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Teachers' beliefs about low-achieving students and higher order thinking

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Abstract

The goal of this study is to characterize the patterns of teachers' beliefs regarding low-achieving students and instruction of higher order thinking. Subjects are 40 Israeli teachers. Results show that 45% of the teachers believe that higher order thinking is inappropriate for low-achieving students. Findings suggest that teachers' beliefs in this context are related to their general theory of instruction: viewing learning as hierarchical in terms of students' academic level was found to be related to a traditional view of learning, i.e., seeing learning as progressing from simple, lower order cognitive skills to more complex ones. Implications for teacher education are discussed. © 2001 Published by Elsevier Science Ltd.

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1. Introduction

As the drive for teaching for understanding and higher order thinking gains momentum in our schools, there is a pressing need for deeper investigation into the conditions necessary for its success. Since teachers' knowledge and beliefs are crucial factors in determining the effect of any educational endeavor, it is important to study them in the context of teaching thinking. Specifically, the aim of this study is to investigate teachers' knowledge about teaching and learning of low-achieving students in the context of higher order thinking.

In recognizing the current revival of efforts to teach higher order thinking skills, Resnick (1987) claims that they are different in a fundamental way from past efforts that had similar aspirations. As opposed to the past when only a small, elite segment of the population had the opportunity to enjoy such efforts, today's efforts are geared towards ALL students. It is a new challenge, says Resnick, to develop educational programs that assume that *all individuals*, not just an elite, can become competent thinkers.

The aspiration of making thinking and problem solving a target for all our student population has several sources. Changes in technologies and in the job market result in a lesser demand for blue-collar workers and in an increased demand for more sophisticated, highly literate workers. But regardless of these changing demands that are external to the educational system, the contemporary changing views of teaching and learning within the educational system itself also require that

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thinking and problem solving be taught to all students.

According to learning theories that had been embraced until about 25 years ago, learning was seen as linear and sequential. Thus, learning had been described hierarchically. Learning objectives were sequenced to progress from simple, lower order cognitive tasks to more complex ones. Complex understanding was thought to occur only by the accumulation of basic, pre-requisite learning (e.g., Bloom, 1956; Gagne, 1974). Shepard (1991) argues that the most serious consequence of the mastery learning model of instruction is that higher order skills that occur late in the hierarchies are not introduced until after pre-requisite skills have been mastered. Often, students never get to the point where they have the opportunity to engage in higher order skills.

Another, related consequence of the learning theories described above, is that learning also often becomes hierarchical in terms of levels of students. As Shepard (1991) demonstrated, behaviorist theories imply that students learn best when complex learning is broken down into smaller parts that are ordered sequentially. Only when the earlier, simple steps are mastered, is the learner ready for more advanced tasks requiring higher order thinking. Low-achieving students may chronically experience lower order instructional emphasis because educators see these students as "stuck" in the early phases of the learning process. In contrast, higher-achieving students, having mastered the basic skills, may be viewed as prepared to handle more complex learning tasks. A specific example of that general claim is manifested in Peterson's (1988) criticism of the traditional elementary school math curriculum. According to Peterson, traditional math curriculum usually emphasizes a learning sequence according to which higher order objectives are more appropriate for later stages in the learning sequence (such as advanced geometry and algebra). Since only a few students progress to studying advanced mathematics, most will fall away before they get the opportunity to encounter truly higher order instructional objectives.

As opposed to that, more recent learning theories see learning in a very different way. Rather than evolving from the fragmented knowledge resulting when complex ideas are broken down into smaller parts, understanding is seen as evolving while learners are engaged in thinking and inquiry in contexts that make sense to them. Cognitive research on children's learning of basic skills reveals that reading, writing, and arithmetic — the traditional three Rs—involve important components of inference, judgment, and active mental construction. Thus, the traditional view that the basics can be taught as routine skills, with thinking and reasoning to follow later, can no longer guide the educational practice (Resnick & Resnick, 1992). As a result of this, thinking is no longer viewed as an optional activity that learners may or may not get to at the final stages of learning a new subject. Instead, *thinking is applied to all learning and to all learners.*

The same view, namely that teaching for higher order thinking is important for the learning of all students in all academic tracks, is emphasized by several other researchers. For instance, Newmann (1990) discusses higher order thinking in the context of social sciences, proposing that it is important for all learners. Other researchers have argued that it is precisely the lower-achieving students who stand to benefit most from instruction of higher order thinking. Peterson (1988) suggests the need for an increased instructional focus on teaching higher-level skills in mathematics to all students, emphasizing that such an increased focus may be particularly important for lower-achieving students who have more difficulty than their peers in learning these higher order skills on their own. More recently, White and Frederiksen (1998, 2000) assessed the impact of a special curriculum (Thinker Tools) designed to teach physics and inquiry, based upon a metacognitive model of research. Their assessment showed that the curriculum was particularly beneficial for low-achieving students: performance on their research projects and inquiry tests was significantly closer to that of high-achieving students than was the case in the control classes. Thus, this approach has the valuable effect of reducing the educational disadvantage of low-achieving students, while also being beneficial for high-achieving ones. White and Frederiksen explain this gain by the importance of metacognition: monitoring and reflecting on the process and

product of one's own learning is crucial to success. Research on good versus poor learners shows that many students, particularly lower-achieving students, have inadequate metacognitive processes, and their learning suffers accordingly. Thus, for lower-achieving students, the new curriculum is more crucial because, without explicit teaching of metacognitive tools, such students lack well-developed metacognitive skills to rely on during learning. Zohar and Dori (submitted) describe four separate projects whose goal was to foster students' higher order thinking in science classes. The results of all four studies showed that low-achieving students improved their thinking following the interventions. Other studies also show that low-achieving students may indeed gain considerably from programs whose main goal is to foster higher order thinking (e.g., Levine, 1993; Pogrow, 1988, 1996).

However, in educational practice these recommendations and suggestions are often disregarded. Raudenbush, Rowan, and Cheong (1993) describe a number of studies reporting that teachers in classes of high-achieving students are substantially more likely to emphasize higher order thinking processes than teachers in classes of low-achieving students. Raudenbush and colleagues suggest the following hypothesis: the higher the academic track of a class, the more likely a teacher will be to report an emphasis on teaching for higher order thinking in that class. If this hypothesis is correct, it can be assumed that the same teacher will teach differently in high and low academic tracks, leading to considerable within-teacher variability. Raudenbush and his colleagues asked teachers in 16 schools to identify their instructional goals for each of their classes and constructed an instrument to capture higher order emphasis in maths, science, social studies, and English. A regression analysis revealed a powerful effect of track on higher order objectives in all disciplines, especially math and science. In maths, the degree of the gap in emphasis on higher order activities between the academic and non-academic track in high school exceeded a standard deviation in magnitude. The gap between honors and nonacademic classes exceeded 1.7 standard deviation units. These results confirm the hypothesis regarding a within-teacher variation, showing that the same teacher tends to emphasize more higher order thinking when teaching students of higher academic achievements than when teaching students of lower academic achievements. Raudenbush et al. (1993) also cite additional studies, showing that to the extent that teaching for higher order thinking is manifested in high school, evidence suggests that it occurs far more often in high- than in low-track classes (Metz, 1978; Oakes, 1990; Page, 1990).

Raudenbush et al. suggest three possible explanations for the disparity between high- and low-achieving classes in the instructional goals teachers have been found to pursue. They cite Metz (1978), who has argued that teachers resort to basic skills instruction in classes serving low-achieving students as a classroom management strategy. In this view, the routine tasks and slow pace of work that accompanies much basic skill instruction keep low-achieving students busy while accommodating their supposed preferences for easy work. The second explanation is founded in Neo-Marxist and critical theories, which see the disparity in instruction across academic tracks as flowing from the educational system's intention to reproduce social inequality. The third explanation relates to the pervasive influence of traditional learning theories reviewed earlier.

The literature shows that teachers' theories and beliefs have strong implications for the way they practice teaching (e.g., Brickhouse, 1990; Clark & Peterson, 1986; Hashweh, 1996; Nespor, 1987). Thus, the belief that achieving goals related to instruction of higher order thinking is beyond the abilities of low-achieving students, may have enormous instructional consequences. According to this belief, when teaching low-achieving students, teachers should stick to instruction on the level of lower-cognitive activities. The consequences of that belief might be that low-achieving students would be deprived from tasks requiring higher order thinking, tasks that are so crucial for their development. Thus, teachers' beliefs in this context might become a self-fulfilling prophecy. Since such beliefs are likely to influence teachers to expose only high-achieving students to tasks requiring higher order thinking skills, the gap between low- and high-achieving students will only grow wider.

2. Research question

The literature review presented in the previous section forms the rationale for the present study. Gaining a more profound understanding of teachers' theories and beliefs about this issue carries considerable educational significance. Thus, the goal of the present study is to answer the following question:

What are the patterns of teachers' beliefs regarding low-achieving students in relation to instruction of higher order thinking?

3. Methodology

3.1. A general comment about terminology

The terms low- and high-achieving (LA and HA) students are used here in a somewhat loose way. They are used as relative terms, for the purpose of contrasting between two parts of the student population: HA are students who generally do well in school and have high academic achievement, while LA students are students who generally do not do well in school and have low academic achievements. These categories often correspond to students with low versus middle or high socioeconomic background, but this is by no means necessarily so. As will be described below, the student populations in the schools in which our study took place are heterogeneous in terms of students' academic levels and socioeconomic background. Within the school culture, it is clear to teachers in an informal way, who are the "LA" and who are the "HA" students, according to the way they participate in the classroom's written and oral work, and according to their test scores. Thus, although we did not define the terms LA and HA to the teachers we interviewed in any formal way, it was clear from the content of the interviews that a shared meaning for these terms existed between interviewers and interviewees. In their responses, teachers often replaced the term LA with the term "weak students", and the term HA with "good students" or "strong students".

3.2. Instrumentation

Data collection was carried out using a semi-structured interview. All teachers were asked the same core questions, but the interviewers then proceeded in a free way to ask questions of clarification and to probe teachers for the meaning of their responses.

The interview (see Fig. 1) opened by presenting the Melinark problem, illustrating the acquisition of an imaginary concept (i.e., "Melinark"). While no prior knowledge was necessary to solve this problem, it did require some thinking patterns such as making comparisons, analyzing, hypothesizing, eliminating possible factors and drawing conclusions. Following a successful solution of the problem, the solver had actually acquired a new concept (Melinark), and she/he was able to define it. The problem had been adapted for the present purpose from Lawson, Abraham, and Renner (1989).

The purpose of opening the interview with the Melinark problem was to represent a learning process that takes place by way of problem solving and thinking. In the first part of the interview, teachers were asked to choose between two hypothetical teaching methods for teaching the imaginary concept of a "Melinark": (a) letting students acquire the concept through active learning, by solving the problem; or, (b) teaching the concept by a transmission of knowledge approach. In what follows these two teaching methods will be referred to as "problem solving" or "thinking based" learning versus learning by "transmission of knowledge" or by "presenting information".

Some teachers had already raised the issue of LA students and thinking as they were responding to the first and second questions of the interview that did not refer explicitly to that issue. Other teachers were asked specifically about this issue in subsequent questions (see questions 3–5). The second part of the interview (questions 6–9) asked teachers to explain their beliefs regarding their own teaching practices. Questions 7–8 referred to questioning patterns during class discussions and in tests. Question 9 asked about teachers' beliefs regarding appropriate teaching methods at the beginning of a new topic. The third part of the interview

(questions 10–11) solicited information about the teachers' background. The full protocol of the interview is presented in Fig. 1.

3.3. Subjects

The interviewees were 40 teachers (thirty-five women and five men) who taught in two different schools in Israel (20 teachers from each school). One of the schools was a junior high school located in a large city and the second was a combined junior high school and high school (junior high school runs from grade seventh to ninth, and high school runs from grade tenth to twelfth). The number of years these teachers had been teaching ranged from 3 to 29 ($\bar{X} = 15.82$ yr, S.D. $= 8.14$). The interviewees represented all academic school subjects (maths, sciences, social sciences, humanities and foreign languages).

These two schools were chosen for the present study because they were regional, non-selective schools, drawing students from varied backgrounds. Accordingly, the student population of the two schools was mixed, including students of low, medium and high socioeconomic backgrounds. Students' academic abilities were also varied, ranging from very high to low. In junior high school, most classes were heterogeneous, including students of very mixed abilities in the same class. Tracking took place at the beginning of high school (grade 10). Although high school classes tended to be more homogenous than junior high school classes, virtually all the teachers we interviewed had experience with students of mixed abilities. They either taught at least some of their classes at the junior high school level or they taught high school classes that were at a low academic level.

3.4. Data collection and analysis

The interviews took place at either the teachers' lounge in the school or at the teachers' homes. They were conducted by the second and third authors and lasted approximately 30 min each. Teachers were told in advance that they were being asked to participate in a study of an educational problem, but the exact nature of the problem was not revealed to them. Only one teacher who was asked to participate refused to do so. Interviews were tape-recorded and later transcribed and analyzed. All the excerpts included in the result section were translated into English by the first author.

All three authors read the transcripts of all 40 interviews several times and categories for recurrent ideas were established. Then, the responses for each section of the interview were classified according to these categories (a section may consist of either a single interview question or a group of questions referring to the same idea). The agreement between two independent readers was at least 80%. We also carried out a longitudinal analysis, classifying each individual interview as a whole unit (see more elaborate explanation in the next section). When appropriate, the classified responses were also subject to a quantitative analysis.

4. Results

Interviews were analyzed using two different perspectives. The first was a longitudinal analysis in which the unit of analysis was an individual interview, from beginning to end. The second was a horizontal analysis in which the unit of analysis was a particular segment of the interview, across all interviews.

4.1. Longitudinal analysis—three different categories

In analyzing each individual interview from beginning to end, we were looking for internal consistency in terms of whether or not teachers made a distinction between LA and HA students with respect to instruction of higher order thinking. Interviews were divided into three categories:

"Distinguishing consistently (DC)". The teacher was consistent in drawing a distinction between LA and HA students throughout the interview, expressing the view that instruction of higher order thinking is more appropriate for HA students than for LA students.

"Not-distinguishing consistently (NDC)". The teacher was consistent in not drawing a distinction between LA and HA students throughout the interview, expressing the view that instruction of higher

Introduction to the interview:(Letting the teacher solve the Melinark problem….and then…)
Let us suppose that "Melinark" is a concept included in the curriculum. You now have to choose between two teaching methods for this concept. In the first method, you would begin teaching by presenting the Melinark problem to your students, and then ask them to define the concept. In the second method, you would begin teaching by first presenting the definition of the concept "Melinark", or by asking your students to look for the definition in the Encyclopedia, and then require students to answer some questions about Melinarks.

1. Suppose you are teaching in a typical heterogeneous class that includes students from multiple cultural backgrounds and a wide range of academic achievements. Which of the two methods would you choose for teaching the concept of "Melinark"? Why?
2. What are the advantages and disadvantages of each method? Please explain.
3. (This question is to be asked in case teachers made some differentiation in their response, but not between LA and HA students): In your response, you have made some distinctions between students. What about a distinction between students with low academic achievements compared to students with high academic achievements? Please explain.
4. (This question is to be asked in case teachers did not make any differentiation in questions 1 and 2). I have been talking to some other teachers who said that they prefer to use the first method with students who have higher academic achievements, and the second method with students who have lower academic achievements. What do you think about this idea?
5. (This question is to be asked only when teachers' responses in the previous question need further clarification). So for what type of students would you prefer to use the first method ? For what type of students would you prefer to use the second method? Why?
6. Until now we have discussed a theoretical situation. Now, I would like you to refer to what actually happens in your own lessons. What percentage of the time do you apply each of these two teaching methods? Why? (If needed, may clarify the question by referring explicitly to the two teaching methods as "problem solving" versus "transmission of knowledge").
7. (Ascertain that the interviewee is teaching at least some heterogeneous classrooms. If so, ask the following:) Several studies have showed that teachers who work in heterogeneous classrooms tend to ask LA students questions on a lower cognitive level than HA students. Do you think this is also true for your own classrooms? (If the interviewee does not teach in a heterogeneous classroom, find out what type of students s/he is teaching, and ask how one should teach students with lower/higher academic achievements). Why is that so?
8. When writing a test, teachers usually include items of varied cognitive levels: recall, comprehension and higher order thinking (i.e., application, analysis, synthesis and evaluation). How do you think a good test should be constructed in terms of the relative weight given to the following levels:
   a. for LA students- knowledge comprehension higher order thinking (explain)
   b. for HA students- knowledge comprehension higher order thinking (explain)
9. When you begin teaching a new topic- what do you think should be the correct order of instruction: starting the new topic by first presenting basic information and then tasks requiring higher order thinking, or starting with a task that requires higher order thinking? Why?
10. Background information: gender, subjects and grades of instruction, number of years in teaching, Institution granting teacher's certificate.
11. Did you recently attend an in- service teachers' course about the development of students' higher order thinking skills? If so, how did the course affect your work?

Fig. 1. The full protocol of the interview.

order thinking is equally appropriate for HA and LA students.

Inconsistency (*INC*). The teacher drew a distinction between LA and HA students with respect to instruction of higher order thinking in some parts of the interview, but did not draw that distinction in other parts of the interview.

In order to illustrate this classification, let us examine selected sections from interviews with two teachers: one that was classified as "DC" and the other that was classified as "NDC".

4.2. An illustration of a teacher classified as DC

The teacher we chose to represent the group of "DC" teachers was a woman who had been teaching high school chemistry for 10 years. The following are selected sections from her interview:

T: Well, I would not choose the problem solving method, but the other one - presenting the concept. Because in a heterogeneous class, some students are very weak, and they would not be able to grasp the correct concept by using the problem solving method. It will be too difficult for these students. The problem solving method will work in a class that consists of good students.

… I: In your response, you have made some distinctions between students. What about a distinction between students with low academic achievements compared to students with high academic achievements? Please explain.

T: Strong students are able to find out the characteristics of this creature [i.e., Melinark] by using inquiry. Weak students cannot do it. They do not have the necessary tools. They need you to give them everything ready-made …. Strong students … It is better to teach them through inquiry.

I: So for what type of students would you use each method?

T: Presentations by the teacher for students who are not so good - average and below. Problem solving for the students who are average and above ….

T: A test for the stronger students consists of 40% knowledge, 30% comprehension and 30% higher order thinking. A test for the weaker students consists of 65% knowledge, 25% comprehension and 10% higher order thinking.

I: When you begin teaching a new topic-what do you think should be the correct order of instruction: starting the new topic by first presenting basic information and then tasks requiring higher order thinking, or starting with a task that requires higher order thinking?

T: It depends what kind of class we are talking about. [In a class of mixed-ability students] … basic knowledge came first, and questions that required comprehension and thinking came only later. [In a strong class] … I think knowledge and comprehension should be taught in parallel to each other …

As can be seen from the interview, this teacher was making a clear and consistent distinction between LA and HA students. She believed that teaching by using methods that require higher order thinking, such as inquiry and problem solving, is appropriate for HA students (whom she referred to as "good" or "strong" students), because they have the intellectual abilities required for coping with that method. Problem solving would contribute to sharpening their thinking even further. HA students would also find these teaching methods more interesting than teaching by transmission of knowledge. Thus, teaching a new topic to HA students may be done by using teaching methods that require students to be active thinkers. Such learners construct their own meaning for new concepts while they are engaging in inquiry and problem solving. However, the interviewee also believed that teaching by using the same methods is inappropriate for LA students (whom she referred to as "weak" students), because they lack necessary intellectual abilities. These students should be taught by a transmission of knowledge approach: the teacher should first present information in an orderly and clear manner, and then drill her students about that

information. Thus, teaching a new topic to LA students should be done using teaching methods that make these students passive learners. The same belief was also reflected in the way this teacher viewed testing. Tests for LA students should consist of more knowledge items and less comprehension and higher order thinking items than tests for HA students.

4.3. An illustration of a teacher classified as NDC

The teacher we chose to represent the group we classified as "NDC" was a man who taught philosophy, sociology and history in high school. The following are selected sections from his interview:

I: Which of the two methods would you choose for teaching the concept "Melinark"? Why?

T: I would choose the riddle.... Because if I would choose the other method they would simply be learning by heart whatever I would be telling them ...

I: I have been talking to some other teachers who said that they prefer to use the first method with students who have higher academic achievements, and the second method with students who have lower academic achievements. What do you think about this idea?

T: No, no, no, I disagree absolutely.

I: Why?

T: Because learning is either happening or not. There is only one way in which learning can take place. The type of student doesn't matter. If students are of a lower level, I will ask questions and give problems that are adequate for their level. But learning must come from them. Otherwise it is not learning, but merely memorization. From my point of view this is not real learning.....

T: I teach a new curriculum that consists of informal logic [as a result of this experience] ... I suddenly realized that low- achieving students are capable of learning informal logic. This surprised me. In the past, I used to think that philosophy is suitable only for a small minority of talented students.... But after I started teaching it, I saw that LA students understand informal logic without any difficulties.... Here, look at this-[showing a written question] ... This is a complicated question- and they can do it! These are not strong students. In other subjects they may even be low-achieving students - and they are succeeding.... This led me to think that you can get a lot out of such students too. You simply need to teach them to think ... I am also applying this approach when I teach history and sociology - I am now devoting more time to the development of thinking in these subjects also ...

As is apparent from this excerpt, the interviewee drew a distinction between "memorization" which he did not consider real learning, and meaningful, or true learning, in which students are given the opportunity to be active learners by engaging in thinking and problem solving. This view of learning rejects the distinction between LA and HA students: since the goal is true learning, all students must engage in active thinking. Otherwise, all they can do is learn by heart. This is not to say that this teacher was insensitive to the difficulties of LA students, because he saw his role as a moderator between the high cognitive requirements of his teaching and the initial abilities of LA students. He described several means by which he performed this role: translating difficult questions into simpler formulations, providing additional explanations and organizing peer interactions between LA and HA students (the full script of the interview offers more elaboration on these issues than has been cited above). It is interesting to note that these views had been crystallized following this teacher's experience with a special program designed to teach higher order thinking through informal logic. As opposed to his earlier beliefs, he had been positively surprised to see the success of LA students in this program. He saw their success as a source of professional pride and satisfaction. Our interviewee had learnt from this experience that given an adequate treatment, LA students were indeed capable of more than he had ever thought possible before.

4.4. Numerical summary of the longitudinal analysis

In classifying the 40 interviews into the three categories mentioned before—DC, NDC and INC, we found that only eight teachers (20%) were consistent in their view that higher order thinking was equally appropriate for LA and HA students, and were thus classified as NDC. Eighteen teachers (45%) drew the distinction between LA and HA students with regard to the teaching of higher order thinking consistently throughout the interview, and were thus classified as DC. The remaining 14 teachers (35%) were inconsistent, expressing different views in various parts of the interview, and were thus classified as INC (see Fig. 2).

4.5. Reasons for and against each of the two teaching methods

In interview item #2 –"What are the advantages and disadvantages of each method? Explain"–teachers were asked to refer to both sides of the issue, namely, to describe both the pros and cons of each of the two teaching methods (transmission of knowledge versus teaching of higher order thinking). In addition, teachers often gave several reasons for and against each option in their responses to items 1–5. Consequently, the interview transcript of each teacher usually consisted of several ideas regarding the pros and cons of the two teaching methods. Following a careful reading of teachers' responses, we created categories of reasons. Then, we calculated the percentage of teachers who brought up each reason (out of the total number of teachers). The results are presented in Table 1. Only categories brought up by more than two teachers (5% of all teachers) were included in the table.

As can be seen from Table 1, 70% of the teachers saw thinking-based learning as challenging, developing students' reasoning, and inducing curiosity; 45% of the teachers expressed the idea that learning through transmission of knowledge is boring compared to thinking-based learning; 27.5% of the teachers believed that thinking-based learning brings about better learning than transmission of knowledge. By "better", most of them explained that students would have a deeper

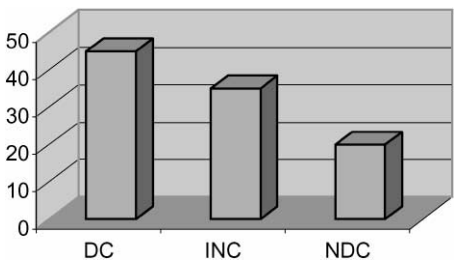

Fig. 2. Longitudinal analysis—frequency of distinguishing consistently (DC), not-distinguishing consistently (NDC) and inconsistent (INC) teachers.

Table 1
Reasons supporting thinking-based learning and learning through transmission of knowledge ($n = 40$)

Reason	Frequency of teachers who brought up each reason (%)
1. *Supporting thinking-based learning*	
Thinking-based learning is challenging, developing students' reasoning, inducing curiosity	70.0
Learning through transmission of information is boring/thinking-based learning is interesting	45.0
Thinking-based learning brings about better learning, as compared to learning through dissemination of information	27.5
Thinking-based learning is suitable for group work, providing adequate means for peer learning	17.5
2. *Supporting learning through transmission of knowledge*	
Learning through transmission of knowledge is a structured, clear means of instruction that does not evoke confusion	57.5
Thinking-based learning creates difficulties for weak students. They do not know how to solve the problem, become perplexed and consequently may cease to be involved in the lesson	45.0
Thinking-based learning takes more time than transmission of knowledge	20.0
Thinking-based learning induces frustration in weak students	17.5
Supervisors and students request this method and expect it	12.5

understanding of concepts and remember them for a longer period.

The most frequent reason brought up to support learning through transmission of knowledge was its clarity. The idea that the advantage of this method is that it is structured, clear and does not evoke confusion was expressed by 57.5% of the teachers. The idea that thinking-based learning creates difficulties and confusion for weak students, alienating them from the lesson, was expressed by 45% of the teachers. Thus, it seems that the belief that higher order thinking is inappropriate for LA students is indeed a major factor in dissuading teachers from using this method. Some teachers (17.5%) expressed another, related reason, namely that thinking-based learning may induce frustration in weak students. This reason refers to what many teachers saw as the affective consequences of the cognitive difficulty described earlier. Teachers expressed these ideas in the following ways:

1. Formulations expressing the idea that LA students will have difficulties with thinking-based learning

- The weak ones will not get it.
- Less able students do not investigate, they lack tools for investigation and truth seeking … . They need you to give them everything, to spell it all out for them.
- The second method (i.e., transmission of knowledge) is appropriate for the less able students. Perhaps the appropriate way for working with such students is to dictate, to spoon feed them with the correct answers … . They will be unable to find the solution on their own.
- The better students are also the ones who think. The weaker ones do not think.
- Some students are weak, they will not get it … and then they will be totally out. But by using the transmission of knowledge method I have more control over them.
- Low-achieving students need a rigid structure for the lesson.

2. Formulations expressing the idea that problem–based learning may induce frustration in LA students

- LA students may feel frustrated because they usually don't know the answer to problems. They need the structure that a teacher provides in the other method.
- T: … But it can create much frustration for some students.
  I: What kind of students?
  T: Weak students who are influenced by competition …
  T: The moment somebody else in the class will get the right answer … they will be demoralized, you see, it will cause them to fail.

4.6. Ideas about special pedagogical means for teaching higher order thinking to LA students

Some of the teachers ($n = 12$, 30% of the teachers) who were classified as either NDC or INC explained that LA students may be taught higher order thinking by using special pedagogical means. For instance:

- … In my school there are several … very weak classes …. With them too, sometimes … we can get somewhere by … using a problem solving approach. They too, are fed up with listening to me lecturing all the time. They too, deserve to be pushed a little upwards. One of the ways to move them forward, to develop them in some way is to ask them questions. To use what we have called the problem solving approach. But obviously, I would not do it with a problem like the Melinark, but with much smaller units, in order to let them have a feeling of success. Because they too feel good when they are succeeding, finding out solutions on their own, making their own generalizations. With these students it is important to use special methods.
- This method [i.e., the problem solving approach] could work with everybody, but sometimes you should use some variations. Sometimes a learner … might need an additional step, another small thing to lean on - but eventually … I believe everybody can do it.
- You must break it down for them [i.e., for LA students]. To show them things along the way, to go one step at a time, and not to do everything at once.
- Perhaps some students will need more examples. The weaker ones will need some more examples.

- I will give the same problem to all students, but in groups. This way the stronger ones will be able to help the weaker ones.
- T: No. I think you should guide each student according to his or her level. That means that we … should not just throw them into the deep sea and abandon them. The better students - they would be able to deal with it. You can give it to them as is …
  I: What do you mean by guidance?
  T: Tell them to look for the characterizations of the creatures in the first row. Then to look at the second row. Next, ask - what is missing? etc.

These excerpts show that many of the teachers who believed that higher order thinking may be appropriate for LA students were not simply indifferent to their potential difficulties. They assessed these students' abilities in a realistic way, but did not see their difficulties as a reason for giving up on higher order thinking goals altogether. Instead, they were searching for ways to work toward these teaching goals by adapting special pedagogical means that included the following: breaking up a complex task into several simpler components; leading students through a sequence of steps necessary to solve a problem; giving clues; adding more examples; and letting students work in groups of mixed ability so that peers can learn from each other. In general, these teachers saw their role as providing guidance and support, so that LA students would be able to solve the reasoning problem and to experience feelings of self-satisfaction. Teachers were hoping that LA students would eventually be able to solve progressively more complex problems on their own.

4.7. Patterns of questioning in a heterogeneous class

Interview item #7 referred to the issue of whether or not teachers tend to pose different questions to LA and HA students who study in the same classroom (i.e., do teachers tend to ask LA students questions that are on a lower cognitive level than the questions they tend to ask HA students). Teachers' responses were divided into two categories:

1. Affirmative responses in which teachers said that they do indeed tend to question LA and HA students in a different way, according to students' level: higher order questions were posed more often to high-achieving students, lower order questions more often to low-achieving students. Altogether, the responses of 12 teachers (30%) were classified into this category. Teachers' justifications for this type of response were very similar to the ideas expressed in the previous sections, mainly the prediction that higher order thinking questions would be too difficult for LA students and the wish to avoid feelings of failure and frustration.

2. Negative responses in which teachers said that they do not tend to question LA and HA students in a different way, but ask the same type of questions of all students, independently of their academic level. Altogether, the responses of 28 teachers (70%) were classified into this category.

A qualitative analysis of the reasons teachers gave for this response showed that in many cases teachers applied questions in a uniform way because of factors that were not intrinsic to their pedagogical beliefs about LA students and instruction of higher order thinking.

One type of reasons teachers gave for their negative responses was that identical final ends require identical tasks. Since their goal was to prepare everybody for the same final exams, teachers explained, they must let them practice with the same type of questions. This idea was especially (but not exclusively) popular with teachers who prepared students for the matriculation exam:

- I ask everybody the same questions because all students will have to take the same tests.
- When you teach for the matriculation exams, you must ask everybody the same questions.
- Questions will not necessarily be different, even if the classes are on different levels, because they take the same matriculation exam … the same level, a uniform question to all students, of all levels.

A second type of reason teachers gave for their negative responses was that posing different questions to students of different levels was in fact impractical:

- I can't adapt my teaching according to students' level.
- I don't ask students different question, I can't work it out technically.
- I only have them for two or three hours a week, I have no time for such things.

Some teachers seemed to feel that they should have given differential tasks to students of different level, but unfortunately, they were not up to it:

- I don't prepare the lesson well enough, to the degree that I would be able to give higher level thinking questions to higher level students and vice versa.
- No, but I suppose they don't do as well as they could because I don't do it [i.e., ask differential questions].
- I think this is a great compliment to the teachers who can do it. I am sorry to tell you that I am not doing it.

As can be seen from these excerpts, teachers' reasons for not differentiating between questions they pose to LA and HA students in a heterogeneous class were not necessarily related to their beliefs about whether or not higher order thinking questions were appropriate for LA students. Thus, it can be concluded that this question was not a valid measure for assessing whether or not teachers made a distinction between LA and HA students with respect to instruction of higher order thinking. Therefore, it was decided not to include this question in the longitudinal analysis we have described earlier (see the numerical summary of the longitudinal analysis above).

4.8. Testing patterns

In interview item #8, teachers were asked about the relative weight given in testing to the cognitive levels of knowledge, comprehension and higher order thinking. The results are presented in Table 2.

The results show that the frequency of knowledge items that teachers included in tests for classes that were academically strong is significantly lower than in classes that were academically weak ($\bar{X} = 62.67$ and 53.6, respectively, $t = -1.9$; $P < 0.05$). On the other hand, the frequency of higher order thinking items that teachers included in tests for classes that were academically strong is significantly higher than in classes that were academically weak ($\bar{X} = 22.5$ and 13.0, respectively, $t = 2.9$; $P < 0.05$).

4.9. Preferred teaching method at the beginning of a new subject

In interview item #9, teachers were asked how they prefer to start a new subject: Whether by first presenting basic information and only then introducing tasks requiring higher order thinking, or by beginning with a task that requires higher order thinking. Teachers' responses were classified into four categories:

1. *Knowledge first*. Teachers said that they prefer to begin a new topic by presenting basic knowledge. Teachers gave the following reasons for this preference:

- basic knowledge is necessary for students' self-confidence;

Table 2
The mean frequency of knowledge, comprehension and higher order thinking questions in tests for LA and HA classes ($n = 28$)

	Knowledge		Comprehension		Higher order	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
LA class	62.7	16.8	24.3	13.2	13.0	10.3
HA class	53.6	17.8	23.8	7.8	22.5	13.3
T test	$t = -1.96$[a]		$t = -1.70$		$t = 2.93$[a]	

[a] $P < 0.05$.

- thinking is a higher level than knowledge, and one ought to start with the foundation;
- basic knowledge can be a common denominator for all students;
- starting with basic knowledge consists of a more structured and orderly way of teaching.

2. *Thinking first*. Teachers said that they prefer to begin a new topic by presenting tasks that require higher order thinking. Teachers gave three main reasons for this statement:

- discovery learning enhances students' motivation;
- tasks that require higher order thinking improve learning;
- thinking is appropriate for a strong class.

3. *Combining the two methods*. Teachers said that they like to combine the two methods. Some teachers said that they combine them in the same lesson, others said that they alternate, sometimes starting with one method and sometimes with the other, depending upon the particular subject, upon students and even upon the teacher's mood.

4. *Other*. Teachers said they begin a new topic by using methods other than the ones described in the previous section.

The frequency of teachers' responses in each of the four categories is presented in Fig. 3, showing that the responses of 18 teachers (45%) were classified in category 1 ("knowledge first") and the responses of only eight teachers (20%) were classified in category 2 ("thinking first").

The categorization described in Fig. 3 raised a further question regarding possible relationships between teachers' ideas about how to begin a new subject and the longitudinal analysis described earlier. As we have seen in the literature review, viewing learning as hierarchical in terms of students' levels is related to the view of learning as hierarchical in terms of cognitive levels. Since mastery of low-level cognitive tasks in a specific domain is thought to be a pre-requisite for engaging in higher order cognitive tasks, and since LA students often do not manage to master low-level cognitive tasks, thinking goals seem appropriate for HA but not for LA students. This view suggests the hypothesis that teachers who have been classified as DC would tend to prefer a "knowledge first" approach when beginning to teach a new subject, while teachers who have been classified as NDC would tend to prefer a "thinking first" approach or a combined approach.

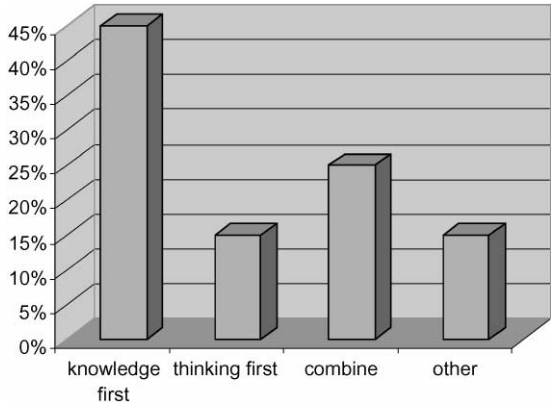

Fig. 3. Frequency of preferred teaching method when beginning a new topic.

To test this hypothesis we separated the categories described in Fig. 3 according to whether the teacher was classified as a DC or NDC in the longitudinal analysis. The results are presented in Table 3.

These data suggest a relationship between the two sets of categories. 55% of the DC teachers were classified in the "knowledge first" category, while none of the NDC were classified in that category. On the other hand, 50% of the NDC category were classified in the "thinking first" category, while only 5.5% of the DC teachers were classified in that category. These figures support the above hypothesis, namely that teachers classified as DC indeed tend to prefer a "knowledge first" approach when beginning to teach a new subject, while teachers classified as NDC indeed tend to prefer a "thinking first "approach. Since one of the observed cells in Table 3 equals 0, a chi-square test for statistical significance could not be performed.

4. *In-service teachers' courses*. Analysis of interview item #11 showed that 23 teachers attended some kind of in-service teachers' course about the development of students' higher order thinking

Table 3
The relationship between the classification of teachers as DC or NDC and preferred teaching method when beginning a new subject

	Knowledge first (%)	Thinking first (%)	Combined (%)	Other (%)
DC ($n = 18$)	55 ($n = 10$)	5.5 ($n = 1$)	16.6 ($n = 3$)	22.2 ($n = 4$)
NDC ($n = 8$)	0 ($n = 0$)	50 ($n = 4$)	37.5 ($n = 3$)	12.5 ($n = 1$)

Table 4
The relationship between the classification of teachers as DC or NDC and their participation in a thinking course

	Participated in a thinking course	Did not participate in a thinking course
DC ($n = 18$)	10	8
NDC ($n = 8$)	4	4

while 17 teachers never attended such a course. In order to find out whether or not there is a relationship between teachers' participation in such a course and their beliefs about teaching thinking to LA students, we broke the data regarding teachers' participation in a course according to their classification in the longitudinal analysis (DC or NDC). The results are presented in Table 4, showing that the DC teachers are approximately evenly divided between teachers who attended and did not attend relevant teachers' courses. The same is true for NDC teachers. A chi-square test showed no statistically significant difference. Thus, it seems that teachers' participation in an in-service course about teaching higher order thinking is not related to their beliefs about LA students and teaching thinking.

5. Discussion and implications

Our data show that many of the teachers we interviewed (45%) believed that higher order thinking is inappropriate for LA students. Rather, they believed that these students should be taught by a transmission of knowledge approach. The most common reason for this view was that teachers believed that the cognitive demands of tasks requiring higher order thinking were beyond the capabilities of LA students. Another related common reason was the belief that LA students would become frustrated by such tasks. These findings thus support the third explanation given by Raudenbush et al. regarding the disparity between low- and high-achieving classes in the instructional goals, namely that low-achieving students may chronically experience lower order instructional emphasis because educators view these students as "stuck" at an early phase of the learning process.

Some of the teachers (20%) drew no distinction between LA and HA students, viewing higher order thinking as an equally appropriate goal for all students. These teachers were not simply indifferent to the difficulties LA students may have with tasks requiring high cognitive levels. Instead, they saw their role as mediators, adapting specific pedagogical means to provide guidance and support for LA students.

The distinction teachers drew between LA and HA students was more apparent when we compared classes of different academic levels than when we compared individual students of different levels who studied in the same class. Seventy percent of the teachers said that when they teach in a heterogeneous class, they tend to pose the same higher order thinking questions to all students. The reasons for this are: (a) that identical final tests require identical tasks during learning; and, (b) that during practice, differential questioning is impossible in large classrooms. These two explanations were not intrinsic to teachers' pedagogical beliefs about LA students and instruction of higher order thinking. The data suggest, however, that LA students who study in a heterogeneous class may be more likely to have an opportunity to engage in tasks that require higher order thinking than LA students

who study in homogeneous classes of low academic level.

Our data also suggest that teachers' beliefs about LA students and instruction of higher order thinking skills were indeed connected to their general theory of instruction. Viewing learning as hierarchical in terms of students' academic levels was discovered to be related to the view of learning as hierarchical in terms of cognitive levels. Thus, teachers who had a more traditional view of teaching and learning, seeing learning as progressing from simple, lower order cognitive tasks to higher order thinking tasks, would be more likely to think that higher order thinking is not equally appropriate for LA and HA students. On the other hand, teachers who had a less traditional view of learning, implying that thinking should be integrated into the very early stages of the learning process, tended to believe that teaching higher order thinking is equally appropriate for LA and HA students. As we have seen above, many of these teachers also often had ideas about specific pedagogical means that allowed them to provide guidance and support for LA students.

Numerous previous studies have shown that teachers often see their role as transmitting knowledge and covering the curriculum rather than guiding students in thinking and constructing their own meaning of what they learn (e.g. Brickhouse, 1990; Hand & Treagust, 1994; Hoover, 1994; Tobin & Fraser, 1989; Tobin & Gallagher, 1987; Tobin, Tippins, & Hook, 1994; Shulman & Carey, 1984). Our findings suggest that teachers who see their role in this way may also draw the distinction between LA and HA students in the context of higher order thinking. However, our findings cannot be validly generalized without further studies that will address this issue with a larger number of teachers, from various populations.

These findings have important implications for teacher education. Many of the projects whose goal is to teach thinking skills run staff development programs (e.g. Adey & Shayer, 1994; Fogarty & McTighe, 1993; Iqbal & Shayer, 2000; Zohar, 1999). As cited above, many previous studies have shown that teachers' theories and beliefs are prominent factors in the shaping of their practice (Clark & Peterson, 1986; Brickhouse, 1990; Hashweh, 1996; Nespor, 1987). Based on these studies, on the findings of Raudenbush et al. (1993), and on the findings from the present study, it makes sense to assume that the initial ideas of many teachers regarding LA students and instruction of higher order thinking may hinder successful implementation of programs designed to teach thinking. In homogeneous classes of LA students, almost half of the teachers may be reluctant to use tasks that require higher order cognitive abilities. In heterogeneous classes, almost one-third of the teachers may tend to direct questions that require higher order thinking exclusively to the HA students. Our findings also imply that existing in-service teachers' courses about teaching higher order thinking do not affect teachers' beliefs about LA students and learning to think.

Therefore, the first practical implication of this study is that the issue of LA students should be explicitly and elaborately addressed in teacher education, during staff development programs addressing the issue of developing students' higher order thinking. It is important to note that these recommendations apply to courses whose main goal is the teaching of thinking skills as well as to courses that highlight teaching for understanding because students' thinking has a prominent role in constructing understanding. It is suggested to address this issue through three main approaches:

1. Show extensive empirical evidence demonstrating that LA students may indeed benefit from teaching and learning of higher order thinking skills, sometimes even more than HA students (e.g., Feurstein, Rand, & Rynders, 1988; Levine, 1993; Pogrow, 1988, 1996; Shayer & Beasely, 1987; Tzuriel & Alfasi, 1994; White & Frederiksen, 1998, 2000; Zohar & Dori, submitted). Such empirical evidence may contribute to convince teachers that it is worthwhile to teach thinking to LA students, and thereby establish their belief in the appropriateness of such teaching.
2. Work with teachers on the development of practical teaching methods for providing guidance and support, without giving up on requiring students to be active thinkers. In suggesting such teaching methods we may turn to the teaching practices described by our interviewees. These

practices include: breaking up a complex task into several simpler components, leading students through a sequence of steps necessary to solve a problem (but not "spoon feeding" them with the correct answers, thereby preventing active thinking!), giving clues, adding more examples, and letting students work in groups of mixed ability so that peers can learn from each other. In order to turn the above theoretical statement into concrete learning materials for teacher education, what is required is a set of cases demonstrating students' difficulties in specific tasks. Teachers and student-teachers may then have the opportunity to practice concrete means for guiding students through their learning difficulties, and to reflect upon the advantages and disadvantages of various means. In addition, following the recommendations of White and Frederiksen (1998, 2000), metacognitive activities may also be used for fostering the thinking of LA students.

3. While the two previous suggestions may make sense, they may also create a discrepancy in what teachers believe. The finding that teachers' beliefs about LA students and thinking are related to teachers' general theory of instruction suggests that a deep restructuring of teachers' beliefs should be related to a deep change in their views about the nature of teaching and learning. Work in several projects has indicated that it is possible to help teachers reconstruct their instructional model from a transmission of knowledge model into a constructivist one (e.g. Hand & Treagust, 1994; Lampert, 1984; Northfield, Gunstone, & Erickson, 1996). While highly successful, such projects are usually characterized by a very small group of teachers working with a university team of experts over a relatively long period of time. The transition of teachers' theories of learning from a traditional, transmission of knowledge approach to a constructivist–oriented approach is a profound change that cannot be expected to take place overnight. Nevertheless, our findings suggest that perhaps such a comprehensive and time-consuming change in teachers' beliefs is indispensable if the goal is to seriously convince teachers that higher order thinking is a suitable goal for all students.

Future empirical research is needed to test these three suggestions for teacher education, and to assess their relative effectiveness. Such future studies will also contribute to further clarification of the relationships between teachers' general theories of teaching and learning, their subject specific pedagogical content knowledge, and their beliefs about the teaching and learning of low-achieving students.

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