Learning by constructing self-explanation diagrams

Conference or Workshop Item

Learning by Constructing Self-Explanation Diagrams

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Introduction

Previous research has shown that students develop a deeper understanding of material they study if they generate explanations to themselves whilst learning (Chi, Bassok, Lewis, Reimann, & Glaser, 1989). Subsequent studies have found that this self-explanation effect is observed in a wide variety of domains from physics problem-solving to geometry and programming. Recent research has demonstrated that the way that material is presented influences the self-explanation effect. Ainsworth & Loizou (2003) presented students with information about the circulatory system in either text or diagrams and prompted them to (verbally) self-explain. Diagram students outperformed text students on almost every measure of learning. Students given diagrams generated more self-explanations and also self-explaining was more beneficial when working with diagrams. They explained this result by showing that diagrams supported learner's working memory and furthermore made information explicit which prompted beneficial self-explanations. However, there is an alternative explanation, namely that it was the impact of translating self-explanations across modalities that led to enhanced learning. Consequently, in the current study, half the students were given diagrams and asked to write self-explanations and the other half were given text and asked to draw self-explanation diagrams. This study therefore sought to answer the following questions: a) What are the benefits of drawing self explanation diagrams? b) What does a self explanation diagram look like and does it differ from a 'normal' diagram? c) What are the differences between self explanations in diagrams and self explanations in text? d) Does translating information between representations without self-explaining enhance learning?

Participants

12 participants were randomly assigned to each condition. All were university undergraduates ranging from 20-24 years of age who had not studied biological subject past the age of 16.

Materials

The same materials as Ainsworth and Loizou (2003) teaching and assessing the human circulatory system were used. In addition, two training regimes were created which explained how to write self-explanations or draw diagrams as self-explanations, modelled on that of Bielaczyc, et al (1995).

Procedure

All participants completed a pre-test which involved answering 10 multiple choice questions and drawing a blood path diagram. Participants then studied the text material whilst self-explaining. Finally, all participants took a post-test which included all the pre-test material plus six implicit questions that required integration of information and six knowledge inference questions that required the generation of new knowledge.

Results

Table 1. Pre and post test scores by format of presented material

	Blood path diagram (10)				Multiple-choice (10)			
	Diagram (n=12)		Text (n=12)		Diagram (n=12)		Text (n=12)	
	M	SD	M	SD	M	SD	M	SD
Pre test	3.46	1.30	3.33	1.07	5.42	1.88	5.67	1.15
Post test	7.46	1.63	7.54	1.50	8.08	1.16	8.25	1.86

Analysis by two mixed 2-by-2 ANOVA showed a single significant effect of time ($F(1,22)=223.86$, $MSe=0.903$, $p<0.001$, and ($F(1,22)=40.613$, $MSe=2.036$, $p<0.001$) but not for format. Analysis of deeper understanding questions also revealed no effect of format (Table 2).

Table 2. Scores on Implicit and Knowledge Inference questions by condition

	Implicit questions (13)				Knowledge Inference questions (14)			
	Diagram (n=12)		Text (n=12)		Diagram (n=12)		Text (n=12)	
	M	SD	M	SD	M	SD	M	SD
Score	6.83	1.85	7.86	2.34	6.83	1.99	8.04	1.57

Participants' statements in the self-explanation conditions were coded and analyzed by a 2-way between groups MANOVA (Table 3). The only significant difference was that participants translated significantly more information when drawing diagrams from text than when writing self-explanation from diagrams ($F(1,22)=17.066$, $MSe=550.860$, $p<0.001$). Furthermore, the amount of information translated correlated with learning outcomes ($r=.47$, $p<0.05$) whereas in this study the amount of self-explanation did not.

Table 3. Mean number of types of statements by condition.

	Diagram (n=12)		Text (n=12)	
	M	SD	M	SD
Principle based	0.08	0.289	0.08	0.289
Goal driven	6.00	4.90	4.58	4.80
Elaborations	15.58	8.76	17.83	11.6
Noticing coherence	0.33	0.651	0.33	0.89
Monitoring	1.33	2.06	4.00	8.60

False	2.17	1.95	2.00	3.36
%information translated	46.2%	12.99%	84.5%	16.15

Discussion

This study shows that learners could overcome the text disadvantage found by Ainsworth and Loizou (2003) if they drew self-explanations. Furthermore, students appeared to find it as easy to draw self-explanations as they did to write them since there is no difference in either the quality or quantity of self-explanations between conditions. Figure 1 shows an example of a diagrammatic self explanation of the sentence "Human life depends on the distribution of oxygen, hormones, and nutrients to the cells in all parts of the body."

The only striking difference between the groups is for the amount of information translated whereby students given text included significantly more of this information directly into the diagram than vice versa. It would appear that before they can add self-explanation components to diagrams, students first need to include more factual information. Analysis of the students diagrams is on-going to examine the nature of the representations created (e.g. how iconic were the diagrams) and their relationship to student's prior knowledge. However, this study suggests that drawing diagrams as self-explanations is just as effective as writing self-explanations and suggests that some of the previously reported benefits may be due to translating information and explaining across different representational formats.

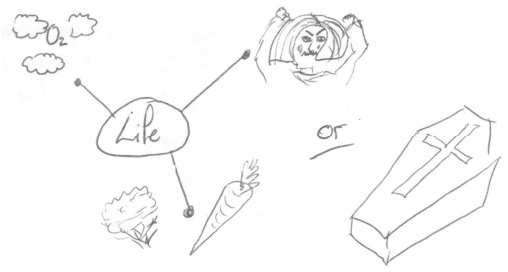

Figure 1. Self-Explanation Diagram

References

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