Attentional Guidance: Does It Foster Children's Learning With Text and Pictures?

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Abstract. The present study focused on the question, whether multimedia and modality principles hold true in primary schools and whether attentional guidance is effective for children's learning from science texts. Primary school children learnt about the human blood circulation system. A 4x2 study design distinguished four types of learning material (text; text + pictures; text + pictures + selection aids; text + pictures + selection and integration aids), presented in two text modalities (written vs. spoken). Results indicate that although adding pictures to text enhances learning (showing a multimedia effect), further performance improvements could neither be achieved by using spoken instead of written text (contradictory to the modality principle) nor by providing learners with attentional guidance by means of selection and integration aids. These results are largely in line with recommendations derived from the Cognitive Theory of Multimedia Learning (CTML, Mayer, 2009).

Keywords: Multimedia Principle; Modality Principle; Attentional Guidance.

Introduction

The CTML (Mayer, 2009) claims that people learn better from words and pictures than from words alone (multimedia principle) and when words and pictures are presented audio-visually rather than merely visually (modality principle). Although many studies were successful in replicating these effects (e.g., Carney & Levin, 2002), a considerable amount of studies failed to do so (De Westelinck, Valcke, De Craene, & Kirschner, 2005; Tabbers, Martens, & van Merriënboer, 2004). In this regard, guiding learners' attention to relevant aspects of the material by means of instructional design devices could be a useful basis for learning, because selection, organisation and integration of information can be enhanced that way (e.g., Brünken, Plass, & Leutner, 2004). Studies with 4th and 5th graders (Moreno & Durán, 2004) indicate that visual and verbal guidance can be effective for primary school children.

Method

Participants were 226 primary school children (mean age 10.0 years, *SD* = 0.63; 55 % girls), who were randomly assigned to one of eight conditions (see below).

Paper-pencil-based learning materials on functionality of the human heart and blood circulation were developed. Two learning units with corresponding pictures were designed. Learning unit 1 focused on functions of the pulmonary and systemic circulation. Learning unit 2 described the structure of the heart and the process of blood circulation. According to Carney and Levin (2002) representational and/or interpretational pictures were used. Following Peeck (1994), the information was divided between text and pictures. Thus, there were three information sources: information presented in (1) text only, (2) pictures only, and (3) both text and pictures. Selection and integration aids were designed as written questions which had to be answered by the children. These questions tried to draw children's attention to important aspects of the learning materials.

A 4x2 study design with two independent variables was used: (1) type of learning material (text only, text + pictures, text + pictures + selection aids, text + pictures + selection + integration aids) and (2) mode of text presentation (written vs. spoken). This resulted in eight experimental groups. The dependent variable was learning performance as measured by criterion-referenced tests including text, pictures, both text and pictures as well as transfer items. This test was conducted immediately after learning as well as in a Follow-up measure two months later.

Results

In a first step, children's scores on the learning tests were adjusted for reading comprehension and spatial ability. After that, a MANOVA was computed with the adjusted overall test scores of learning units 1 and 2 (both directly after the learning phase and two months later) as dependent variables, and type of learning material and mode of text presentation as factors. This revealed a main effect for type of learning material for learning unit 1 ($F(3,218)=7.34$, $p<.001$; Follow-Up: $F(3,218)=5.80$, $p=.001$) as well as for learning unit 2 ($F(3,218)=4.29$, $p=.006$; Follow-Up: $F(3,218)=2.72$, $p=.045$). In addition, neither a main effect for text presentation mode ($F(4,215)=1.46$, $p=.215$) nor an interaction between type of learning material and text presentation mode were found ($F(12,651)=1.13$, $p=.335$).

In order to investigate the role of information source, ANOVAs with planned comparisons were computed for the subscales of the two learning tests. Because both learning units display similar patterns, only the results for learning unit 1 are reported here. Furthermore, as there were no differences between the groups receiving selection aids and those receiving selection plus integration aids, these groups were merged into one group.

Results for the ***picture scale*** of learning unit 1 (Fig. 1a,b) are as follows: **(1)** Adding pictures to text increases achievement, $t(222)=9.55$, $p<.001$ (Follow-Up: $t(222)=5.27$, $p<.001$). **(2)** Additional picture processing aids do not increase achievement, $t(222)<1$ (Follow-Up: $t(222)=-1.43$, $p=.153$).

Results for ***transfer*** are as follows (Fig. 1c,d): **(1)** Adding pictures to text increases achievement, $t(222)=2.98$, $p=.003$ (Follow-Up: $t(222)=3.13$, $p=.002$). **(2)** Additional processing aids even decrease achievement, $t(222)=-2.28$, $p=.023$ (Follow-Up: $t(222)<1$).

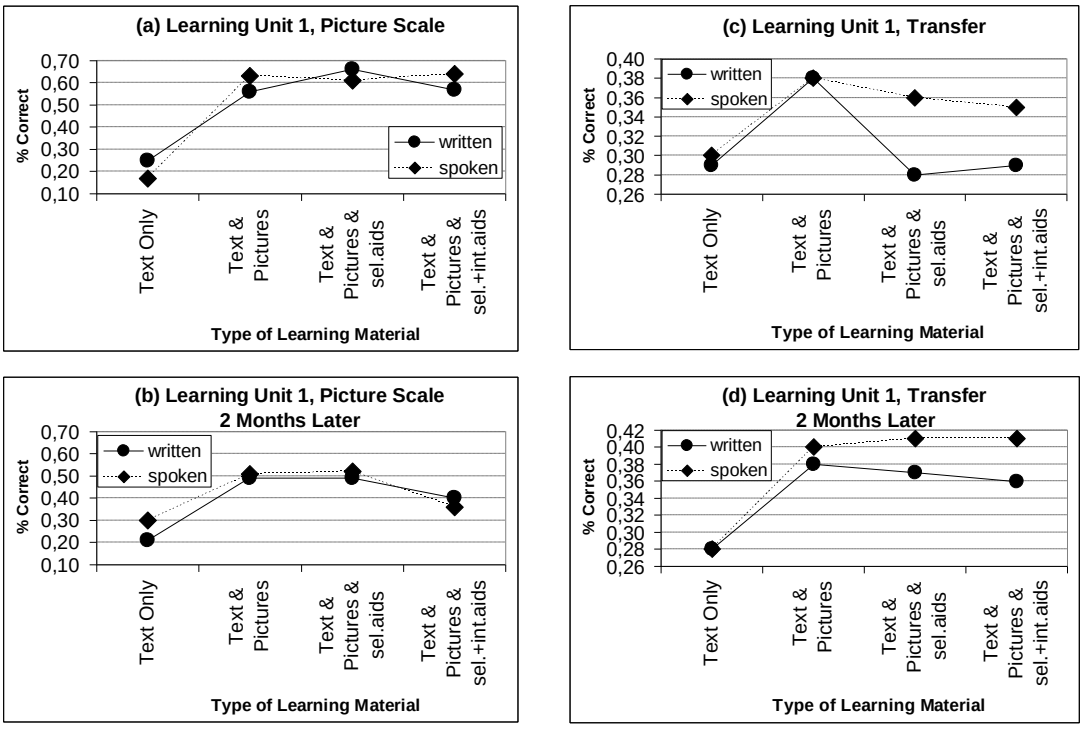

Figure 1. Learning Results Depending on Information Presented in Pictures Only or Transfer, Post Test or Follow-Up, Type of Learning Material, and Mode of Text Presentation (Written/Spoken).

Discussion

Our results are largely in line with common multimedia principles (Mayer, 2009).We found a multimedia effect with 4th-graders in real school settings. However, the modality effect did not show

up. This is in line with studies of Tabbers et al. (2004) or Segers et al. (2008). As Ginns (2005) suggested, it might have been that the more time that was available to the children, the better they got along with written text because they had enough time to process and re-read it, which is more difficult with (transient) spoken text. The absence of *attentional-guidance effects* could be due to visual search processes being caused by the arrangement of selection and integration aids (split-attention) or by learners being overwhelmed by the additional options offered to them (Opfermann, 2008).

When looking at information sources, a more elaborate result pattern emerges: While adding pictures had a positive impact on performance regarding information presented in pictures only as well as on transfer, performance regarding information presented in text only and regarding information presented in both text and pictures did not seem to benefit from additional pictures. Thus, the multimedia effect was mainly based on the results of the picture and the transfer scale. Consequently, especially in light of the fact that there are a number of studies failing to show the multimedia effect (Opfermann, 2008; Segers, Verhoeven & Hulstijn-Hendrikse 2008), Peeck's (1994) suggestions concerning the differentiation of source of information should be further considered within future research.

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