With respect to knowledge about functional relations, in the immediate posttest no significant main or interaction effects of the independent variables were found. In the delayed posttest a small main effect in favour of the conditions with prior expository instruction was detected, F(1; 23.36) = 4.48; p h2 = .01.With respect to understanding of the scientific theory, in the immediate posttest significant main effects in favour of the conditions with low content-specificity of guidance, F(1; 23.12) = 9.50; p h2 = .05, and the conditions with summary expository instruction, F(1; 23.12) = 6.62; p h2 = .03, as well as an interaction effect between prior expository instruction and summary expository instruction, F(1; 23.13) = 6.32; p h2 = .03, were found: In the presence of prior expository instruction, summary expository instruction or both, learners acquired deeper understanding of the scientific theory than without both of them. In the delayed posttest, however, this interaction effect and the main effect of summary expository instruction disappeared. Instead, there was a significant main effect in favour of the conditions with prior expository instruction, F(1; 23.28) = 9.24; p h2 = .03.

Discussion

The results indicate a superiority of low content-specificity of guidance during inquiry activities with respect to the understanding of scientific theory. With general prompts for inquiry, the function of the current activity in the investigation of theoretical assumptions might be more transparent to the learners than with highly content-specific questions. Furthermore, prior expository instruction proved beneficial for knowledge about functional relations among observable phenomena and understanding of the scientific theory. While immediately after the learning phase a summary might be at least a functional equivalent to prior expository instruction – as evidenced by the interaction of prior and summary expository instruction –, in the long run prior expository instruction proves superior. This effect might be explained by the opportunity provided by prior expository instruction to apply the theory to be learned during inquiry activities, thereby yielding deeper theoretical understanding. In sum, this study demonstrates that primary school children can learn about challenging topics involving scientific theories that cannot readily be discovered, provided that they are supported appropriately.

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PAPER PRESENTATION

Use of concept maps to follow up the effect of discussing atmosphere dynamics with satellite images

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Concept maps (Cmaps) are useful for representing students' knowledge to foster meaningful learning. However, assessment of Cmaps in real classrooms is a time-consuming task which hinders its application by teachers. We proposed an assessment procedure based on the use of a compulsory concept and its neighbors to check the students' understanding about a specific aspect of a topic. Our case study involved a discussion about climate change during the Natural Science course offered for 1st-year higher education students. Preliminary results confirmed the possibility to get relevant information from Cmaps after assessing only part of the whole propositional network.

Aims

Concept maps (Cmaps) were proposed by Novak and colleagues during the 1970s. They can be defined as a set of concepts embedded into a propositional framework. Concept mapping plays a key role as a tool to represent knowledge held by a learner, and also the structure of knowledge in any subject matter domain (Novak, 2010). The aim of this work is to propose a new way to evaluate students' Cmaps, based on the use a compulsory concept to check the quantity and the quality of propositions established from it. Our hypothesis suggests this analysis reduces the time required for assessing the Cmaps without compromise the information obtained about the students' understanding about the compulsory concept.

Methodology

Data collection

Individual Cmaps (n=69) were produced by 1st-year higher education students during the Natural Science course offered at Universidade de Sao Paulo (Correia et al., 2010). Climate change was the topic under discussion (classes 6-10) and a video with satellite images (NOAA, USA) was used to show the atmospheric dynamics (class-8). Dispersion

(of pollutants) was assumed as the key-concept to allow an in-depth understanding about climate change local and global consequences (Fenger, 2009; Ungar, 2000). Therefore, dispersion was the compulsory concept and must be used by the students during the Cmap elaboration (class-10).

Data analysis
All Cmaps were analyzed considering only the propositions (n=175) that involved "dispersion" as the initial or final concept. They form the data subset to be considered in this paper. The evaluation of Cmaps followed these steps:

1. Count the number of "neighbor concepts" associated with dispersion through propositions.
2. Check what are the "neighbor concepts" more used by the students, by using the word cloud provided by Wordle (wordle.net).
3. Categorize the propositions considering their semantic meaning (content analysis). Two different researchers took part into the process of category creation to minimize subjectivity.
4. Compare the number of "neighbor concepts" (1) and the categories assigned for the propositions for each Cmap (3).

Results and discussion
All Cmaps presented a total of 985 propositions. The concept "dispersion" was present in 175 propositions (18% of the total), and it was used as the final concept in 60% (n=102) of them. Two or three "neighbor concepts" were associated with "dispersion" in 73% of the Cmaps (Figure 2).

The frequency of the concepts used in the propositions containing "dispersion" was qualitatively estimated by using the word cloud obtained in Wordle website (Figure 3). More frequent concepts (e.g. climate change, global, greenhouse gases, and pollution) are in bigger fonts, while the less frequent ones (e.g. atmosphere, energy, fossil, and technology) are in small fonts. It should be highlighted that the frequent concepts were not always used by the students to express ideas accepted by the current scientific understanding about climate change. The naive use of this concept may be related to the previous knowledge that the students have about the current environmental problems, which are noticed by the mass media. On other words, the evaluation of the propositional meaning (right/wrong) was not considered until now.

The content analysis classified the propositions into eight different categories. Table 2 shows that the category environment predominated in the Cmaps with 1-5 neighbor concepts. Students who used 2-3 neighbors presented a broad understanding of dispersion and how to relate this concept into the propositional framework. On the other hand, the Cmaps with 6 and nine concepts showed a large number of meaningless and wrong propositions, suggesting these students used "dispersion" without any concern.

Two illustrative Cmaps (Figure 4) were selected to highlight the bad (Fig.4a) and the good (Fig.4b) use of dispersion.

Theoretical and educational significance of the research
The comparison of these Cmaps suggests the proposed Cmap analysis using only the neighbor concepts and propositions may be useful for speeding up the assessment of a large number of Cmaps. This strategy overcomes one of the main obstacles to the constant use of Cmaps in real classrooms.

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PAPER PRESENTATION
Comparing three theories of visual expertise: A meta-analysis of eye movements
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The purpose of this study was to compare three theories of visual expertise by a meta-analysis of eye movements. The theories were the theory of long-term working memory (Ericsson & Kintsch, 1995), the information-reduction hypothesis (Haider & Frensch, 1996), and the holistic model of image perception (Kundel et al., 2007). Analysis