Constructivism and authentic pedagogy: state of the art and recent developments in the Dutch national curriculum in secondary education

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The recently introduced national curriculum for the first stage of Dutch secondary education requires not only a change in educational content but also a change in educational processes. The knowledge students acquire is expected to be related to everyday life, and to be meaningfully embedded in society. Furthermore, the student is expected to use social and cognitive strategies such as researching, collaborating, and expressing opinions. The accompanying learning environment necessitates active and interactive learners as well as teachers who use various strategies to promote 'authentic learning'.

To what extent do Dutch teachers use teaching strategies to foster authentic learning? From 1993 to 1996, three large Dutch secondary schools (between 1000–1400 students) were subjected to an in-depth inquiry. These schools were expected to implement the state-mandated innovations in the 1993–1994 core curriculum. The results show that none of the schools scores highly on the characteristics of authentic pedagogy. Authentic pedagogy demands a major change in the teacher's role, including a change in the use of curricular materials and the development of new teaching strategies embedded in a supporting school organization. The results are viewed in the context of the recent discussion on information-processing theory versus radical constructivism. Implications for curriculum and classroom practice are suggested.

Introduction

At the beginning of the school year 1993–1994, a major innovation was introduced in the first stage of Dutch secondary education. All students in the new system are to cover a national curriculum (called 'basic education') containing common objectives for 15 subjects and are given two years or more to attain these objectives. In the second stage students are reallocated to different levels, leading to certificates for particular streams.

Apart from changes in academic content, the following characteristics of an 'ideal' teaching–learning process are formulated in the new programme: *Application, Skills,* and *Connectedness* (ASC). The knowledge to be acquired has to be true to life, i.e. authentic, and relevant to students' everyday lives. Students must be able to benefit from their education in their private as well as in their social lives. In addition, students are expected to play a more active part in learning and the focus must be on

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the acquisition of skills: expressing opinions, co-operating in research, making connections with various professional practices, and making use of independent criteria for assessing student work. In addition, within schools, more attention must be paid to connections among the different subjects. Teachers are expected, in line with ASC-characteristics, to incorporate forms of authentic pedagogy in their teaching, and to depart, at least in some respects, from traditional teaching patterns in which they do the work and students are left to internalize knowledge passively.

It is difficult to give an unambiguous definition of 'authentic pedagogy'. Among the connotations associated with the term 'authentic', we note 'real', 'true', 'based on original principles' and 'genuine' (Freudenthal 1973, 1991, Taylor 1992, Newmann *et al.* 1996). A more precise definition can only be given in the context of the philosophy of education, theories of teaching and learning, and innovation movements or practice in particular schools. Our focus is on the nature and the function of the knowledge acquired at schools within the context of the Dutch national curriculum for 12- to 15-year-olds,[1] with examples from a foreign language (i.e. English) and mathematics education. In our conceptualization of authentic pedagogy, we use three sources: ideas from pedagogical reform movements; recent developments in educational psychology, e.g. situated learning and constructivism; and findings from theoretical and experimental research.

Theoretical background

Ideas from pedagogical reform movements

Critical pronouncements on school teaching and learning have a long history. At the beginning of this century educational reformers spoke of the irrelevance of schooling to the real world (Scheibe 1978). These criticisms indicated that classroom knowledge was so formal and abstract in nature that application to everyday life was alien to most students. As a result, learning inside and outside school remained for the most part unrelated. The two worlds were separate, and school learning more often than not occupied second place in students' interests.

To remove this artificial barrier, educational reformers such as John Dewey in the US, Ovide Decroly in Belgium, Peter Petersen in Germany, and Hans Freudenthal in The Netherlands conceived of learning processes based on the personal experiences of the students. A basic principle in the work of Dewey and Freudenthal is 're-invention'. Instead of being presented as a 'closed' system, subject-matter originates before the student's eyes in a process of re-invention (Wielenga 1964, Freudenthal 1973, Franssen and Lagerweij 1987).

Contemporary 'authentic pedagogy' is thus a modern form of much older ideas about educational reform. Those ideas involve a pedagogy in which everyday experiences, and students' interest in those experiences, play a central role. In terms of pedagogy, the process of 're-invention' is a 'bottom-up' rather than a 'top-down' approach. Events and persons from the real world, wherever possible, are part of teaching and learning.

Learning experiences are lifelike and instantly applicable to social situations.

Situated learning

The concept of 'authentic pedagogy' has been influenced by new insights into the nature of learning. Contemporary educational psychologists characterize knowledge acquired in schools as 'inert knowledge' (Brown *et al.* 1989). Schools, it is suggested, convey knowledge that is largely inflexible and unusable in real-life situations. There is, in short, no transfer between the two worlds (Simons 1990). The cause of this failure to transfer is seen as stemming from the way in which knowledge is imparted in the schools (Rogoff and Lave 1984, Carraher *et al.* 1985, Resnick 1987, Brown *et al.* 1989). Students experience the curriculum as an arbitrary set of facts or procedures that they internalize passively as listeners, without any intention of applying the knowledge they have gained.

Vygotsky (1978), Wertsch (1985), Greeno (1988), Lave (1991), De Bruijn (1993) and others argue that the acquisition of knowledge is the product of activities that take place in a particular cultural context. Knowledge is thus inseparably bound up with the social and physical environment in which it is developed and used rather than being an abstract entity. The situation largely determines the structure, content and coherence of the concepts used (Brown *et al.* 1989). In other words, knowledge is linked with developments and changes in the cultural environment. The very use of language entails ambiguity because meaning is located in situational contexts (Miller and Gildea 1987). According to this conception, learning always takes place in context. The ideas associated with this particular view of education are often summed up by the term *situated learning*.

An understanding of situated learning has led to a different view of pedagogy in that the educational context is accorded greater significance. The school constitutes a different context from that of daily life. Lave (1988) has shown that whereas there is little difference between the way ordinary people and professional practitioners learn, that way of learning differs in several respects from the learning that takes place in schools. Lave's ideas can be related to those of Resnick (1987): although, in ordinary life, working people think and act in real situations, the problems presented in schools are abstract and lack context; although in ordinary everyday life problems are often opaque, and adequate structuring is based on people's individual perceptions, problems in school contexts are clear, relatively simple, pre-structured, and usually provided with unique solutions.

Constructivism

Another movement in psychology that has influenced the concept of authentic pedagogy is *constructivism*. Notions within constructivism consider knowledge as the product of a learner's activities (von Glasersfeld 1991). Consequently, knowledge is directly associated with the individual

learner. In this context, Carpay's (1993) reference to an aphorism of the American psychologist, William James [1842–1910] that 'truth is in the making', reveals that constructivism has roots that go far back in the history of philosophy. Rather than being the result of transmission, knowledge is constructed by the learner in the sense that he or she relates new elements of knowledge to already existing cognitive structures (Bruer 1993). The reactivating of existing knowledge is a *sine qua non* in this process. Knowledge is shaped within a continually changing social context – the idea of objective knowledge is fictitious. Knowledge is created by doing, researching and actively experiencing reality. This makes it possible for reality to be represented in more than one way (Cognition and Technology Group 1990). The most important task of a teacher lies in the stimulation and coaching of a learner. In this way, the student develops an independent and active attitude of great importance for his or her functioning in a modern, dynamic society (Taylor 1992).

Empirical background

State of the art

A large-scale survey, begun in 1989, of Dutch innovations in secondary school physics, chemistry and biology resulted in the following conclusions: textbooks play a dominant role; textbooks with assignments in real-life situations (contexts) are rarely used; context-based modes of treatment of the subject-matter are rare; and whole-class instruction is the dominant (and non-participatory) mode of instruction (Kuiper 1993).

The Ministry of Education in the Netherlands recently commissioned two studies into curriculum innovation. The first study concerned mathematics, physics, chemistry and biology (Terwel *et al.* 1997), and the second, language education (Withagen *et al.* 1996). Both studies cover the last three to four decades of curriculum innovation. Data were derived from the research literature, interviews, and document analysis. The impetus for these studies was an expressed presupposition by the Dutch Ministry that curriculum innovation in most subjects might not be as successful as in mathematics.

In foreign language education the most important innovation of the last decades has been a shift from a grammatical–structural to a communicative approach, in which authentic situations and texts play a central role. Attempts are made to situate language learning in the daily life of the students. Learners are required to speak in the foreign language and, where possible, to communicate with native speakers. The emphasis is on such methods as listening to radio broadcasts, watching and discussing television programmes, and writing letters in the target language. Similar developments are found in mathematics, physics, chemistry and biology. There has been a development from the transmission of the 'structure of the discipline' toward the development of physics, chemistry and biology in 'realistic situations'.

Mathematics takes on a somewhat different position in this development. From 1960 to 1995, a set of 'European cognitivist and constructivist' ideas was the source of innovations in the Dutch mathematics curriculum, while such notions as 'new mathematics', 'structure of the discipline' and 'mastery learning' have been ignored. Emphasis has been placed on 'mathematics as a human activity', 're-invention', 'realistic mathematics education' and 'mathematics for all'. Moreover, understandings from innovation-theoretical research have been helpful in implementing these notions, especially the findings of Freudenthal (1973, 1991).

The assumption that the Dutch innovation in mathematics has been more successful cannot be definitely confirmed, although mathematics education in the Netherlands has undoubtedly been a Mecca for scholars from other countries. But the success of the innovation in mathematics must be qualified; first, because successes were also found for the other subjects, and, second, because the success of the innovation in mathematics itself may be questioned. The Dutch 'theory' of mathematics education has to prove itself on the operational level, and the implementation of the innovation still has not been completed. In this respect mathematics is similar to other subjects. However, it is the success of mathematics at the formal level (examinations and curriculum materials) that can be seen as an important factor in the positive image with which innovation in mathematics is viewed. Despite important qualifications, all respondents spoke positively about innovation in mathematics.

Characteristics of authentic pedagogy

Conceptualization in the context of pedagogy

Within the framework of authentic pedagogy there are concepts closely related to, or sometimes even based on, ideas from pedagogical reform movements, situated learning, and constructivism. The most important of these are: the meaningfulness of the learning context; the connection between learning and behaviour; knowledge as a tool rather than as a goal in itself; the significance of the interactions among learners; the influence of cultural attitudes; the idea of the learner as an active researcher; less emphasis on the teaching of facts and greater emphasis on the personal aspects of knowledge; more attention to coherent forms of knowledge as well as greater emphasis on the way in which the learner arrives at a solution; more focus on the complex problems that learners (re)structure for themselves; application of the 're-invention' principle; and the acceptance of more than one solution to an existing problem. Teaching can be shaped on the basis of some or several of these features. Thus it is not the case that education is either authentic or non-authentic: authenticity is always a matter of degree, depending on the demonstrability of the associated characteristics, but one of the most striking differences is the changing task of the teacher.

Conceptualization in the context of research

In the context of research into curriculum, teaching and learning, it is desirable to provide a clear delineation of the concept 'authentic pedagogy'. In our view, this concept has implications for three main components of teaching: *types of instruction, quality of academic tasks,* and *types of assessment.*

Newmann *et al.* (1995, 1996) distinguish three standards of authentic performance from which they derive standards for instruction and assessment tasks: (a) construction of knowledge, i.e. acquiring an organization of knowledge and higher-order thinking; (b) disciplined inquiry, i.e. asking students to develop deep disciplinary knowledge and to use processes common to disciplinary inquiry such as elaborated communication; and (c) value beyond school, i.e. the students make connections between substantive knowledge and either public problems or personal experiences. In the present study we have slightly adapted these characteristics (Roelofs *et al.* 1996). In our view 'value beyond school' should be divided into two parts: *personal value,* or 'connectedness to the students' personal worlds', and *value for the professional world.* The latter relates to what psychologists call the 'culture of practice'. In addition, we added 'in complete task-environments' to the characteristic 'construction of knowledge', because that is what situationists and constructivists emphasize when they talk about knowledge-building.

We will not mention 'disciplined inquiry' as a discrete characteristic of authentic pedagogy. This is subsumed under 'construction of knowledge in complete task-environments' and under a different characteristic which we label 'communication and co-operation'. By 'communication and co-operation' we mean the ways in which knowledge-users typically interact about knowledge, that is, by means of conversation, negotiation, and co-operation. In short, four aspects of authentic pedagogy can be distinguished:

- construction of knowledge in complete task environments;
- connectedness to students' personal worlds;
- value of learning activities beyond school; and
- co-operation and communication.

The implementation of authentic pedagogy is dependent on several factors, including changes in the classroom climate, the role of technology, and democratic decision procedures. The change-over to greater authenticity entails a far-reaching change and is therefore difficult to implement (van Essen 1990, Kuiper 1993, Newmann *et al.* 1995). King (1995) suggests that teachers at schools with shared power relations are more easily prepared to stimulate the quality of learning in the direction of greater authenticity. Authentic pedagogy also requires different methods of *assessment.* The idea of ultimate achievement gives way to image-formation in relation to the development and growth of learners (Hart 1994, Fischer and King 1995, King 1995). Student portfolios that provide an opportunity for richer, more authentic and more valid assessment of student achievement are useful (Calfee and Perfumo 1993).

The study

Research questions

In this study we examine these questions:

- According to teachers' and students' perceptions, to what extent were the characteristics of authentic pedagogy found in the first grades of Dutch secondary education 1 year and 3 years after the implementation of the national curriculum?
- To what extent did textbook-use reflect the characteristics of authentic pedagogy?
- To what extent were conditions for authentic pedagogy met?

Research methods

The study was an extensive, multiple case study of the implementation of authentic pedagogy. During three school years, 1993–1996, three large Dutch secondary schools (between 1000–1400 students) were subjected to an in-depth inquiry. These schools were expected to implement the state-mandated innovations of the 1993–1994 core curriculum.

Instruments

We used three indicators for authentic pedagogy: a situation-specific questionnaire for teachers; two situation-specific student questionnaires for mathematics and English; and data from classroom observations and interviews on teacher textbook use. All instruments covered the four characteristics of authentic pedagogy.

The three-section teacher questionnaire solicited opinions, intentions, and reported teacher behaviour with regard to the characteristics of authentic pedagogy as defined above. The first section contained a short description of a learning situation in which the characteristics of authentic pedagogy are visible (i.e. from a researcher's point of view). The questions concerned the instructional processes in which teachers engage, homework assignments, and their means of assessing learning outcomes. Responses to the questions were on a six-point scale (1 = never/fully disagree, 6 = always/fully agree).

Within each characteristic the questions made up one scale. Data on scale items and scale reliability are displayed in table 1. Typical activities with reference to *construction of knowledge* include: use of tasks with different possible solutions; giving open-ended assignments, accompanied with criteria about the products; independent collection of information by students. *Connection to students' personal worlds* referred to such activities as analysing students' experiences during the introduction of new content, choice of lesson topics from the students' personal worlds, and possibilities of talking and writing about subject-related personal experiences. *Value*

beyond school is reflected in the following types of activities: attention to recent developments in society; media (newspaper, television, radio) use; assignments addressing societal problems; and presenting results to out-of-school experts. *Cooperation and communication* refers to activities like: having students work together in groups on collective tasks; teacher acting as a facilitator; and students playing an important role in assessing the results of collective tasks.

Teachers were also asked about the conditions for authentic pedagogy and about their problems in implementing authentic pedagogy. The following subjects were covered: suitability of their textbook in designing open-ended tasks; possibilities for using different media (newspaper, radio, television); support at the school level (flexible timetable, co-operation among subject departments); and feasibility of authentic pedagogy with regard to student characteristics.

A second situation-specific questionnaire on English and mathematics was developed for the students. The questions concerned students' perceptions of teaching behaviour. Each question was preceded by a description of an imaginary classroom situation that highlighted a characteristic of authentic pedagogy. Subsequently, the student indicated the frequency of the presented teaching activity in his or her own classroom. Examples of different questions are: 'Do you ever start learning activities without an assignment from your teacher?' 'Do you also get complex tasks that require you to put different pieces of information together?' The students responded on a five-point scale, from 1 ('never') to 5 ('very often'). Both questionnaires made up one scale, labelled *authentic pedagogy* (see table 2).

In addition to the questionnaires, we interviewed nine mathematics and English teachers. First, the teacher was given a short transcription of his or her assignment practice to initiate the interview. In addition, aspects of daily textbook use were investigated, representing all four characteristics of authentic pedagogy. Teachers were asked to what extent they took measures to support authentic pedagogy. They were also asked about their own opinions and motives in teaching English and mathematics according to standards of authentic pedagogy and the role of the textbook used.

Research situation and sample

The schools in this study were different in size and used different policies for assigning students to classes. In school A, students were assigned to heterogeneous classes, based on the expected level of subsequent secondary education. The school is situated in a socially deprived area and has a relatively large number (10%) of non-native speakers within its population of 1400 students. In school B, the student population (1000 students) consisted of native speakers of Dutch. In the first year students were placed in multi-grade classes: students of a given expected level and of the level next above were placed in one class. In school C, students from one expected level were placed in one class, although in 1996 they were also placed in multi-grade classes. In addition, schools differed in their religious identity.

The teacher questionnaire was administered to the complete teaching staffs of all three participating schools; a total of 254 and 317 teachers, respectively, participated in the teacher surveys in 1994 and 1996. The response rates for school A were 20% in 1994 and 36% in 1996, for school B 71 and 79%, and for school C 84 and 90% Among the reasons offered for not returning the questionnaires were: difficulty of questions, unreality of questions, and lack of time.

In 1994 half of the first grade students received the mathematics questionnaire ($n = 438$), the others the English questionnaire ($n = 465$). In 1996 first to third grade students received questionnaires ($n = 1014$), half of them on English, half of them on mathematics ($n = 930$).

In the fall of school year 1994–1995 nine teachers for both subjects were visited and interviewed by research assistants.

Analysis

We selected for analysis only those teachers who taught in the first stage of secondary education and who completed both the 1994 and the 1996 questionnaires ($n = 89$). Changes in the reported behaviour within schools were analysed with t-tests for paired observations. Differences in changes between schools were analysed with variance-analyses of difference scores, with school as a factor.

Students' perceptions of their teacher's teaching behaviour were based on data from the first to the third grade. Differences between schools were tested by means of a one-way analysis of variance on the data of two school years, with school (A, B and C) as a factor. Changes over the two school years and between schools were tested with a two-way analysis of variance on the grade one data, with research year (1994 and 1996) and school (A, B and C) as factors.

To determine the relation between teacher and student perceptions, all data from the first and second research years were pooled. The data from the second and third grades (relating to 1996) were also included in the analysis. First, class means were calculated for the student questionnaire scores for English and mathematics. These are the scale scores for 'authentic pedagogy' (English, 22 items, $\alpha = 0.78$; mathematics, 20 items, $\alpha = 0.77$). In this way more class averages per teacher would be created, depending on the number of classes that completed the questionnaire for a given teacher. Subsequently, each set of class scores was related to a corresponding teacher score on the teacher questionnaire. These latter scores are the total scale scores for 'authentic pedagogy' (48 items, $\alpha = 0.91$). Product-moment correlations were computed between student scores and teacher scores for authentic pedagogy.

All statements from the interviews on textbook use were transcribed, coded and counted using the methods suggested by Miles and Huberman (1994). Questionnaire data from teachers and students and interview data about teachers' textbook use were combined, to allow triangulation of conclusions.

Results

Part 1: teacher perceptions of authentic pedagogy

Table 1 presents the data for the four scales of authentic pedagogy as perceived by the teachers. In the description below we will comment on the various items that comprise the scales. Individual item means will not be presented.

In general, the results show that knowledge-construction takes place only occasionally (means 3.3 and 3.4 for 1994 and 1996 respectively).

Table 1. Implementation of characteristics of authentic pedagogy (means and standard deviations).

Scale and item number	Total (n = 89)		School A (n = 13)		School B (n = 34)		School C (n = 42)	
	1994	1996	1994	1996	1994	1996	1994	1996
Authentic pedagogy (48 items, α = 0.91)								
Construction of knowledge in complete task environments (15 items, α = 0.78)	3.3 (0.6)	3.4 (0.5)	3.6 (0.5)	3.5 (0.5)	3.4 (0.4)	3.4 (0.4)	3.2 (0.6)	3.3 (0.7)
Connection to students' personal worlds (10 items, α = 0.81)	3.6 (0.7	3.6 (0.6)	3.8 (0.5)	3.7 (0.7)	3.7 (0.8)	3.7 (0.7)	3.5 (0.6)	3.6 (0.5)
Value of learning activites beyond school (4 items, α = 0.68)	2.9 (0.7)	3.0 (0.6)	2.9 (0.5)	2.8 (0.5)	3.2 (0.8)	3.3 (0.8)	2.7 (0.5)	2.8 (0.5)
Co-operation and communication (7 items, α = 0.71)	3.2 (0.8)	3.3 (0.7)	4.0 (0.6)	3.9 (0.8)	3.3 (0.8)	3.3 (0.7)	2.9 (0.8)	3.1 (0.7)

Note. 1 = never; 2 = almost never; 3 = sometimes; 4 = often; 5 = very often; 6 = always. Total scale for authentic pedagogy includes teachers' intentions regarding authentic pedagogy (12 items).

Table 2. Scale means for authentic pedagogy, on student questionnaires for English (as a foreign language) and math (means and standard deviations).

Activities authentic pedagogy	English[†]		Math[‡]	
	1994 (n = 465)	1996 (n = 1014)	1994 (n = 438)	1996 (n = 930)
Grade 1 (n English 334, n math 294)	2.2 (0.4)	2.1 (0.4)	2.3 (0.4)	2.4 (0.4)
Grade 2 (n English 302, n math 350)	—	2.2 (0.4)	—	2.4 (0.4)
Grade 3 (n English 378, n math 286)	—	2.1 (0.5)	—	2.1 (0.4)

Note. scale points: 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = very often;
[†] = 22 items α = 0.78,
[‡] = 20 items, α = 0.77.

Teachers undertook some activities that characterize knowledge-construction – mainly the activation of the students' thought processes by using scaffolds instead of complete answers in the case of students' questions, calling on student expertise, and focusing on the whys and wherefores of solution processes. Teachers attached greater importance to the way a solution had been arrived at than to its correctness. However, verbalization of the way in which a problem was solved took place only occasionally. This was a striking result in view of the importance the teachers attached to students knowing how a solution can be arrived at and why a solution is correct. It is possible that time limitations played a role in this process, leading to situations in which the teachers themselves took the responsibility for the verbalization of thought processes.

The learning situations did not contain complex or complete assignments with integrated subject-matter. Teachers rarely asked for research activities that required connections with other subjects. Independent collection of information by students was not clearly indicated. Neither the teaching nor the assignments and assessment procedures called for subject integration.

Between 1994 and 1996, no large shifts in perceived teaching behaviour could be observed. For school A, a stronger orientation was found toward the 'construction of knowledge in complete task environments' than for schools B and C, although a significant increase in this respect can be observed for school C.

On average the teachers endorsed the importance of 'relating to students' personal worlds'. Measures to achieve this were taken rather frequently (means 3.6 both in 1994 and in 1996). A closer inspection of item means revealed that what matters is how far teachers are prepared to go in this respect.

In clarifying instructional content, teachers often chose examples from daily life. According to the teachers, students often had space to discuss their own experiences in relation to the subject. The teachers' choice of subjects taken from daily life for their lessons was somewhat less frequent. The selection of problems related to daily life ranged from occasional to frequent. Slightly less frequent were teachers' choices of subjects in which students take a personal interest. Teachers occasionally analysed student experiences of daily life by introducing new topics. The same held for giving students space to express their personal opinions in the context of controversial problems. Teachers' choices of homework assignments directly related to daily life were rare. Situations in which students had a say in determining the lesson content occurred very rarely according to teachers at the three schools.

Overall there were few changes in the process of relating teaching to students' worlds during the implementation of the core curriculum. Differences between teacher scores for the three schools are non-significant in 1994 and 1996.

Teachers occasionally paid attention to the 'relevance of learning beyond school', given the average score of 3.0 on the corresponding sub-scale. Returning to the individual items, here too we notice that the more dramatic the measures, the less they are applied. For example, on average

there was regular attention to current developments in society as well as to the relevance of subject-matter to professional contexts and daily life. By contrast, media were only sparingly used in teaching that dealt with professional situations and current developments. The most extreme way of focusing on out-of-school applications involved tasks that dealt with social problems, from which the results were subsequently submitted to a person or an institution outside the school. This type of practice was extremely rare.

A comparison between schools for the years 1994 and 1996 shows that school B paid most attention to the relevance of instruction to out-of-school situations (1996: $F = 6.1$, $df = 285$; $p = 0.00$). The differences between the schools remained the same in 1996. These differences are explained mainly by the increased attention at school B to media and professional situations. The relative lack of focus on media at school C (mean 2.4) can be explained by the religious identity of the school, which discourages the use of certain media (television in particular).

The fourth aspect of authentic pedagogy, 'co-operation and communication', did not yield a general picture for the three schools, because differences between school A on the one hand and schools B and C on the other were too great. Both in 1994 and 1996 the learning situation at school A was more often characterized by 'co-operation and communication' (mean 3.9) compared with the other schools (1996: $F = 5.9$, $df = 285$, $p = 0.01$). At school A co-operation in groups occurred fairly frequently, with teachers acting as background facilitators. Assessments of the results of group processes were, according to the teachers, the result largely of consultations between teacher and students. However, monitoring of group-work progress occurred much less often as a student task than might be expected. Also, interdependence was created only sparingly in group work, contrary to what might be expected for co-operative learning. This lack of interdependence was even greater for the other schools.

As mentioned earlier, there was less co-operation and communication at schools B and C. Where co-operation and communication was seen or described, the teacher's role was slightly more prominent than at school A. This was particularly true for school C, although this school did show an increase in co-operative learning ($t = -2.2$, $df = 41$, $p = 0.05$). At school B students were given a more important role in the assessment of collective tasks. In other respects there was little change for schools A and B, and the respective differences remained.

Conditions for authentic pedagogy

Teachers' actual teaching behaviour was partly determined by the degree to which some particular conditions were fulfilled. Table 3 provides a picture of the extent to which this was the case, especially for the support of authentic pedagogy.

Fulfilling the necessary conditions for a learning environment in which knowledge-construction is supported was not an easy task. First, the textbooks did not leave much room for providing students with problems

Table 3. Perception of conditions and problems regarding authentic pedagogy (means and standard deviations).

Item number	Total (n = 89)		School A (n = 13)		School B (n = 34)		School C (n = 42)	
	1994	1996	1994	1996	1994	1996	1994	1996
Instructional time blocks are sufficiently long to enable the accomplishment of multi-response tasks	2.6 (1.4)	2.7 (1.4)	3.2 (1.3)	3.0 (1.5)	2.4 (1.3)	2.9 (1.5)	2.5 (1.5)	2.5 (1.2)
Forms of authentic pedagogy are supported on school level (flexible time table, co-operation between subject departments)	2.9 (1.3)	2.8 (1.3)	3.3 (1.4)	3.1 (1.7)	2.7 (1.2)	2.7 (1.1)	2.9 (1.4)	2.9 (1.2)
School offers adequate possibilities to use media (newspaper, radio, television)	3.0 (1.5)	2.6 (1.4)	3.3 (1.3)	2.5 (1.3)	4.3 (1.0)	3.6 (1.3)	1.8 (0.9)	1.9 (1.0)
Text book leaves space to design open-ended tasks which allow maximum freedom for students to work	3.0 (1.2)	3.1 (1.2)	3.1 (1.1)	2.8 (1.1)	3.3 (1.2)	3.5 (1.1)	2.8 (1.2)	2.8 (1.3)
School facilities enable students to collect information independently	3.7 (1.5)	3.4 (1.3)	4.3 (1.4)	3.2 (1.3)	4.1 (1.6)	4.0 (1.2)	3.2 (1.4)	3.1 (1.4)
The text book in use encourages the choice of topics from everyday life	4.1 (1.4)	4.0 (1.1)	4.5 (1.0)	4.0 (1.0)	4.5 (1.2)	4.3 (1.1)	3.6 (1.5)	3.7 (1.1)
Lesson content and lesson design are highly dependent on the text book used	4.4 (1.4)	4.5 (1.4)	4.9 (1.0)	4.7 (1.0)	4.4 (1.5)	4.4 (1.4)	4.3 (1.5)	4.6 (1.4)

Note. 1 = fully disagree, 2 = strongly disagree, 4 = slightly agree, 5 = strongly agree, 6 = fully agree.

that allowed a real freedom for their solution. The instructional time-blocks were not seen as long enough to accomplish multi-response tasks. According to teachers from school B, school facilities that enabled students to collect information independently were available to a reasonable degree, but teachers from school C were less satisfied in this respect (1996: $F = 4.7$, $df = 2$, 85, $p = 0.01$). Teachers from school A showed less satisfaction in the course of two years ($t = -2.8$, $df = 12$, $p = 0.02$). However, the text-book used was seen as offering the opportunity to choose subjects from the real world; school B (mean 4.3) especially, and to a lesser extent school A (mean 4.0), showed a fairly high degree of satisfaction in this respect. Less satisfaction was shown at school C (mean 3.7; 1996: $F = 3.2$, $df = 2$, 84, $p = 0.04$).

Possibilities for media use also make up an important precondition for teachers who wish to give attention to the value of learning activities that go beyond the school. There were significant differences between the schools in this respect (1996: $F = 21.5$, $df = 2$, 85, $p = 0.00$). In general, the

possibilities for media use were regarded as limited, and deteriorated
between 1994 and 1996 ($t = 2.8$, $df = 84$, $p = 0.00$). The was especially in
the case of schools A ($t = 2.2$, $df = 11$, $p = 0.05$) and B ($t = 3.3$, $df = 31$,
$p = 0.00$). In 1994 school B teachers were relatively positive about poss-
ibilities of media-use.

Implementing authentic pedagogy requires supportive measures at
school level, including flexible timetables and co-operation between depart-
ments. In general, teachers stated that forms of authentic pedagogy were
not supported at school level. This situation remained unchanged over the
two school years investigated.

Finally, teachers agreed with the statement that lesson content and
lesson design are highly dependent on the textbook used. There was no
change in this point of view during the period 1994–1996.

The differences between schools B and C were significant. Four item-
scores differed significantly between the schools: the possibilities for media
use, the amount of room for open-ended tasks in the textbook, and school
facilities for independent collection of information, were all rated higher in
school B than in C. Furthermore, teachers from school B were more
inclined to say that the textbook used encouraged the choice of topics
from everyday life.

Part 2: student perceptions of authentic pedagogy

Table 2 reports the results of the student questionnaires from the first three
grades in the period between 1994 and 1996. The table reports the mean
scores on the overall scale for authentic pedagogy for English and math-
ematics. With regard to composition, the scales were not completely
parallel, because a subject-specific elaboration was made of the concept
'authentic pedagogy'.

In general, we conclude that first to third-grade students did not
characterize English classes as being oriented toward what we define as
authentic pedagogy (means 2.1 both in 1994 and in 1996). Thus, in English,
teachers rarely used topics from different school subjects and students
rarely started activities on their own initiative which supported indepen-
dent learning. Students mainly carried out assignments set by the teacher.
Complex assignments in which reading and writing were combined did
occur, but very rarely. The students' own experiences and interests played
little part in lessons, they were hardly ever allowed to bring objects from
home for use in the lesson (e.g. compact disks), assignments for an out-of-
school audience almost never occurred, and they did not work on joint tasks
on a frequent basis.

With reference to mathematics lessons, first to third-grade students
again reported that teachers rarely engaged in authentic pedagogy (means
2.3 and 2.4 for 1994 and 1996). In general, the classes in mathematics were
not much more authentic than classes in English but, on some aspects of
authentic pedagogy, the item-scores were higher than for English classes.
Thus, students reported that they sometimes performed complex assign-
ments requiring a combination of information in mathematics classes,

whereas in English students noted such assignments only rarely. Another difference relates to the extent to which teachers used topics from different school subjects: the frequency of such inclusion was higher during mathematics classes than during English classes. On the other hand, students more often reported assignments in English with a real-life character than did their peers in mathematics.

Both English and mathematics classes in grade 1 did not become much more authentic during the implementation of the national curriculum. Differences between schools were both significant for mathematics and for English in 1993–1994 ($F = 47.8$, $df = 2$, 731, $p = 0.00$; $F = 53.4$, $df = 2$, 797, $p = 0.00$). Teachers from school A had higher scores for authentic pedagogy in both subjects than did their colleagues from schools B and C. In 1995–1996 the levels of authentic pedagogy varied across schools and grade levels for both English and mathematics (F mathematics $= 4.2$, $df = 4$, 921, $p = 0.00$; F English $= 4.4$, $df = 4$, 1005, $p = 0.00$).

Relationship between student perceptions and teacher perceptions

The correlation between the class means for authentic pedagogy on the student questionnaire and the corresponding teacher score on the teacher questionnaire was relatively high for mathematics ($r = 0.76$, $p = 0.00$, $n = 36$). In other words, the differences between teachers, as established by the teacher questionnaire, were confirmed by the results for the student questionnaire. But, if we compare the mean scores on 'authentic pedagogy', we noticed a difference between the student judgements (see table 2) and the teachers' judgements (see table 1). Independent of the differences in the scales used (a five-point scale for students, a six-point scale for teachers), teachers appeared to present a more positive picture of themselves than did their students.

This is also true for the English classes. The teachers indicated a higher frequency of activities that can be characterized as authentic pedagogy. However, in the case of the English classes there was a zero correlation between the student questionnaire and the teacher questionnaire scores ($r = 0.00$; $n = 37$).

Part 3: Textbook use
Construction of knowledge
In our interviews we gathered data concerning aspects of daily textbook use related to all four characteristics of authentic pedagogy.

Both English and mathematics classes can be characterized as providing practice in basic skills and strategies. But, the English and mathematics textbooks used in the schools rarely offered complete assignments and learning situations in which students had a say. Situations requiring compensating strategies to overcome a lack of fluency in English occurred infrequently and, according to the teachers, the mathematics textbooks

infrequently offered room for students to develop their own solution strategies to a problem.

In explaining these teaching practices, the English and mathematics teachers claimed that first-grade students, and especially less able students, benefited from learning the basics, before being confronted with complex tasks. In this respect teachers 'covered' their textbooks. Another reason for not using complete tasks was lack of time, because of an overloaded curriculum. However, English teachers did adapt their textbooks in one respect. Although grammar was not emphasized in the teaching of English, most teachers preferred to teach some basic grammar rules before students began to communicate. In this way teachers acted conservatively in the light of the central characteristic of modern textbooks which use grammar only to support communication. Although complex tasks did not occur, there were indications that words and idioms were learned in the contexts of whole stories. In mathematics we noticed an orientation to the school subject itself. Mathematical strategies and concepts were only occasionally connected to other school subjects. In other words, these findings suggest that, in learning English and mathematics, one cannot speak of construction of knowledge in complete task environments, because of textbook characteristics, the way textbooks are used, and specific objections to knowledge-construction.

Connectedness to students' personal world

In mathematics we investigated the extent to which students can get a clear picture from the learning situations presented in the textbooks. The use of concrete imaginative materials is also part of connecting content to students' personal worlds. In addition, student determination of parts of lesson content is an aspect of authentic pedagogy.

Textbooks themselves, and the way they are used, did not reflect an orientation to students' personal worlds in all respects. The learning situations in mathematics textbooks were often considered imaginative because of the inclusion of many real-life illustrations – which teachers did use. However, teachers did *not* use concrete materials in their classes quite as often. Students did *not* have a say in determining class content and procedure, beyond what was planned in the textbook. Moreover, teachers regarded such participation as undesirable in the first grade, because the curriculum was already overloaded.

In English classes students should recognize English from their own daily experience (e.g. television, computers). Beyond that, students should be allowed to read, write and speak on their own terms. But the English textbooks, to which the teachers adhered, did not offer room for students' initiatives. Teachers also complained about a lack of books in the school library. In addition they claimed that students have to master basic reading and writing skills before they can be given freedom in choosing material for listening, speaking, reading and writing. Teachers sometimes made use of English from the school environment, mainly by telling anecdotes from out of school. Their objections to taking account of the students' personal world included the changing nature of that world, differences among

students, lack of quality of (text) materials brought from home, and the argument that 'students should transcend their own world'.

In sum, for many reasons teachers were not willing or able to take students' worlds into account, beyond that which was already addressed in the textbooks.

Value of learning activities beyond school

The relevance of learning English and mathematics for situations beyond school can be expressed in the perceived usefulness of the learning situations found in textbooks. Beyond that, in English, students should be able to fulfil real communicative needs, such as being able to discover information they need. Attention to language customs in English-speaking countries, especially those helpful for out-of-school users of mathematics, is also important.

We noticed a difference between the two subjects. English teachers were more satisfied with the usefulness of the learning situations in their texts than were the mathematics teachers. According to the teachers, everyday use of English was depicted adequately in textbooks, although only UK English was used.

Teachers from school A, but not those from schools B and C, took initiatives to make mathematics more useful, including a project on integrating school subjects. Most teachers in the three schools used examples from daily life to explain basic knowledge. Some had doubts about the importance of relating to the world outside on the supposition that the use of many contexts could be confusing for students.

Complete authenticity in communication would mean that students could have direct face-to-face contact with English-speaking people. Teachers were not asked to comment on this argument. We only looked at textbook situations. When asked to communicate in textbook situations, students were rarely asked to meet a real communicative need.

We may conclude that relevance of learning for out-of-school situations was addressed as far as the textbooks permit. But, except in the case of school A, teachers did not go beyond their textbooks.

Co-operation and communication

Teachers were asked if they used learning situations in which students were dependent on each other to achieve learning goals.

In English, there was evidence of this mutual dependence. Students practised English expressions and short conversations in pairs, as planned in the text and student workbook. And, in both English and mathematics classes, students were allowed to discuss answers to individual assignments with classmates. But, according to most of the mathematics teachers, the texts offered little room for co-operation among students. In this sense one cannot speak of communication of knowledge.

Teachers from school A encouraged their students to help one another, especially when teacher advice was not available, by creating groups and communicating rules for giving and receiving help. These teachers sometimes changed textbook assignments in such a way that students became mutually dependent. In schools B and C none of these measures were

taken. Indeed, they sometimes replaced mutual oral exchange of information by mutual reading-aloud of previously prepared written sentences. Teachers indicated that they wanted their students to learn and practise standard English expressions they can use in the future.

The teachers mentioned certain conditions for collaborative learning situations that were usually not met: social skills, sound classroom management, availability of a partner, a joint task, and division of tasks.

In sum, we conclude that in school A, but not in schools B and C, the use of textbooks reflected, to some extent, a climate of co-operation and communication.

Conclusions and discussion

We conclude from the results of this research that, in the context of the national curriculum for the first stage of Dutch secondary education, the characteristics of authentic pedagogy were not found to any real extent. Our conclusions are consistent with the Dutch studies of Kuiper (1993), Withagen *et al*. (1996) and Terwel *et al*. (1997). These findings also match those of Newmann *et al*. (1995, 1996), who indicates that an 'authentic pedagogy' was observed in a very small minority of the 24 US schools he and his colleagues investigated. In this respect, the ideas and developments being instigated by small, enthusiastic groups of subject specialists, curriculum developers, teacher educators and supervisors seem to be far ahead of school reality.

Even the assumption that Dutch innovation in mathematics has been successful could not be substantiated to any major degree. The inspiring work of Freudenthal, who can be seen as a proponent of authentic pedagogy before his time, has apparently not resulted in major innovations at the operational level in all or most schools in the Netherlands. However, two positive results of his work can be mentioned. First, positive effects on processes and learning outcomes were found in intervention studies into authentic pedagogy in secondary mathematics (Terwel 1990, Terwel *et al*. 1994). Second, the results of the Third International Mathematics and Science Study (TIMSS) show that Dutch students perform well (Kuiper *et al*. 1997), but indications that allow policy makers to attribute these results to the 'realistic mathematics and science movement' in the Netherlands are scarce.

One of the striking results of our study was that, as far as authentic pedagogy is concerned, students were less positive about their teachers' pedagogy than were the teachers themselves. Whereas teachers indicated that they regularly or often practised certain aspects of authentic pedagogy, the students indicated that teachers did so infrequently or very infrequently. It is possible that teachers indicated a higher frequency because they totalled their activities for all classes whereas students focussed on one class per teacher. Another possibility is that teachers and students had different conceptions regarding aspects such as 'everyday life' and 'value beyond school'. What was regarded by teachers as part of everyday life may turn out to be alien to students.

Nevertheless, there were indications that the teachers created learning situations that may be characterized in terms of 'knowledge construction'. The teachers themselves claimed that they used student expertise and encouraged students to find their own solutions. According to the teachers, attention during learning tasks was often focussed on solutions. However, in textbook use this was rarely the case. Individual student research, reports of findings, and integration of instructional content – in short 'complete task environments' – are rare, partly because of the textbook used. And, as mentioned above, students in both mathematics and English classes only rarely recognized situations in which their teachers tried to encourage them to construct knowledge. According to the students, integration of knowledge elements from several subjects was practically non-existent. Data on textbook use for English confirmed these findings: teachers tended to concentrate on teaching basic skills, not on integrating skills.

From the teachers' point of view, a somewhat more positive picture emerges in relation to the 'connection of learning to students' personal worlds'. Teachers were prepared to take measures that fitted in with the textbook; thus, in the explanation of instructional content, examples from the everyday life of the students were included. However, teachers frequently adhered to their textbooks and were not inclined to use the students' own experiences. Student contributions to classes based on everyday life were realized to an even lesser extent. Here too, the difference with student perceptions was notable. According to the students, everyday life was mentioned infrequently in lessons. But, as stated above, there may be clear differences of views concerning the real world between teachers and students.

In regard to the 'relevance of learning to situations beyond the school', we noticed that the more far-reaching the measures, the less frequently they were seen. According to the teachers, fairly regular attention was paid to current developments in society, as well as to the relevance of instructional content to professional and real-life situations. The most far-reaching method of focusing on out-of-school application was assigning tasks that involved some kinds of social problems where solutions were subsequently submitted to an outside institution or person. This hardly ever occured, partly because such teaching has to transcend the textbooks, a task that consumes time in an already overloaded curriculum. Contacts with outside professionals were practically non-existent. Authentic media (such as radio, newspapers or television) were used very rarely as teaching aids in teaching and learning. Again, the students' views were even less positive in this respect.

The fourth characteristic of authentic pedagogy, 'co-operation and communication', was observed to different degrees. School A showed clear initiatives to support co-operation among students. This was much less the case for the other schools. In particular, tasks involving mutual dependence were very rare, as seen both in the questionnaire data and in the data on textbook use. Such aspects of communication as presenting peers with the results of learning assignments or jointly performing roles that mirror social roles occurred only occasionally. At all three schools,

knowledge was rarely seen as being the product of mutual communication and negotiation. Again, students recognized elements of co-operation and communication during the lessons less often than their teachers.

There were differences among the three schools, although these were not striking. On the authentic-formal/traditional dimension, school C was closest to a traditional learning environment, whereas school A lay slightly more in the direction of authentic pedagogy. For most characteristics school B occupied a middle position, except for the value-beyond-school characteristic.

A comparison between the years 1994 and 1996 shows that there were few changes in the degree to which teachers achieved the characteristics of authentic pedagogy. This is not surprising. The innovations were only in their first years of implementation, given their initiation in 1993. There may simply have been not enough time for the necessary conditions for implementing an authentic pedagogy to emerge: time is needed to explore the multiple perspectives, research findings and, especially, the practical experiences *and* to support the extensive deliberations needed to change classes into 'communities of inquiry'.

Several reasons for the less-than-wholehearted pursuit of authentic pedagogy emerge from the a consideration of the issue of implementation time. Authentic pedagogy requires school organizations to fulfil some particular conditions. The teachers saw the degree to which such conditions were met as either limited or low. For example, it is desirable to make scheduling adjustments, including the use of extended instructional time-blocks, in order to reserve time for cross-disciplinary activities. School B maintained a 50-minute schedule, whereas school A reduced its teaching periods to 45-minutes.

Other obstacles exist in the form of teaching resources and textbooks. Teachers indicated that their classroom practices were strongly influenced by their textbooks. The question is how far existing textbooks are based on or support forms of authentic pedagogy. According to the teachers, this was the case only to a limited extent. How flexible are textbooks in the way they relate current social developments or students' personal worlds to the learning situation? Here, we are confronted with the problem that the real world, as seen by the designers of teaching aids, does not necessarily coincide with the real world of the students. While media and interactive programmes such as electronic mail and 'CSILE' (Scardamalia *et al.* 1989) could have been investigated, there is a general lack of hardware and software in Dutch schools. But, it also appears that teachers do not appreciate the opportunities that media can provide (Bronkhorst and Rouwen 1996, Kleis Jager 1996).

In addition, learning tasks presumed to have value beyond the school presuppose contacts with external institutions – which are difficult to realize in practice. In the 'Community of learners' programme (Campione *et al.* 1995) such contacts are effected by the use of e-mail between students and outside experts (e.g. biologists). Contacts of this kind were unknown at the schools we investigated, but they raise the following question: Who should be responsible for such contacts, the individual teacher, or the subject department? Learning by means of complex tasks requires

collaboration among various departments as well as support at the school level.

In addition, teaching large numbers of separate subjects, each with their own programme, hinders authentic pedagogy. Current forms of teaching require control and efficient management, as does the organization of Dutch schools: there are separate classrooms for each subject; short lessons, followed by homework checked in subsequent lessons, are typical; and there are strict limitations on time-consuming contacts with the outside world. As long as this situation prevails, the implementation of authentic pedagogy will remain difficult. This situation may change when 'authentic learning outcomes' (Newmann *et al.* 1995, 1996) are incorporated as *goals* for schools.

Finally, there remains the question of whether all of the characteristics of authentic pedagogy should be found in teaching and learning *at all times*. There may, for example, be sound reasons to not create complex learning environments that incorporate discovery learning, re-invention, and self-regulated learning. With this observation we arrive at the very heart of the question of whether learning should take place 'top-down' or 'bottom-up', be deductive or inductive, formal or informal, and whether it should concentrate on the structure of the discipline or on authentic situations/contexts, or on transmission or construction (Walker 1990, 1992).

We do not share the position of Anderson *et al.* (1996a, b), who strongly reject constructivism and situated learning without acknowledging the limitations of information-processing as an incomplete framework in which learning is viewed as a passive, atomistic and mechanical process (Mayer 1996). But, at the same time, we do not accept the ideas behind radical constructivism – that knowledge can only be constructed by the student, that learning can only happen in complex situations, and that transmission by the teacher is impossible. Although constructivism undoubtedly has a valuable contribution to make to curriculum innovation, we are uneasy at the thought that so many subject-matter specialists and curriculum designers embrace – almost uncritically – a form of 'radical constructivism'.

Inspired by the work of Mayer (1996) and our results from other studies[2] we are searching for a third, more practical option. In this third way there is no dogmatic rejection of 'bottom-up' or 'top-down' approaches. In accentuating the strategic aspects of teaching and learning from 'real-life contexts', we can overcome this dichotomy. In this option the process may start from the 'bottom' of the real-life world and proceed by designing intermediate models toward more formal structures and concepts. This is a process of modelling in which teachers play a central and guiding role. Teachers are *cognitive guides* as well as role models, and students are *sense-makers*. Thus, we recommend a combination of whole-class instruction, discussion methods, guided re-invention, supervized participation in meaningful academic tasks, and working in co-operative groups. There are moments when it may be necessary to provide guidance to students who do not have sufficient prior knowledge, or the required

skills and meta-cognitive strategies. In our interviews, teachers indicated that some students lacked these prerequisites. In such cases the teacher can undertake the role of expert and provide scaffolding for those students who cannot cope with a given task independently. If such student needs are ignored, friction is created between offered guidance and needed guidance (Simons 1995).

We conclude that the school of the future is faced with the task of creatively combining traditional forms of education with authentic pedagogy. This task implies a high degree of flexibility and the courage to explore new ways of teaching. Experiments based on sound principles of educational research seem to represent the most obvious instruments of progress in this respect. Thus, it would be interesting to investigate which elements of authentic pedagogy can be realized and under what conditions this realization may be accomplished.

Some methodological problems

Some methodological problems may threaten the validity and reliability of this multiple case study. In view of the low response rate for the teacher questionnaire at school A we must place some question marks against the picture obtained for this particular school. Also, the overall means obtained are distorted by the unequal numbers within the schools. However, it should be pointed out that our results are confirmed by other investigations (Kuiper 1993, Newmann et al. 1995, Withagen et al. 1996, Terwel et al. 1997).

Another problem lies in the fact that the practices of authentic pedagogy were, to some extent, examined on the basis of standards that we set. A different method could have involved the mapping of the teachers' own views on teaching and learning and the way in which these views reflect authentic pedagogy. However, we opted for an elaboration of the characteristics of authentic pedagogy from three data sources: teacher and student questionnaires about teaching and learning activities, and interviews on textbook use. This ensured the possibility of triangulation, and the use of a uniform terminology.[3]

Finally, it must be kept in mind that the main study reported in this paper was a descriptive one. No interventions were undertaken. We described the innovation as seen through the eyes of the teachers and students. It turned out that the changes in practice were very modest and no data about the effects of learning are available. However, from our intervention studies, we conclude that aspects of authentic pedagogy, if adequately developed and supported, can be implemented and can result in significant learning gains. Comparing the results from the present descriptive case study and our earlier intervention studies, we learn that changes in classroom processes can be accelerated by providing teachers and students with experimental curriculum materials and by giving support through training in the use of strategies.

Notes

1. In Dutch secondary schools, grade 1 consists of 12/13 year-olds, grade 2, 13/14 year-olds, and grade 3, 14/15 year-olds.
2. Experimental data about classroom processes and learning results are scarce. However, there are well-documented intervention studies in language and mathematics education in the Netherlands. Thus Terwel's research group has been involved in a series of projects for more than 15 years. In those projects a pretest-posttest control group design has been used. The number of students in the various projects ranged from 400 to 800. The experiments were conducted in real school settings.

    The first project was entitled *Mixed ability teaching in mathematics for 12- to 16-year-olds*. A mathematics curriculum, based on the ideas of Freudenthal, was developed by the Stichting Leerplan Ontwikkeling [The Dutch National Institute for Curriculum Development]. The main characteristics of this curriculum are learning in real-life contexts and learning in small co-operative groups. The outcomes of the study showed that students in the experimental groups outperformed the students in the control group (effect size 0.22). However, indications were found that low-achieving students profited less from co-operative learning than high-achieving students (Terwel 1990, van den Eeden and Terwel 1994).

    The second project was entitled *Adaptive instruction and co-operative learning in mathematics for 12- to 16-year-olds*. An instructional model, the AGO-model, was developed, in which whole-class instruction, learning in small co-operative groups and individual work were combined. This model can be described as a whole-class model that allows for student diversity through daily *ad hoc* remediation and enrichment with small groups. The AGO-model consists of the following stages:

    - Whole-class introduction of a mathematics topic in real-life contexts;
    - Small-group co-operation in heterogeneous groups of four students;
    - Teacher assessments: diagnostic test and observations;
    - Alternative learning paths depending on assessments consisting of two different modes of activity: (a) individual work at individual pace and level (enrichment), in heterogeneous groups with the possibility of consulting other students, or (b) opportunity to work in a remedial group (scaffolding) under direct guidance and supervision of the teacher;
    - Individual work at own level in heterogeneous groups with possibilities for students to help each other;
    - Whole-class reflection and evaluation of the topic; and
    - Final test.

    The model provided for diagnostic procedures and special instruction and guidance by the teacher in a small remedial group for low-achieving students. In this second project an effect size of 0.68 was found. However, indications were also found that low-achieving students profited less from learning in small groups than high-achieving students (Terwel *et al.* 1994).

    In the third project, entitled *Social and cognitive strategies in mathematics 12–16*, the AGO-model was again used as a point of departure. Special training was given to students in the use of social and cognitive strategies for problem solving from real-life contexts in co-operative groups. Special attention was given to the analysis of differential effects for high- and low-achieving students. A focus on differential effects was derived from research into learning in small co-operative groups and from the results of meta-analyses into the effects of training in learning strategies.

    From the earlier intervention studies we concluded that, in general, these programmes contributed to learning. However, it seemed that low-achieving students were unable to benefit from interventions of this kind. The overarching question is whether it is possible to design an instructional programme in which all students benefit and in which the low-achieving students profit more than their counterparts in the control programme. The outcomes of the last investigation clearly showed the effects of the intervention. Teaching students how to use strategies had the expected, positive effects (effect size 0.52). In addition to this main effect the differential effect was mitigated in a more egalitarian

direction. The low-achieving students in the experimental condition outperformed their counterparts in the control group. To put it differently, the special training and the special remedial instruction of low-achieving students provided a compensating effect (Hoek *et al.* 1997, Perrenet and Terwel 1997).

In language education there has also been a growing interest in real-life learning strategies. De Glopper *et al.* (1996) conducted an experiment into the effects of training in word-learning strategies from authentic mother-tongue texts. The quantitative effects were measured with paper-and-pencil tests, whereas the qualitative effects were assessed in a thinking-aloud sequel. In this small-scale, random experiment an effect size of 0.2 for the paper-and-pencil test was found, which was not significant. However, the analysis of the think-aloud protocols clearly revealed a positive effect. In contrast to the untrained students, the trained students more often used elements of the strategy to derive word meanings from contexts.

The general conclusion is that characteristics of the experimental programmes in language and mathematics produced positive outcomes through the use of real-life situations and learning in small co-operative groups. Recently, there has been an emphasis on strategic learning from contexts. The promotion of learning from real-life contexts by training in the use of strategies seems to be an attractive avenue for further development and research in languages and mathematics within the Dutch national curriculum. These experiences and conclusions are consistent with studies in the US, e.g. Schoenfeld and Lampert (in Collins *et al.* [1989]), Cognition and Technology Group (1990), the 'Community of learners' project of Brown and Campione (1994), the research and development group led by Scardamalia (Scardamalia *et al.* 1989), and the project entitled *Schools for thought* (Lamon 1995).

3. It is possible that the observed difference in perception between teachers and students lies in the nature of the testing instruments. For teacher and student questionnaires different scales were used, each with different scalar intervals. It would seem advisable in future to harmonize the scales in this respect.

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