by both forms of instructional explanation (responsive vs. rough). Consistent with our interpretation, given that they were not assisted in identifying the flaws in their ongoing understanding, learners receiving rough explanations were less able to use the explanations as the basis for repairing the flaws, as indicated by the fact that they scored lower in detecting and repairing with respect to their counterparts.

References

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