**The Effects of Metacognition Scaffolding on Accuracy of Metacomprehension Judgment in a Digital Environment**

Introduction

In recent years, learning methods have transitioned from reading on paper to reading in a digital environment. Studies show that learning in such an environment is inferior to paper learning due to poor monitoring. Monitoring is a metacognitive process based on judgments of self-knowledge that are made while learning is in progress or at its end. Metacomprehension judgment, a process undertaken during learning, answers the question: “How well do I understand the text that I’ve just read?” Faulty judgment leads to ineffective learning and poor achievements. Studies show that metacognitive scaffolding improves students’ achievements in text comprehension and solving mathematical problems in both paper and digital learning (Z.R. Mevarech & Fan, 2018). Still unexamined, however, is its contribution to improving the accuracy of metacomprehension judgment in a digital environment. Described below is the effect of metacognitive questions embedded in a text on the accuracy of judgment in the course of two forms of literacy studies— reading and mathematics—in a digital environment among primary-grade pupils.

Method

Participants

One hundred forty fifth-grade pupils took part in the study. They were divided into four learning groups: Group 1, engaging in reading literacy with metacognitive scaffolding and titled “read+meta,” Group 2, learning mathematics literacy and receiving metacognitive scaffolding, called “math+meta,” Group 3, engaging in reading literacy without metacognitive scaffolding and called “control\_read,” and Group 4, dealing with mathematic literacy without metacognitive scaffolding—“control\_math.”

Intervention Program and Procedure

Courseware titled “Literate—That’s Me,” which presented students with six different texts that test literacy proficiency, was developed for the purposes of the study. To provide metacognitive scaffolding, four metacognitive questions using the IMPROV model (Z. Mevarech & Kramarski, 1997, 2003) were inserted into the texts that were administered to the trial groups: a comprehension question (“What does the text deal with?”), a context question (“To what topic that I know is the text related?”), a strategy question (“What strategies should I use to help me understand the text?”) and a reflection question (“I’ve read the whole text. Did I understand it? How should I improve my reading next time?”). When they finished reading, the participants pressed an on-screen command confirming that they had finished. At this stage, the text disappeared and a prediction-of-performance question appeared on the screen: “You are about to answer seven questions related to the text. How many of the seven can you answer correctly?” Pupils answered by sliding a cursor along a ruler. Afterwards, they were asked: “Do you wish to read the text again?” If they answered “Yes,” the text came up again. Otherwise, a multiple-choice test appeared, examining how well the text was understood. Students were asked to select the right answer. This stage took place six times, in the course of six sessions.

Measurements

Assessment of Reading-Literacy and Mathematics-Literacy Achievements

Literacy achievements were assessed by having the participants read and study texts and derive insights from them. The mean length of the Hebrew-literacy texts was around 650 words; that of the mathematics-literacy texts was some 100 words. For each text, a seven-item multiple-choice test was administered. The six texts and the tests on which the study was based were shown on screen.

Measuring Accuracy in Comprehension Judgment

To calculate the accuracy of the participants’ metacomprehension judgment, judgment was compared with test results in two respects: relative accuracy (resolution) and absolute accuracy (calibration). In this study, six judgments and six tests were compared.

Results and Discussion

Literacy Achievements

To determine whether the participants improved their achievements between the first test (pre) and the last (post) and to parse the results by research groups, the reading-literacy groups and the mathematics-literacy groups were analyzed separately. In an additional repeated-measures variance analysis with a 2 \* 2 matrix (two points in time: pre-test and post-test; and two research groups: “read+meta” and “control\_read”), and in simple-effect analyses, the “read+meta” group’s achievements were found to be significantly better on the post tests than on the pre-tests: *F*(1,30)=7.381, p<.05, $η\_{p}^{2}$.= 197. In the “control\_read” group, no significant differences between the tests were encountered. In an additional repeated-measures variance analysis with a 2 \* 2 matrix (two points in time: pre-test and post-test; and two research groups: “math+meta” and “control\_math”), the “math+meta” group improved its achievements between the pre-test and the post-test: *F*(1,32)=40.245, p<.001, $η\_{p}^{2}$=.557. In the “control\_math” group, no significant differences between the tests were found.

When differences among mean literacy achievements on the six tests were checked, the mean achievements of the “read-meta” group were found to be significantly higher than those of the “control\_read” group: t(63)=2.967, p<.005. Also, the mean achievements of the “math+meta” group significantly exceeded those of the “control\_math” group: *t*(70)=3.413, *p*<.005. These outcomes attest to an improvement in reading-literacy and mathematics-literacy achievements in the specific groups that received metacognitive scaffolding. They reinforce previous studies that tested the effect of metacognitive scaffolding on improving achievements (Mevarech & Fan, 2018; Valencia-Vallejo et al., 2019).

Accuracy of Judgment

In this study, we defined absolute accuracy (calibration) as the absolute difference between judgment before the test and achievement on the test [judgment on the pre-test and judgment on the post-test?]. The smaller the absolute difference, the better the absolute accuracy is.

To determine whether absolute accuracy improved between the pre-test and the post-test and to parse the outcomes among the research groups, the reading-literacy groups and the mathematics-literacy groups were analyzed separately. In an additional repeated-measures variance analysis with a 2 \* 2 matrix (two points in time: pre-test and post-test, and two research groups: “read+meta” and “control\_read”) and in simple-effect analyses, a significant difference between the tests was found in the “read+meta” group: *F*(1,30)=11.316, *p*<.005, $η\_{p}^{2}$=.274, meaning that absolute accuracy was better (the disparity was smaller) on the post-test than on the test [the pre-test?]. In the “control\_read” group, no significant differences between the tests were encountered. In an additional repeated-measures variance analysis with a 2 \* 2 matrix (two points in time: pre-test and post-test, and two research groups: “math+meta” and “control\_math”) and in simple-effect analyses, a significant difference was found in the “math+meta” group between the tests: *F*(1,32)=8.067, *p*<.01, $η\_{p}^{2}$=.201, meaning that absolute accuracy was better (the disparity was smaller) on the post-test than on the pre-test. In the “control\_math” group, no significant differences between the tests were found. These results attest to an improvement in absolute accuracy of judgment in the specific groups that received metacognitive scaffolding.

The results of this study have important implications for education systems. Literacy studies in digital environments are becoming more and more common in schools. However, students find it difficult to monitor their learning in such environments. This study offers an effective way of improving judgment accuracy, an important element in the monitoring of learning, that enhances achievements in reading literacy and mathematics literacy.

References

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