Concept Mapping or Summary Writing as Subsequent Strategies to Learning from Management Games

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Abstract. This study reports the effects of concept mapping and summary writing on promoting students' learning processes in the field of business sciences. Both strategies were used complementary to a management game which aims at providing students with knowledge about the supply chain of an industrial company. Forty-one ninth-grade students at a public high school took part in the study. The students were assigned to concept mapping, summary writing or a control group. They took a knowledge test before and after playing the management game. The results showed a significant increase in knowledge over time for all groups. The concept mapping group had the highest increase in knowledge, followed by the summary group and the control group. However, the groups did not differ significantly in their knowledge increase from pre-test to post-test. Thus, our data can only provide support for the assumed effectiveness of elaborations strategies by trend.

Keywords: concept mapping, summary writing, management game, learning strategy

Background and Aim

One central goal of school education is helping students to cope successfully with complex situations in daily life. For that purpose, educational researchers and teachers recommend relating school instruction more closely to practice and real life (Brown, Collins, & Duguid, 1991), e. g. by using management games. Though the last 30 years of research account for the effectiveness of management game based instruction, it by no means does sell itself by just keeping the students busy playing. Rather, the phases of playing and exploring have to be complemented by systematic elaborations of the contents. Elaborations can be regarded as extra processing that result in better memory and better understanding of the material to be learned (Reder, 1980, p. 7f.). Many different elaboration strategies have been investigated by researchers, among them concept mapping and summary writing.

From a theoretical point of view concept mapping is superior to summary writing mainly for the following reasons: 1. Concept mapping is based on the assumption that knowledge has the structure of a semantic network (e. g. Collins & Quillian, 1969). Because of the network format, concepts maps better support students in externalizing their knowledge than linear texts. 2. Concept maps represent every concept only once, whereas summaries comprise similar or same concepts several times. Thus, conceptual interrelationships are more clearly and unequivocally defined in concept maps compared to texts. 3. Learners have more freedom to construct and work through concept maps than to construct and work through texts. Texts require linear processing (Schnotz, 1994).

Consistent with theoretical consideration, studies suggest a slight advantage of concept mapping over summary writing (e.g. Hall & O'Donnell, 1996, Nesbit & Adesope, 2005). However, the results are undetermined and more research is needed. Against this background, our aim is to investigate whether concept mapping or summary writing is more suitable for promoting students' learning processes.

Method

Participants and intervention: Forty-one ninth grade students at a public high school took part in our study during the school year 2009/2010. They were 14.9 years old on average. All students played the management game "Easy Business™" which provides students the opportunity to learn the supply chain of a company and the decisions involved. After finishing the management game, the students

were randomly assigned to one of two experimental groups (either concept mapping or summary writing) or to a control group (no additional strategy). The students of the experimental groups received a list of concepts and relations as an aid for concept mapping or summary writing. We trained the concept mapping group twice before starting the study. They received a written manual presenting the procedure of concept mapping based on a worked-out-example.

Hypotheses: 1. Concept mapping and summary writing are superior to the control condition; 2. Concept mapping is superior to summary writing.

Data Gathering: Before and after the treatment the students took a knowledge test consisting of tasks in short answer or essay format. In order to control the learners' verbal abilities we applied two subtests (analogies and concept meaning) of the WIT-2 (Kersting, Althoff, & Jäger, 2008). Last, but not least we collected data of the learning processes, namely the concept maps and the summaries.

Data Analysis: The knowledge tests were analyzed using a qualitative content analysis. The intercoder reliability measured 96.4% (Spearman-Rho) underscoring the reliability of the category system. On the basis of the qualitative content analysis a test score was calculated for each student. To determine whether differences in knowledge increase between the pre-test and the post-test could be explained by concept mapping or summary writing, a two-way mixed analysis of variance was carried out and effect sizes were determined.

In addition, the quality of the students` concept maps and texts was scored by the means of a quality index. For that purpose, the expert map as well as the students' concept maps and texts were transformed into lists of propositions. The quality index, then, equals the corresponding propositions in the student's and the expert's propositions list divided by the total number of propositions of the expert map. ANOVAS were conducted in order to determine whether there are differences in quality between texts and concept maps and whether the quality of texts and concept maps influences the knowledge increase.

Last, but not least, we conducted ANOVAs in order to determine whether prior knowledge influences the quality of concept maps resp. texts on the one hand and the knowledge increase on the other hand.

Results

The two-way mixed ANOVA showed a main effect for the factor time ($F(1,30)=82.768$; $p=.000$), indicating a significant increase in knowledge over time for all groups. However, the groups did not differ significantly in their knowledge *increase* from pre-test to post-test ($F(2,30)=1.125$; $p=.338$). The effect sizes with regard to both experimental groups versus control group ($d=.579$) and concept mapping group versus summary group ($d=.292$) are medium or small. Nevertheless, by trend, the results show a relative advantage for concept mapping, i. e. the concept mapping group had highest increase in knowledge (8.09 points), the summary group was second best (7.25 points), and the control group reached the lowest increase in knowledge (5.73 points). In addition, we found that the quality of the concept maps is significantly higher than the quality of the texts ($F(1,20)=4.481$; $p=.047$). Knowledge increase did not differ dependent on the quality of the concept maps and texts $F(1,20)=3.176$; $p=.092$).

The groups did not differ in pre-test scores ($F(2,30)=2.280$; $p=.120$). However, knowledge increase

differed dependent on the level of prior knowledge: Students with high prior knowledge showed a low increase in knowledge, and students with low prior knowledge showed a high knowledge increase (F(1,31)=16.354; p=.000). Moreover a significant interaction effect for prior knowledge and group could be identified (F(1,20)=4.723; p=.043). That means, students with low prior knowledge constructed low-quality concept maps, and students with high prior knowledge constructed high-quality concept maps. For the summary group prior knowledge had only a small effect on the quality of the texts.

Lastly, the groups did not differ in verbal abilities and no significant correlation between verbal abilities and knowledge increase (r=.035 p=.848) or verbal abilities and quality index (r=.222 p=.320) could be found.

Conclusions

The management game contributes to a significant knowledge increase for all groups (significant main effect ANOVA). However, both hypotheses have to be rejected. The additional elaborations strategies concept mapping and summary writing only by trend support the learning processes better than the management game alone. In addition, concept mapping is only by trend superior to summary writing. These results are in line with theory and the majority of findings, and once more, point to the meaning of learning strategies. The superiority of concept mapping may be explained by its graphical features. As two-dimensional diagrams concept maps may better facilitate the understanding of the macrostructure of information than linear texts. Another explanation might be that the lists of concepts and relations given to the students better fit the concept mapping task than the summary task. Further research should concentrate on different instructions.

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