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THE EFFECT OF TEACHING STRATEGIES ON 4TH GRADE CHILDREN'S SCIENTIFIC REASONING SKILLS

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More and more countries of the world admit the outstanding importance of high-quality teachers. Studies started to focus on teacher's effectiveness by the examination of teaching strategies and students' performance's connection. The first aim of our research is to discover whether the strategies favoured by our teachers are consistent with the international findings; then to correlate the found strategies to children's level of scientific reasoning skills on classroom level. We hypothesize a correlation between classroom teachers' teaching strategy and children's performance.
Our research consists of two parts: (1) teachers' questionnaire about teaching and (2) students' reasoning skills assessment. The online data collection was carried out in 2015 among 237 classroom teachers and 4010 Grade 4 primary school students. The teachers' questionnaire consists of 30 items; the students' test consists of 64 items. The reliability of both tools was good (questionnaire: Cronbach's alpha=.81, test: Cronbach's alpha=.85). We have directly linked each teacher to his/her classroom; therefore we received more accurate results than the school level based studies. Similarly to the international findings, we could identify three subscales of teaching strategy with factor analysis (KMO=.785): teacher-directed, cognitive-activation and active learning strategy. The most commonly used instructional strategy is teacher-directed, which is followed by the cognitive activation and at last the active learning strategy. Active learning the only strategy that shows significant correlation with the scientific reasoning test (r=.22, p<.05), and those teachers, who have participated in further trainings about teaching scientific subjects, use active learning methods more frequently (r=.18, p<.01).
In the light of all these, we have to emphasize and foster the opportunities for teachers to expand and improve their teaching practices in the direction of active learning strategies' classroom application.

Keywords: Teaching Methods in Science, Reasoning, Primary School

THEORETICAL FRAMEWORK

More and more countries of the world admit the outstanding importance of high-quality teachers. Studies started to focus on teacher's effectiveness by the examination of teaching strategies and students' performance's connection (Gaetana Catalano, Perucchini & Vecchio, 2014; OECD, 2016; Samson, Enderle & Grooms, 2013). Due to the international student assessments, many background research started to examine the extent of different effects on student performance. The outstanding importance of high-quality teachers is more and more recognised, examined all over the world. OECD (2016) linked the PISA 2012 mathematics results to the teaching strategies part of the TALIS questionnaire in order to get an insight of teachers' effectiveness in the 8 participating countries. This research identified three main teaching strategies on school-level: active learning, cognitive activation and teacher-directed instruction. Students' discussions, teamwork, cooperation and both peer's and tutor's reflexions are playing key role in the use of active learning. The cognitive activation strategy is using such instructional methods that create challenges for students, therefore their higher order thinking skills are needed to solve the problem. Teacher-directed instruction is clear, simple and easy to follow; requires no complex thinking skills. According to their results, students learning through cognitive-activation strategy gained significantly higher results than others; and the teacher-directed strategy is mostly used among lower-preforming students. The study did not find any significant connection between the used strategies and the level of students' engagement. Teachers working at the same school tend to use similar strategies, and the teachers of disadvantageous socio-economic background schools tend to have less opportunity to attain further training.

Only little data is available about the instructional methods used by Hungarian classroom teachers and their impact on students' scientific knowledge. The aim of our study was to twofold. First, we explored the underlying factors of teachers' teaching strategies in 4th grade science class. Secondly, we examined the effect of the used teaching strategy on students' scientific thinking and reasoning performance. We hypothesize a correlation between classroom teachers' teaching strategy and children's performance.

METHOD

To explore teaching strategies, we composed a self-reported questionnaire based on the TALIS items (OECD, 2014). Besides background variables (gender, age, qualifications, professional experience, further training) we examined the used instructional methods with 22 items. The online data collection took place in 2015, when the questionnaire was completed by 237 teachers, who had to response on a 4-point Likert-scale. The reliability of the questionnaire was good (Cronbach's alpha=.81).

The mean age of classroom teachers was 47.8 (SD=8.6), and they have an average 25.0 years of experience (SD=10.5). 96.2% of teachers was female. 93.2% of the sample had a college degree, and 1.7% of them had a college degree different from classroom teacher. 4.7% of classroom teachers had a further university degree in either biology, physics, geography or chemistry; and 0.4% had university degree without teaching qualification.

To assess students' scientific reasoning, a 64-item online test was developed (Cronbach's alpha=.85). In order to complete the tasks students had to operate different thinking processes such as conservation, proportional, correlational, probabilistic, inductive reasoning, classification and inquiry skills in science context. The tests were administered to 4010 students in Grade 4 (males 49.5%), from 206 classes in 113 schools of Hungary. The data collection was carried out in May 2015 within the framework of the Hungarian Educational Longitudinal Program (HELP). The measurements were conducted via the eDia (Electronic Diagnostic Assessment) system in the schools' ICT rooms.

SELECTED RESULTS

According to the exploratory factor analysis (KMO=.785), we have identified three subgroups in accordance with the PISA-TALIS link report (OECD, 2016): active learning, cognitive activation and teacher-directed strategy. We created arithmetical means from the responses of the variables in the factors. The most commonly used instructional strategy is teacher-directed (mean=.80, SD=.09), which is followed by the cognitive activation (mean=.73, SD=.09) and at last the active learning strategy (mean=.51, SD=.09). The strongest correlation is between the application of active learning and cognitive activation strategy (r=47, p<.01), while the teacher-directed strategy shows higher correlation with the cognitive strategy (r=.31; p<.01) than with the active strategy (r=.14, p<.05). For background variables, the only detectable correlation is in the case of further professional training: those, who have participated in further trainings about teaching scientific subjects, are those who use active learning methods more frequently (r=.18, p<.01). This is the only strategy that shows significant correlation with the scientific thinking and reasoning test (r=.22, p<.05).

DISCUSSION AND CONCLUSIONS

Our data suggest that teachers in the Hungarian educational system prefer frontal methods, teacher-directed processing of the instructional material and practicing. The usage frequency of cognitive activation strategy is similar, in which students are given the opportunity to discuss the issues raised and to get to know the social relevance of the learning material. The least typical in the classroom is the presence of methods building on students' activity (e.g. student experiments, project work, presentations, inquiry-based learning). We would expect that in the development of scientific thinking both cognitive and active strategies have a demonstrable effect. Our data, however, only confirmed the role of the active learning strategies. On the usage of active learning strategies – that are most effective in the development of scientific reasoning –, the related teacher trainings have higher impact

than teaching experience has. Our research draws attention to the importance of teacher trainings, and to the key role of modern teaching methods' integration into classroom practice.

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