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# EFFECTS OF KNOWLEDGE-BASED INFERENCES TRAINING ON PRIMARY GRADE CHILDREN WITH READING DISABILITIES

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**ABSTRACT.** Student development and use of effective reading comprehension strategies is one of the most important goals for content area reading instruction. Therefore, strategy instruction should be part of the total school curriculum, and students should be taught to apply strategies in various content area classes. Students with reading disabilities in primary school grades need assistance in content reading to integrate new information with their prior knowledge, to obtain important information from the text, and to remember what they have read. Thus, content area reading instruction is an important component of curricula and includes strategy instruction in comprehension skills. The purpose of this article is to assess the impact of introducing inference training to less skilled comprehenders. Children 3-ed grades, classified as skilled or less skilled comprehenders, were instructed on how to make inferences from and generate questions about a text over a period of seven sessions. Comparison groups of control and experimental were trained in standard comprehension strategies. The experimental group showed a significantly greater improvement in inference generation than the control group. It is concluded that the value of explicitly teaching children inferential skills is that the enjoyment of the task of reading is enhanced and is therefore more likely to be undertaken readily, even by pupils who may have initially found reading difficult.

***Keywords:*** *inference, reading, text comprehension*

**ZUSAMMENFASSUNG.** Eines der wichtigsten Ziele des Unterrichts ist die Entwicklung und die Anwendung der wirksamen Lesestrategien. Somit müsste das Erlernen der Lesestrategien ein wichtiger Teil des Schulcurriculums sein, denn man müsste Schülern ganz konkret unterrichten, wie sie diese Strategien in verschiedenen Kontexten einsetzen können. Schüler aus den Klassen 1-4, die Lese- oder Verstehensschwierigkeiten aufweisen, brauchen Hilfe, wenn es um die Integration der neuen Informationen in deren Wissensbasis, um den Auswahl der Hauptideen des Textes oder um die Erinnerung an dem Gelesenen geht.

Der vorliegende Artikel nimmt sich vor die Auswirkungen eines inferenziellen Trainings bei Lesern mit Verstehensschwierigkeiten zu evaluieren. In diesem Sinne hat man mit Schüler einer dritten Klasse sieben Trainingseinheiten durchgeführt. Die Schüler sind je nach ihren Verstehensfähigkeiten in verschiedenen Gruppen eingeteilt worden (gute Leser vs. schwache Leser) und haben gelernt Inferenzen zu

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ziehen und anhand einiger gelesenen Texte Fragen zu formulieren. Bei der Gruppe hat man eine bedeutende Verbesserung der Fähigkeit Inferenzen zu ziehen festgestellt. Abschließend kann man sagen, dass es möglich ist Fertigkeit Verstehen durch Training (Inferenzen) zu verbessern, so dass man die Leseaktivität, auch bei Kindern die anfangs Leseschwierigkeiten aufwiesen, in eine angenehme Beschäftigung umwandelt.

***Schlagwörter**: Inferenz, Lesen, Textverständnis*

The process of generating inferences is central to most mental operations (Cain., Oakhill, Barnes, & Bryant, 2001; Garnham & Oakhill, 1996; Long, & Chong, 2001; van den Broek, 1994). Thus, according to Rips (1988) it is common for all forms of thinking. Therefore, research on generating inferences has practical relevance apart from the field of reading. For instance, children invest the world around them with meaning by making inferences about differences and similarities between what is new to them and what they already know (Cain, 2003; Hansen & Pearson, 1983). If we refer to reading, on the one hand an inference results from linking the content of the text with the knowledge base of the reader and, on the other hand, forms the associations that the reader makes between the information read in the text and the products resulted from prior information processing. The capacity to make inferences is the ability to use two or more pieces of information from a text in order to arrive at a third piece of information that is implicit. Inference can be as simple as associating the pronoun 'she' with a previously mentioned female person. Or, it can be as complex as understanding a subtle implicit message, conveyed through the choice of particular vocabulary by the writer on the reader's own background knowledge. Inferencing skills are important for reading comprehension, and also more widely in the area of literary criticism and other approaches to studying texts (Kispal, 2008).

Most of the prior research on reading argues that knowledge plays a primary role in understanding text. Thus, it was considered that the extent of text comprehension depends on the lexis size and the subject's knowledge base represents one of the most important indicators for successful understanding (Long et al., 1996; Casteel, 1993). Cain et al. (2001) also underlined the indispensable role of general knowledge: indeed, relevant background knowledge for a passage is a better predictor of fourth graders' ability to generate inferences from and elaborate on that text than is their comprehension skill. The relationship between background knowledge and inferencing is not reciprocal. Elaborative inferences cannot be drawn without the prerequisite knowledge. However, just because a reader has that background knowledge does not automatically guarantee that the reader will necessarily make the inference (Kispal, 2008). Swanson (1999) conducted a metaanalysis based on 95 studies on the effects of training, which targeted the influence of lexical abilities on text comprehension. He found a significant effect of instructions regarding vocabulary

on understanding the text one has read. Stahl & Jacobson (1986) argue that the training based on knowledge improves, but this **does not eliminate** problems about understanding. Moreover, Trabasso & Magliano (1996) explains the importance of basic lexical training for generating inferences and implicitly, for improving comprehension. He considers that the general knowledge base of the reader and his prior knowledge related to the content of the text he has read represent very important preconditions for understanding written text. Surely, the knowledge base represents a crucial premise (absolutely necessary condition) for understanding a text. Without understanding basic concepts from the text or the formulated questions, a person cannot construct inferences. But, as the study by Pressley & El-Dinary (1997) concludes and many other studies from this field support, a person's knowledge about reality is not sufficient to produce effective understanding.

Effectively understanding a text implies combining the size of the knowledge base with the subject's ability to adequately combine this information. Consequently, there are students who have a knowledge base that is comparable with that of students of the same age but who have serious difficulties in operating with this knowledge in ecological conditions (McNamara & Kintsch, 1996).

In the present study we aim (a) to develop the optimal ability to use knowledge (generating inferences) in pupils who are less skilled comprehenders (LSD) and at the same time (b) to evaluate the degree of knowledge transfer. In order to increase the participation of students in the instruction process, Rosenshine & Meister (1994) recommend teachers to adopt a pro-active attitude. In order to augment the engagement levels of pupils we designed a generative intervention program (similar to that proposed by Witrock, 1989). This involves engaging participants by writing summaries and offering generating responses. We believe that this kind of activities will significantly improve text comprehension. A generative model implies that the student discovers some linguistic elements concerning location, timing, action, motivation etc. A second type of support consists of the methods derived form the concept of reciprocal teaching (Lederer, 2000; Reutzel & Cooter, 1991). The procedure requires a reciprocal exchange of roles between teacher and student. Thus, the teacher is not only the person who models and teaches, but he also answers questions and learns, and pupils take on the teacher role. The theoretical background of this procedure is based on the concept of "proximal development zone" developed by Vygotsky (1978). The author suggests that cognitive functioning first emerges at the social level (inter-psychological), and only later is transferred to the individual level (intra-psychological). Starting from the theories of Vâgotski and Wretsch, Palincsar & Brown (1984) designed the method of "reciprocal learning" with the aim of improving reading. The intervention based on the mentioned method, implies interactive learning through games, where the instructor and the student successively conduct a dialogue based on a text fragment. Initially, the teacher is the one who addresses questions, summarizes and makes predictions for each studied fragment. Gradually, the student takes on the role of the teacher, through a progressive

delegation of responsibility from the teacher to the student. Lederer (2000) and Pearson (1985) present a series of advantages of such a role exchange. The hypothesis of the present study is that the inferential training based on reciprocal inferences generation will improve the text comprehension capacity through generating a series of inferences by the LSD.

## Method

*Subjects*. A number of 24 LSD took part in the experiment. The age of participants varied between 9 and 10 years old. They were pupils in four schools (two from Cluj and two from Sighet). Half of the students were included in the experimental group and the other half in the control group. The pupils were selected based on the scores they received at the comprehension tests (TCC, Mih, 2004). Thus, only students with scores in the first four normalized classes were included. The period allocated to reading instructions was 50 minutes.

*Experimental design.* We used a multifacotrial design. The independent variable was the group type (experimental or control), and the dependent variables were the scores from the tests. There was no significant difference between the two groups in what concerns the initial comprehension abilities $t(22)=0.84$, $p > .69$. The training was conducted by four trainers, who were Pedagogy students. Data were analyzed in accordance with a set of research questions derived from the formulated hypotheses.

**Table 1**.

**The lesson about inferences generation**

| | | |
|---|---|---|
| 1. Lesson | Location deduction | Children were taught to generate inferences about location were it happen an event. |
| 2. Lesson | Subject deduction | Children were taught to generate inferences about person who made a thing. |
| 3. Lesson | Timing deduction | Children were taught to generate inferences about time when an event it happen |
| 4. Lesson | Action deduction | Children were taught to generate inferences about action a person made |
| 5. Lesson | Causal deduction | Children were taught to generate inferences about who / what made an effect or a result. |
| 6. Lesson | Effect - cause deduction | Children were taught to generate inferences about an effect or a result of one action. |
| 7. Lesson | Recapitulate | It takes again above inferences. |

*The trainers instruction.* The four trainers involved in the study participated in two instruction sessions prior to the experiment. These sessions were conducted by the authors. Trainers were asked not to talk to each other during the experiment about the teaching methods or lessons content. The four trainers were trained separately,

namely two were instructed concerning one teaching method and the other two received training on the other teaching method. This was done in order to avoid the possible contamination that would have resulted from collective training.

Tutors from the two groups received the lesson content and the instruction procedures corresponding to each lesson. The trainers from the control group received the content for 7 lessons they had to teach in a classical way. On the other hand, tutors from the experimental group received the same lessons, but the teaching method they were instructed to apply was a generative one. They were instructed on the quality of explanations, demonstrations and spontaneous examples. Also, the importance of providing detailed descriptions of the inferential operations and not just labeling them (i.e. action) was emphasized.

*Instructional procedures*. The two groups (experimental and control) participated 7 days, at the interval of one week in 50 minutes sessions and received reading instructions. Trainers received assistance through guiding instructions depending on the occurring problems.

*The experimental group.* The content of the lesson regarding the generation of inferences was designed to include 6 deductions (inferences) selected from a set of 10 deduction types proposed by Johnson & Johnson (1990). The content of each lesson is synthesized in table 1. Each lesson comprised 4 instruction stages.

(1) *Introduction.* In this section of the lesson, the tutor introduced a new inference category and summarized the inferences that were taught previously. The students identified the key words for elaborating the inference. They themselves also generated short passages, similar to those provided by the teacher. Afterwards, the teacher explained the correctness/ error of the inferential response offered by the student. The teacher emphasized the vocabulary indicators identified by the student as well as the ones omitted while generating the inference. The aim of the exercise was to highlight the function of the different text components (lexis) in the elaboration of inferences.

(2) *The objectives and motivation for the lesson. Modelling*. The objective of each lesson was presented by the teacher so that the students should be informed on the method that they can be helped to particularly understand some materials and become better readers. Based on the different passages, the tutor exemplified the target inferential ability and also, explained the role played by this skill in the reading activity. Moreover, the tutor demonstrated the way in which a certain skill can be learned. The responsibility to gain new knowledge was gradually transferred from the tutor to the pupils. Also, the trainer constantly evaluated the extent to which the students understood the information that was taught.

(3) *Practice and application*. In this stage of the lesson, the students played the role of detectives. They had the task to look for certain key words that would justify the deductions that were made. Thus, the method of

generating inferences was applied. The students were initially grouped in pairs. In the beginning, each student had made a list of key words corresponding to the type of deduction that was taught that day and also during the previous lesson. Based on this list, pupils generated their own passages. Each student generated and highlighted the key words in the passages generated by other students. They made an inference and at the same time explained the inference that formed the basis for that particular passage. The student who wrote that passage would tell him/her if the inference was correct or not.

(4) *Offering feed-back*. At this last stage of the lesson, a discussion was initiated and conducted by the teacher. Often, he would use passages generated by the pupils as examples for the other participants from the group.

*The control group*. The tutors who were allocated to the control group taught the students basic sequences of the lessons, using the usual teaching methods.

*Evaluation materials.* In order to build the two students groups, the TECC was applied in the beginning. In parallel, 3 comprehension tasks that targeted the following dimensions were developed: (a) an immediate transfer task, (b) a distal transfer task, (c) an inferential responses task (offered for the questions based on a passage).

(a) *The immediate transfer task* comprised 12 short passages (grouped two by two), corresponding to the six types of inferences for which the training was made. The passage was followed by one question that asked the pupil to generate a specific inference. The generated inference was one of location, timing, object, etc. One point was given for each correct answer to the questions. Answers were coded by two persons (instructors) who were trained to do this.

(b) *The question-answer task*. This task was elaborated starting from two passages that comprised 100-150 words each. This corresponded to a third grade difficulty level. Each passage was followed by two literal questions (answers could be found in the text) and three questions that targeted the generation of inferences (responses could be offered based on combining information in the text with those from the knowledge base of the subject) (Pearson & Johnson, 1978). One point was given for each correct response. The maximum score for the literal questions was for and for the deduction questions was six.

(c) *The distal transfer task*. The task was developed based on two text passages of 100-150 words each. The difficulty level was evaluated by two instructors to be suitable for the third grade level. Similar to the task from point b, each passage was followed by two literal questions and 3 deductive questions. The coding scheme was the same as for the previous task.

Evaluation procedures. The four evaluations were made at the end of the training phase. The first 3 tasks were applied two days after the training. The transfer test was applied one month after the training in order to measure the long-term duration of the training strategies.

## Results and discussions

In order to measure immediate transfer and long term transfer ANOVA was used.

**Table 2**

**Comparisons of transfer task by group**

| Evaluation types | Question types | Group types | | | t | p |
|---|---|---|---|---|---|---|
| | | | Experimental group | Control group | | |
| The procedural transfer | Inferential questions (max= 12) | M<br>σ | 8,64<br>(2,15) | 6,43<br>(2,24) | 2,59 | .02 |
| | Literal questions (max= 4) | M<br>σ | 3,53<br>(0,67) | 2,81<br>(0,83) | 2,34 | .05 |
| The immediate transfer | Inferential questions (max= 6) | M<br>σ | 4,12<br>(0, 91) | 2,98<br>(0,80) | 3,26 | .01 |
| | Literal questions (max= 4) | M<br>σ | 3,24<br>(0,45) | 2,38<br>(0,81) | 3,95 | .01 |
| The distal transfer | Inferential questions (max= 6) | M<br>σ | 4,32<br>(0,67) | 3,18<br>(0,65) | 3,22 | .01 |
| | Literal questions (max= 4) | M<br>σ | 3,11<br>(0,45) | 2,65<br>(0,54) | 2,43 | .05 |

Table 2 presents the means and standard deviations of the results in the two groups of participants with low comprehension abilities (from the control and experimental conditions). Results correspond to the evaluation tasks presented above. The effect strength of the training procedures on the two participants' groups resulted from the use of the „t" test.

The table 2 shows the presence of significant differences between the two groups of pupils for more tasks. The results of the study demonstrate that following the inferential training, SD showed improvement for the following skills: (a) key words identification in the text, (b) generating a list of words and personal passages, (c) the transfer of knowledge gained for solving deduction passages generated by others, (d) inferential transfer for unfamiliar materials. The effect of the generative intervention task was reflected in the superior performance of the experimental group, for more types of inferences like: action, cause and effect deduction. On the other hand, results for location deduction and timing were not influenced by the training tasks.

Data analysis from table 2 imposes the general remark: the skills learned following the training (a) identifying key words, (b) linking content form the text with the knowledge base and (c) inferential text elaboration starting from the key words offered by the tutor are transferable. The transfer effects can be observed in the responses of the pupils to the inferential questions corresponding to the used tasks. It is

important to highlight the fact that the effects of the generative training were maintained in time. Consequently, we conclude that the training based on the described algorithm significantly improves the inferential skills of less skilled comprehenders.

Results lend support to data form previous studies from the field (Reutzel & Cooter, 1991). The mentioned authors name a series of experimental data to prove that the significant improvement of comprehension happens following a sustained training that involves time investment (Gersten, Fuchs, Williams, & Baker, 2001). The second observation concerns that fact that important acquisitions will not significantly deteriorate with time. It is possible that a training that involves a longer period of time will highly improve the participants' performance. Results based on the proposed procedures can be further tested in inferential studies for other knowledge, highlighting the role of inferential transfer in improving the comprehension activities.

The study also emphasized the fact that not all types of inferences that were taught are influenced to the same extent by the training procedures. We bring three arguments to explain the discriminative influences of the instruction procedures: (a) first, it is possible that the duration of some tasks was too short, (b) second, the used training procedures could have needed high complexity level processing that were above the actual operating capacity of LSC. (c) third, it is possible that the instructions for generating the six types of deductions were not explicit enough.

It is important to highlight the fact that even though the study focused on the improvement of generating inferences, an unexpected effect of improving literal questions performance was registered. A possible explanation is that the proposed procedure implies different processing levels. Consequently, the first phase focused on a superficial processing level, namely on the literal text form. Only afterwards, more advanced processing levels were required. This differentially influences the literal and inferential understanding. From the analysis of the study tasks such a phenomena does not emerge.

We conclude that higher performances at the literal and inferential tasks of the participants from the experimental group can be explained by: (a) looking for important information in the text, (b) the implicit effort to link information from the text with the knowledge base, (c) generating inferences based on some passages elaborated by others.

All these operations imply a deeper level of text processing, with beneficial consequences for retaining information for longer time periods.

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