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RÓBERT PAP-SZIGETI

**CONTENT-BASED CRITERION-ORIENTED
SKILLS IMPROVEMENT IN GRADE 5**

Theses of a PhD Dissertation

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INTRODUCTION

The development of abilities is one of the most investigated fields of psychology and pedagogy. The different psychological schools all had their own understandings of abilities (*Csapó, 2003; Inhelder és Piaget, 1967/1984; Neisser, Boodoo, Bouchard, Boykin, Brody, Ceci, Halpern, Loehlin, Perloff, Sternberg és Urbina, 1996; Piaget, 1993*), and the psychological definitions have always influenced pedagogical theory and practice (*Case, 1996*). Investigations of the content-dependency of abilities defined as cognitive processes plays an important role in research on abilities. From a practical perspective the question of how much the skill-type components of knowledge are transferrable is cardinal. Can we expect a skill or ability that operates successfully in one subject-area to operate successfully in another content-area? The answer to this question might have a significant effect on the design of skills-development strategies.

The dissertation presents an experiment in which we applied the content-based approach to skills development (*Spencer és Guillaume, 2006; Kasper, 2000*). This approach presumes the limited transferability of skill-type knowledge; therefore it aims to develop the target skills through the contents of one or more school subjects. The curricula of the subjects are enriched with operations that can be accomplished using the given contents, which, in turn, enables (1) the efficient application of the representations of the noteworthy concepts of the curriculum, and (2) the accomplishment of the same cognitive operations with more than one type of contents, therefore the loosening of the bond between the content and the operation (*Adey és Shayer, 1994; Csapó, 2003*).

The theoretical frameworks for the investigations of the components and development of the abilities are provided by *József Nagy's* model of personality (*Nagy, 2000a, 2001*). This differentiates two basic component-systems of personality: the motive-system and the ability-system. Competence is defined as the combination of motives and abilities, in other words, as a psychical component that includes the components of the decision-making and implementation activity of the personality. Besides the differentiation of the distinct component-types, the model also facilitates the identification of a wide range of basic psychical components. The abilities SZÖVEGFER (Developmental Program based on Text Processing – *Nagy, 2007*) aims to improve are the reading ability (*Gambrell, Morrow és Pressley, 2007; Nagy, 2006; Snow, 2002*), the systemising skill on the conceptual level (*Gallagher és Reid, 2002; Inhelder és Piaget, 1967/1984; Nagy, 2003*), perceptual relation comprehension (*Nagy, 2000b*), deduction (*Inhelder és Piaget, 1967/1984; Roberge és Flexer, 1979; Vidákovich, 2002, 2004*) and the basic combinatory skill (*Csapó, 1988, 2001; Nagy, 2004; Piaget, 1970*). The components of these abilities are all unravelled in the above mentioned sense.

The dissertation reports on the results of the training of the above mentioned learning abilities using the methods of the SZÖVEGFER. The responsibilities of the writer of the present theses in the SZÖVEGFER programme included the analyses of Mathematics and History textbooks and curricula, the development of training exercises, student worksheets and methodological aids for teachers, assistance in in-service teacher training programmes and in the development of training materials, coordination of measurements and interventions and regular visits to schools.

The applicability of the content-based improvement model is long established in the field of education. Theoretical considerations suggest that the enrichment of the curricula with operations can be an important means of skills development and knowledge acquisition. Our investigations aim to answer the question of whether the methods of the SZÖVEGFER programme are appropriate for the embedding of skills training programmes in the teaching

and learning process, for the successful development of the above mentioned learning abilities and for initiating a favourable change in the development of some learning motives.

THEORETICAL BACKGROUND

Following the appearance of the concept of ability, investigations of the possibilities and potential methods of ability improvement have become a prominent field of educational research. The need and effort to improve students' cognitive abilities is articulated – either implicitly or explicitly – in numerous pedagogical works and are salient in the documents of educational practice as well (*Gordon Győri, 1999*).

The indirect improving effect of content acquisition does not result in the optimal development of cognitive abilities. Although studies comparing test results assessing school achievement and skills development show that the high-level acquisition of the curriculum (without direct skills training) entails a higher developmental level of cognitive abilities as well (e.g. *Csapó, 1998/2002*), the average development of several cognitive abilities and skills does not reach the optimal level even by the last years of public education (*Nagy, 2001*). Therefore, in order to develop optimal-level skills, besides the acquisition of the curriculum, there emerges a need for intentional skills training activities.

The only way to minimize the disturbing effects of intervention on traditional forms of instruction is to follow the content-based approach to skills improvement. The enrichment of the contents with operations is only possible if the structures and the development of the skills along with the developmental order of the components are completely explored. During the training we find opportunities to intentionally actuate the components in order to help acquisition of content. We assume that declarative knowledge can be made more broadly applicable through operational enrichment. Since the transfer of abilities is not viewed as automatic, the emphasizing and the recognition of the common features of the various operations and patterns developed through different contents can help the application of knowledge in contexts different from that of the acquisition. For this reason, operations should be used with more contents and in different contexts. This can help students loosen the bond between content and operation (*Csapó, 1999, 2003*).

The effectiveness of content-based skills improvement training experiments is not only manifested in the target skills (*Csapó, 2004*). For instance, during the experiments of the CASE programme, researchers detected a long-term, long-distance transfer-effect on students' grammatical skills (*Adey, 1999; Shayer, 1997*).

In case of psychical systems with definable components and available developmental measurement instruments, criterion-oriented assessment and development are also available. The principle behind criterion-oriented assessment is to relate students' assessed achievement to a criterion-level irrespective of the achievement of the other groupmembers. In this case, analytic diagnosis (*Vidákovich, 1990*) provides an accurate description of the already acquired components and of those in need of further improvement. The criterion of the development can refer to the quantity of the components to be acquired (i. e. the elaboration/complexity of the investigated system), the durability of the acquired knowledge and the automatization of the operations (*Nagy, 2007*). Criterion-oriented tests usually set an elaboration criterion, in other words, they define the goal of development in a number of components as related to the total number of components. The durability criterion of a test can be the temporary or the permanent level depending on whether or not the students were informed of the test in advance. The automatization criterion can be defined as the speed of the implementation of

the operation. The first, theoretical part of the dissertation reviews literature on the possible interpretations of the concept of ability, the different approaches to skills improvement and to the model and application of content-based skills improvement. Furthermore, it summarizes the results of the most prominent development experiments targeting the five abilities included in the SZÖVEGFER programme. The system of components is interpreted within the frameworks of a theory that defines personality as a component-system, and competence as a combination of skills and motives. The theoretical assumptions and empirical results of the dissertation can be interpreted as the investigation of some elements of this paradigm.

HYPOTHESES, METHODS AND INSTRUMENTS OF THE EMPIRICAL STUDY

Hypotheses

Our empirical research questions are organized around two major issues:

- (1) Is the embedding of the training exercises into the subject contents efficiently implementable in grade 5?
- (2) What effects does content-based skills training have on the development of cognitive skills and abilities?

The research hypotheses are summarized as follows:

1. With the help of the methodological aids and skills training booklets we developed, text processing skills training can be embedded in traditional, topic by topic instruction.
 - 1.a The conception behind the detailed methodological aids is appropriate for aiding the text processing skills training.
 - 1.b The skills training booklets are suitable for inducing activity-based, cooperative learning.
2. The continuous content-based text-processing training contributes to the acceleration of the development of the reading, systematizing, relation comprehension, deduction and combinatory skills. Supposedly, the spontaneous development of skills revealed by research can be accelerated, and by the end of the fifth class, the ratio of students with optimally developed, permanently operating skills will increase.
3. We expect a positive change in students' cognitive motives. The decline in the mastery motive and in the attitudes towards the targeted subjects will become slighter than that of the national averages of the same age group.

Methods

The training experiment applies the content-based approach to skills training. The conception we used is based on *József Nagy's* theoretical model (2005a, 2005b, 2007) . Our aim with the experiment was to improve some basic learning abilities using methods that facilitate the regular, cross-topic actuation of the components of the given abilities. The curricula of the subjects of the training (Hungarian Language and Literature, History, Mathematics and Natural Sciences) were enriched with tasks aiming at the actuation of the components of the reading ability, the systemising skill on the conceptual level, the perceptual relation comprehension, the deduction and the basic combinatory skill. The tasks were embedded in those parts of the curricula that contained important knowledge with respect to the aims of the subject.

The training is not continued during a whole lesson, but it takes up the first minutes of the lessons following the introduction of a topic. Therefore topics taught by means of the SZÖVEGFER were not scheduled close to each other. We purposefully allowed the teacher to choose the methods of instruction for him/herself for the majority of the curriculum in order to minimize changes in the regular way of instruction in the subject. Therefore, for the embedding of enough training exercises, training is advised to be continued at least for an academic year.

Sample

The dissertation presents the results of two empirical studies. In the first experiment we tested the applicability of the SZÖVEGFER programme and the improving tasks on the basis of teacher feedback along with the immediate effects of the training. Participants of the first study included 350 fifth-grade students from 15 classes and 6 schools.

The second experiment used a control sample. The experimental sample was comprised of 426 fifth-graders from seven (due to the mergers of schools now only five) elementary schools. The control sample included 101 fifth-grade students from three (now only two) elementary schools. The distribution of the samples with regard to the parents' educational level and settlement size could be analysed as identical. Pre-tests were administered – with the exception of the systematizing and combinatory skills which are both measured in the national competence-assessment – at the beginning of the fifth form, while students took the post-test at the end of the same academic year. The total duration of the training was altogether nine months.

RESULTS

The descriptions of the empirical studies are organized into two chapters which build up chapter 3 and 4 in the dissertation. Chapter 3 presents the methods and tasks of the training along with the most important results of the first study (the first experiment). The empirical results of the control-group study are discussed in chapter 4

The embedability of the tasks

During the text comprehension lesson, students and the teacher work together to analyse longer and longer parts of the text by reading it repeatedly. The texts are usually shorter than one unit in the textbook. In comparison with the traditional flow of instruction, this lesson means time loss, therefore, it is essential for these texts to include important concepts.

The embedding of the further tasks takes place in the first minutes of the following lessons. According to the feedback from teachers, these tasks – besides the actuation of the skill components – assist the revision of the curricula. According to the decision of the teacher, the tasks can be solved individually, in pairs or in groups. They can also facilitate cooperative learning.

The development of the abilities

The components of the abilities SZÖVEGFER aims to improve has been unravelled by previous research, large-sample empirical studies has established their spontaneous development and the frequency distributions of the developmental levels at different ages. The measurement instrument we used for the assessment of the reading ability is norm-

oriented in nature, the others include a task for each of the psychological systems, therefore, are regarded as criterion-oriented.

Research on the spontaneous development of *reading ability* revealed a significant development between grade 3 and 4 (the cross-sectional study predicts a 14 %p increase during a period of one academic year). Between the end of grade 4 and the end of grade 6 reading does not develop significantly, the cross-sectional study predicts only a 3 %p improvement (Molnár és Józsa, 2006). In our control-group study, the initial developmental level of the reading ability (55%p), measured at the beginning of grade 5, was lower in case of both the experimental and the control group than the national average at the end of grade 4 (59%p). This may be caused by the lower educational level of the parents compared to the national average, or by a minor backsliding in the development due to the summer holidays.

During the academic year, with a permanent relative variance, the control group showed a 5.5%p development, and by the end of the academic year it has reached the national average measured at the end of grade 5. The development of the experimental group was approximately 10%p, with a slight decrease in relative variances. The Cohen effect size index of the training was $d=0.24$. For the experimental group, the predicted developmental rate between grade 3 and 4 was almost kept. The training was less effective for students with extremely low (below 20%p) achievement scores. The ratio of students achieving between 30 and 60%p has significantly increased, while that of those achieving above 60%p has increased. The mode of the frequency distribution of the experimental group's achievement has shifted from average, 55%p achievements to achievements around 80%p. The explanatory strength of the developmental level measured by the pretest was 38% in the experimental and 49% in the control group. This shows that the training was successful in producing developmental trajectories different from that of spontaneous development.

The results of the national competence assessment in grade 4 were used as pretest results on *the conceptual level systematizing skill*, so the date of the pretest coincided with that of the cross-sectional measurement. The development of the control group (from 37.6%p to 41.8%p) was in line with the findings of cross-sectional studies (from 37%p to 42%p), the relative variance remained constant. The initial developmental level of the experimental group (36.0%p) did not differ significantly from those of the other samples either. As a result of the training a 12%p development was observed besides a modest decrease in the relative variances. The 48%p average measured by the posttest is significantly higher than the posttest achievement of the control group. The effect size of the training was $d=0.27$, the average improvement rate of the experimental group was higher than the rate of spontaneous development from grade 4 to grade 6 (Nagy, 2003).

Although the frequency distribution of the achievements of the experimental group shows a significant shift to the right, the mode of the achievements is still between 20-30%p. In the experimental classes, the ratio of students reaching an optimal developmental level has increased from 4.6%p to 14.1%p. On the pretest 3.5% of the control sample has achieved above the criterion, while on the posttest the same ratio was 4,8%. The analysis of individual achievement has not questioned the appropriateness of the criterion previously set on the basis of theoretical considerations. In case of this ability, the explanatory strength of prior developmental level is significantly lower in the experimental group (10%) than in the control group (31%), so the training significantly altered the possible individual developmental trajectories.

The average initial developmental level of *perceptual relation combination* among fifth-graders was significantly lower both in the experimental and the control group (around 52%p) than the developmental level revealed by the large-sample cross-sectional at the end of grade 4 (64%p) (Nagy, 2000b). Further research would be necessary to explore the possible causes of this discrepancy. The control sample has not shown improvement during the academic year

(the mean changed from 52.3%p to 51.0%p, besides a constant variance and a high $r=0.741$ value). The improvement made by students in the experimental group is significant, the rate of the development (from 51.9%p to 55.5%p) observed during one academic year corresponds with that of the two-year-long spontaneous development of the ability observed in the cross-sectional study *Nagy, 200b*). However, the developmental level of the experimental sample did not reach the end-of-year level of fourth-graders in the cross-sectional study even by the time of the posttest (it changes from 64%p to 68%p between grade 4 and 6). The effect of the training is around significance level, the Cohen effect size index is $d=0.574$. The slightly weaker correlations between the pre- and posttest in case of the experimental group also indicates the effectiveness of the training.

The training did not prove to be efficient for students with a lower initial skills developmental level (below 30%p). It is assumed that their improvement requires the application of other methods or the prior improvement of the prerequisite knowledge. The ratio of students scoring between 30 and 70%p has significantly decreased as a result of the training, although the achievement of most of the students still fall into this category. In the control sample none of the students reached the criterion of optimal automatization (90%p), 3% of the experimental group had optimally automatized skills, and altogether 15% of the students reached a level higher than 80%p (this ratio is nearly three times as high as it was before the training).

The operations required by the *deduction* test were not improved directly during the experiments. Therefore, what we can explore is the effects of the actuation of perceptual deduction (and the components of other fields of abilities) on the systems of two-variable logical operations and two-premise deductions (*Vidákovich, 2004*). As predicted by the low variances in the test results and the high average points of the pretest, the improvement proved to be of low effectiveness. During the nine months of the training, the control group improved by 1.6%p, whereas the experimental group showed a 2.8%p improvement. The effect of the training is not significant. Consequently, improvement through perceptual deduction exercises does not seem to have a significant effect on the skills of deduction of this age group.

Cross-sectional investigation of the spontaneous development of *the basic combinatory skill* depicts a slow, approximately 2%p increase (from 48%p to 50%p) between grades 4 and 5. More intensive development takes place in grades 6 and 7 (*Nagy, 2004*). As pretest results we used the outcomes of the national competence assessment administered at the end of grade 4. Pretest achievements show a lower initial developmental level in case of both the experimental and the control group than the values measured by the national cross-sectional study. One reason for this may be the lower educational level of the parents, but it can also be caused by a developmental delay. Students comprising the control sample reach the level measured by the cross-sectional study after a year of spontaneous development (the average developmental level increases from 41.3%p to 49.9%p). The improvement made by the experimental group (from 41.1%p to 57.7%p) is nearly twice as massive as that of the control group. The effect size of the training is $d=0.24$.

The skills improvement programme did not have the same effects on each of the students. The ratio of students in the experimental group performing below 50% on the basic combinatory skill test is still remarkable. Also, the curve of the frequency distribution graph and the high variances indicate that the development of this ability often happens by leaps and bounds through qualitative realignments (*Csapó, 2001*).

Motivational changes

Within the frameworks of the training experiment related pre- and posttest measurements, we investigated two motivational constructs as well: mastery motivation (*Józsa, 2007*) and attitudes toward school subjects (*Csapó, 2000*).

The evaluation of the mastery motive was carried out by three independent assessors (one of the parents, the form-teacher and the student). The means of motivation corresponded with those of the representative sample of fourth-grade students (*Józsa, 2007*). The highest mean scores were given by parents, and the lowest by teachers. Variances were between 9.9 and 14.4 in all cases, the discrepancies between the variances were not significant. The mastery motive of the experimental group decreased at a somewhat slower rate than that of the control sample; however, the difference is not significant. Changes occurred with strong correlations ($r=0.64-0.86$) for both sub-samples, which suggests that during the experiment we could not manage to induce a significant change in the mastery motive related order of students.

Attitudes towards school subjects were measured using a five-point Likert-scale instrument. Values of the linguistically and emotionally symmetric scale can be regarded as interval-type as long as the emphasis is placed on the number given as an answer. Pretest means varied between 3.4 and 3.9, while posttest means ranged from 3.2 to 3.7. Variances were between .98 and 1.14; discrepancies between the variances were not significant. Posttest scores were lower for both of the groups than those of the national cross-sectional study (*Csapó, 2000*). Not one of the changes in the experimental group is significant, meaning that the improvement did not result in a significant change in attitudes.

Relationships between the variables of the study

The years-long process of the development of cognitive skills and abilities is characterized by significant individual changes. However, the development of several skills and abilities are related to one another and to some other factors that might influence knowledge acquisition, e.g. the developmental level of certain motives, characteristics of the family background.

The developmental system of the cognitive abilities investigated by the SZÖVEGFER programme can be analysed, for instance, by correlations between the results of the tests administered to the same groups of students at the same time. Correlations of the experimental group are largely moderate, thus, the system is homogeneous, the relationships between the abilities are of nearly the same strength. The weakest correlations were found with relation comprehension, although each coefficient with relation comprehension becomes stronger at the posttest. This tendency, however, can be generalized: with only one exception the correlational coefficients all become higher at the posttest. This result indicates that abilities develop in interaction with one another, which tendency was also reinforced by the improvement programme. Correlations of the control sample show similar tendency, but the discrepancy between correlations at the posttest and the pretest are not as massive as in the experimental group.

Regression analysis on the results of the posttests as dependent variables (with pretest results, evaluations of motives and background variables as independent variables) revealed that variance in the development of an ability as measured at pretest plays an important role in individual differences in the development of that ability. Reading ability developmental level contributes to all of the individual differences of the target abilities, except for deduction. Deduction displayed very low variance at both measurement points, thus, despite its prominent role in human cognition, its influence on the development of other cognitive abilities is hardly traceable.

THE REVIEW OF FURTHER RESEARCH

The SZÖVEGFER study pointed out that prior developmental level of abilities influences the effectiveness of improvement, and the strength of this influence varies by abilities. In case of most of the investigated abilities the major part of spontaneous development happens in the first four years of elementary school, therefore the identification of adequate improvement strategies seems necessary. To address this need, with the financial support of the OTKA K 68798 programme in the Szeghalom region we launched the first DIFER-based basic skills training experiments (*Józsa és Zentai, 2007*). Further research on factors that might influence the abilities improved by SZÖVEGFER is being carried out (*Zentai, 2009*). Preparational studies on the improvement possibilities of the abilities of SZÖVEGFER in the early years of schooling are also in progress.

Hopefully, the continuance of the basic skills training with the appropriate methods from kindergarten on, and later the application of SZÖVEGFER, will initiate positive changes in the development of learning abilities by the fifth grade. The most important questions of related studies are (1) whether a conscious, continuous skills training at primary schools is implementable, and (2) whether this skills training enables students to develop the most important learning abilities to an optimal level. Presumably, the methods described in this dissertation are successfully implementable in the years following grade 5 as well, although the optimal amount of effects to be applied should be explored by further experiments.

Supposedly, in the following years, fundamental research will unravel the structure and development of some further important learning abilities. For all of these cognitive components, along with the abilities that proved to be less efficiently aided by SZÖVEGFER, we should find effective improvement methods and appropriate strategies for in-school training programme implementation.

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