Beneficial Effects of Learning from Animations

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ABSTRACT
Animations have the potential to visualize processes changing over time as well as in space. Research on learning from animations reports very inconsistent results concerning the benefits associated with learning from animations. One reason for these inconsistencies might be the use of different assessments of learning success. In an experimental study, we used three assessments of learning success. On the basis of these assessments, we compared learning from static pictures and learning from animations. With respect to the acquisition of conceptual and procedural knowledge, learning from animations was more beneficial.

Keywords
Learning, static pictures, animations

INTRODUCTION
Animations are dynamic representations which very often visualize processes changing over time as well as in space. Commonly, the “interactivity” of animations is limited to simple controls such as starting, stopping, forwarding and rewinding the animation.

On the one hand, animations have the potential to facilitate learning, because they dynamically visualize processes which might otherwise be difficult to explain to learners, to be observed by learners, or to be envisioned by learners. On the other hand, animations place their own demands on learners: they may require learners to process large amounts of continuously changing information as well as to direct their attention simultaneously to different regions of the graphical display, for instance [1].

Correspondingly, research on learning from animations reports very inconsistent results concerning the benefits associated with learning from animations [2]. In many cases, animations seem not only not to improve, but even to impede learning [1, 3]. While in some research the characteristics and competencies of the learners are focused upon in order to understand how learning from animations can be improved [4], in other research the characteristics of the animations are emphasized in order to enhance learning [5].

However, the different studies on learning from animations do not only vary with respect to the characteristics of the learners, the design of the animations, and the animated subject matter, but also with respect to the assessments used to determine learning success. According to Anderson and Krathwohl [6], there are four different kinds of knowledge which can be distinguished: factual, conceptual, procedural, and metacognitive knowledge.

It could well be that animations are inappropriate in facilitating the acquisition of factual knowledge, but that they are suitable for improving the acquisition of conceptual and procedural knowledge, especially if this knowledge is related to the processes visualized by the animations. In an experimental study, we assessed the learners’ factual, conceptual and procedural knowledge in order to compare what they learned from static pictures and from animations.

1. EXPERIMENTAL STUDY
The learning performance of two groups was investigated: (1) a control group who learned from static pictures and spoken text and (2) a treatment group who learned from animations and spoken text. Both groups worked on a pre- and a posttest.

Two six grade classes with 53 students overall participated in the study. They were between 12 and 13 years old and were almost equally distributed among the two groups. While the control group was made up of 26 students (12 girls, 14 boys), the treatment group comprised 27 students (14 girls, 13 boys).

The learning material was about how honey bees dance in order to communicate to other bees as to where resources are located in the environment. While one kind of dance is used in order to communicate the location of resources which can be found up to 100 meters away from the honeycomb, a second kind of dance is used to communicate the location of resources which can be found more than 100 meters away from the honeycomb. In these dances, honey bees take into account the relative positions of the honeycomb, the sun and the resources.

Two different versions of the learning material were designed: (1) animations and (2) static pictures. According to the multimedia principle of Mayer, both kinds of learning material were combined with the same spoken text. Therefore, the students were able to watch the animation or the static pictures and at the same time listen to the spoken text. The animated learning material was taken from Microsoft Encarta [7]. For two minutes, the traces of the honey bees’ dances are visualized dynamically and the principles underlying the dances are verbally as well as graphically described. The students were able to start, to stop, to forward and to rewind the animation.

The static pictures were made up of seven pictures taken as “screenshots” from the animation. Every time new information is introduced in the animation, a picture was taken. In this case, the traces of the honey bees’ dances are not dynamically visualized but are only verbally described. As in the animated learning
material, the principles underlying the dances are verbally as well as graphically described. The sequence of the static pictures corresponds to the sequence of the same pictures in the animation. Furthermore, the static pictures were combined with the same spoken text as the animated pictures. The students were able to move back and forth between pictures. If the students moved to a picture for the first time, the text was automatically spoken. By pressing a button the students were able to listen to the text repeatedly.

Because we expected the students to have only little pre-knowledge about dances of honey bees, we assessed their pre-knowledge only at the factual knowledge level by means of 6 questions. The post-test was made up of 8 questions assessing factual knowledge, 8 questions assessing conceptual knowledge and 8 questions assessing procedural knowledge.

In the beginning, the students worked individually on the pre-test. Thereafter, a short introduction was given to the students. After the introduction was finished, students individually learned about the communication principles of honey bees on the basis of the learning material. Learning time was limited to 30 minutes. Students were allowed to take notes during learning. However, they were not allowed to make use of these notes while working on the post-test.

Because the communication principles of honey bees are expressed by means of dances, we expected that an animation is better suited to explain these dances and their underlying principles than a sequence of static pictures. Therefore, we expected that learning with the animation is superior to learning with the static pictures. This should especially be true with respect to procedural knowledge, which allows one to apply the communication principles to new situations.

There were no significant differences between groups in the pre-test: students who learned with the animation (M=1.01 (15.5%), SD=0.56) knew almost as much about the communication principles of honey bees as students who learned with static pictures (M=1.28 (19.7%), SD= 0.94; t=1.28, df=51, p=.20). The descriptive statistics in the post-test are shown in Table 1. The results of a multivariate analysis of variance of the post-test data are shown in Table 2.

On average, students who learned from the animation and students who learned from static pictures performed significantly different in the post-test. While there are no significant differences between groups with respect to the acquisition of factual knowledge, the group who learned with the animation significantly outperformed the group who learned with static pictures with respect to the acquisition of conceptual knowledge (Cohen’s d=1.13) and procedural knowledge (Cohen’s d=1.18).

2. CONCLUSIONS
We demonstrated that animations might not be of much help if only factual knowledge is to be acquired. In contrast, animations might be well-suited to facilitate the acquisition of concepts and procedures related to processes in time and space. However, like many other studies [1, 3], our investigation also demonstrates that even with animations learning success is not overwhelming. This is true despite the fact that the learning material has been designed according to empirically tested design principles, such as the multimedia principle. Much research on learning with static and dynamic pictures conducted during the last 10 years suggests that students might have no strategies available in order to systematically learn from pictorial learning material, especially if this material is dynamic [1]. In our future research on learning from animations, we intend to focus on developing, teaching and exercising learning strategies which aim at helping students to more successfully exploit the information encoded in animations.

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REFERENCES