

Final report TALENT EDUCATION project - metacognition

There is ample evidence that metacognitive skills can be effectively trained in students, resulting in improved metacognition and enhanced learning performances. Little is known, however, about the crucial role teachers play when instructing metacognitive skills to their students. Teachers are in the position to act as a role model to their students, but they need to know how to effectively support their students. In the present project, teachers are trained to instruct an eight-step action plan for metacognitive skills to their students. Teachers do not simply teach tricks and habits for a particular task, they teach students to apply metacognitive skills across the trained tasks (math and reading). Therefore, transfer of learning metacognitive skills is investigated by assessing improvement of metacognitive skills in students with entirely different tasks.

1. Teachers training

Some teachers involved in the project received a general introduction on the topic of metacognition and attended two workshops by Marcel Veenman during the Prague meeting (October 2015). Moreover, during her stay in Leiden (January 2016), Šárka Portešová was trained to give the teacher training in Brno and Plzen, Czech Republic. In February 2016, he trained the Dutch teachers in Leiden. Finally, he delivered a teacher training in Ljubljana, Slovenia (January 2016).

Before the intervention with students, teachers of the experimental condition were trained by either Šárka Portešová or Marcel Veenman. The training consisted of two parts: Theoretical introduction on day one and practical training on two more days. The theoretical part pertained to metacognition in general, its importance for studying and learning, its relation to IQ, its development during childhood, and how to recognize metacognitive deficiencies in students' behavior. The first day of practical training was devoted to an eight-step action plan of metacognitive skills, along with principles for the instruction of metacognitive skills. During the last day, teachers had to implement this action plan in their own lessons of math and reading. Furthermore, during the training period of students, teachers discussed their approaches, ideas, and also their mistakes in several small-group meetings. Training was open to other teachers from the same schools with metacognition instruction. In the Czech Republic, the teacher training was given to several teachers from four schools in Brno and Plzen, whereas four Dutch teachers came from two schools in Leiden. Ten more teachers from four other schools in Leiden, however, followed the teacher training and subsequently trained their students, although they could not contribute data to the study for practical reasons. In the same vein, one school in Slovenia participated with a teacher without gathering data.

Teachers in the control condition without metacognition training came from separate schools in order to avoid confounding of conditions in the study. In the Czech Republic, three schools were involved in the control condition, while another two Dutch schools from Leiden participated as control group.

2. Teachers training students.

In Leiden, a first cohort of Dutch 8th-grade students was trained by their teachers for three months (March through May 2016). This first cohort consisted of about two hundred students, of which fifty-two students participated in the study. A second cohort of about two-hundred 8th-grade students was trained by their teachers for six months in 2018. Unfortunately, the data for this second cohort are not available yet.

In the Czech Republic, at least seventy-three 8th-grade students were trained by their teachers for an extended period of ten months. An unknown number of additional students were also trained, but they did not participate in the study.

Teachers addressed students with metacognitive instruction during regular math and reading lessons. They stressed the general applicability of metacognitive skills, surpassing tasks and domains. Students were incited to apply and compare the use of the same skills across math and reading. Moreover, students were provided with ample opportunity for practice in order to obtain fluent application of the skills. Control teachers plainly taught math and reading during parallel lessons, so as to control for time on task.

3. Study

Participants. All students were from Grade 8 (that is, about 12 yrs. old). From the first Leiden cohort, fifty-two trained and fifty-six control students participated ($N = 108$). From the Czech Republic, seventy-three trained and seventy-five control students participated ($N = 148$). Due to differences in training duration, both groups are treated as separate samples.

Data acquisition. Metacognitive skillfulness of students was assessed in a pretest-posttest design by means of computerized discovery-learning tasks in the domain of biology. Prior to the metacognition training, the Plant task was administered as pretest. Students had to vary the levels of five independent variables (pot size, amount of water, use of insecticides, dead leaves in the pot, location of the plant) in order to find out how these variables affected plant growth. After the metacognition training period, students were presented with the Otter task, in which they had to discover how independent variables (habitat, environmental pollution, setting out otters, feeding fish in wintertime, public access) affected the otter population size. While performing the tasks, all student activities were registered in a logfile and analyzed for metacognitive skillfulness. Thus, the relative position of students within the entire group was expressed as standardized scores (with mean = 0, sd = 1), separately for pretest and posttest.

Both computer tasks were available in the Dutch and English language. For the Czech students, the English version was used, but they were additionally instructed with a powerpoint in Czech about the task before starting the test sessions. Additionally, students received a sheet with translated materials and instructions into the Czech language. Obviously, there were no differences in testing conditions between trained and control students.

Results. Individual differences on the pretest were controlled for in posttest scores by means of Analysis of Covariance. The effect of training (vs. control) was significant ($p < .05$) for the Leiden cohort, with Mean- $z = +.12$ for the trained group and Mean- $z = -.11$ for the control group. In the same vein, the effect of training (vs. control) was significant ($p < .001$) for the Czech cohort, with Mean- $z = +.29$ for the trained group and Mean- $z = -.32$ for the control group.

Discussion. Training teachers to subsequently train their students resulted in an improvement of metacognitive skills in students. In fact, the longer the training period of students, the stronger the effect on metacognition. Thus, the teachers did a good job. Moreover, these results show evidence of transfer of learning from trained tasks (math/reading) to a different task in a different domain (discovery learning in biology). Students did not simply learn a few tricks for math and reading, they broadly applied the trained skills to a different task context. Such transfer of learning is regarded as the 'Holy Grail' of educational research. Thus, teachers did an excellent job!

4. Dissemination

Results of the metacognition project were presented at the final project meeting in Leiden (June 2018). Moreover, the Erasmus+ project published a leaflet ('Talent Education Toolkit for Teachers') with a summary of training methods and results, while posting materials and examples of lessons on the project's website.

Furthermore, results of the metacognition project were conveyed through scientific channels, such as conference contributions (KORONA conference for teaching gifted students in Brno, EARLI SIG16 meeting on Metacognition in Zürich, and ECHA conference in Dublin), courses in Educational Psychology at Masaryk University, teacher trainings in the Netherlands, and teacher meetings at the National Institute for Education in Prague.

Based on the successful results of the project, the municipality of Leiden in the Netherlands has decided to fund a follow-up study for training secondary-school teachers to instruct metacognitive skills in their students. Moreover, three new schools in and around Brno have expressed their interest in the teacher training for effectively teaching metacognition.

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