A COMPARATIVE APPROACH TO THE TEACHING OF MATHEMATICS AT THE TIME WHEN PUPILS BEGIN ATTENDING GREEK PRIMARY SCHOOL: THE CASE OF THE EDUCATIONAL MATERIAL OF THE 1982 AND 2003 MATHEMATICS CURRICULA

Gerasimos Koustourakis and Kostas Zacharos

Department of Education Sciences and Early Childhood Education, University of Patras, Greece

In this study we have utilised Basil Bernstein's theoretical framework regarding pedagogic discourse and have aimed at a comparative approach to the way school mathematics were taught in the period when 6-year-old pupils begin to attend Greek primary school between 1982-2009.

INTRODUCTION

The time when children leave kindergarten and begin attending primary school marks a critical stage in their schooling and is justifiably a focus of attention of educational research (e.g., Dunlop & Fabian, 2006; Woodhead & Moss, 2007). In Greece, attending the first grade of primary school begins at the age of 6. Pupils come in contact with a curriculum, in the form of a collection code (Bernstein, 1991). That is to say, school knowledge is divided into specialised subjects, of which the most prestigious – in terms of teaching hours per week – are Language and Mathematics (CTCF, 2003).

In 2003 in Greece, a reform of school mathematics took place with the introduction of the Cross Thematic Curriculum Framework for Compulsory Education (CTCF, 2003). This reform was implemented in 2006, when the new mathematics textbooks were published to replace the ones previously used as part of the curriculum of 1982 (Ministry of Education, 1982).

In this paper we have utilised Basil Bernstein's theoretical framework regarding pedagogic discourse and have aimed at a comparative approach to the way school mathematics were taught during the 1st school trimester of first grade of Greek Primary School between 1982-2009. This is to say we are interested in the period when 6-year-old pupils begin to attend Primary School. Moreover, the historical period under examination, which coincides with the modernisation of school knowledge in Primary School, is covered by the curriculum of 1982, which was used until the school year 2005-2006, and that of 2003, which was first implemented during the school year 2006-2007 and is in force to this day.

THEORETICAL REMARKS

The creation of curricula is an ideological process through which the powerful political and social groups endeavour to control official knowledge in order to promote their own aims (Apple, 1999). In Greece, where the educational system is strictly centralised, changes are introduced at the top of the hierarchy pyramid, i.e. by the State through the Ministry of Education (Kazamias, 2004). According to Bernstein (1990), the State, taking into account the general regulative discourse and the particular traits of each historical period, constructs the Official Pedagogic Discourse, which is expressed through laws regarding education, curricula and textbooks. Therefore, the educational reforms we will be examining set different aims: in the case of the curriculum of 1982, its proclaimed aim was to promote the democratisation of education (Bouzakis, 2000). In the case of the reform of the compulsory education curricula of 2003, the aim was to adapt the decisions of the European Union in order for the Greek educational system to follow the new trends in education as these occur in other EU countries, especially after the poor performance of Greek pupils in the PISA2000 test (Alahiotis & Karatzia, 2006).

The creation of school knowledge takes place through a process of recontextualisation, i.e. it is a conscious social act through which, the State and its mechanisms (the official recontextualising field), which in Greece's case is the Pedagogical Institute, oversee the selection of knowledge and data from the primary scientific field of various disciplines, such as mathematics, which are then used to construct the different subjects of the curriculum, such as school mathematics (Bernstein, 1990, 1996). Curricula reforms often express the intention to implement changes in the educational and communicative environment of the school and the classroom which is expressed through the Instructional Discourse (ID) and the Regulative Discourse (RD) (Bernstein, 1990). These particular forms of discourse constitute elements of framing. This concept defines the internal logic of pedagogic practices and refers to the way teaching is formed through the selection of knowledge and the strategies by which it is presented. Moreover, it refers to the shaping of the communicative and interactive pupil-teacher relationship at the micro level of the classroom.

Framing (F) is illustrated by the formula: F = ID/RD, revealing that the RD is the dominant discourse and affects the way the ID is implemented because it regulates the way in which knowledge is transmitted. The RD refers to the forms of hierarchical relations that emerge during the educational communication between teacher and pupils. It is these relations that determine the "control over the social base which makes this transmission possible" (Bernstein, 1996, p. 27). The ID refers to the method and practices selected for the transmission of school knowledge and includes (Bernstein, 1991, 1996) the type of knowledge that has been selected to be taught (acceptance and utilisation or not of the pupils' everyday knowledge), the selection of the communication through which to present this knowledge (selection), the sequence in which the knowledge will be presented (sequencing), the rate of expected time for the knowledge to be acquired (pacing), and the criteria by which to verify whether the pupils have acquired the knowledge being taught (criteria). The RD and ID that shape the context of the pedagogic communicative relationship at school can vary independently of each other (Bernstein, 1991, 1996). That is to say, we may have a weak ID framing in regard to the selection of knowledge, when the school draws upon and utilises knowledge that originates in the pupils' social environment and experiences; or a strong RD framing when a teacher-centered approach to knowledge is selected.

Bernstein (1990, 1996) noted that the successful or unsuccessful acquisition of knowledge depends on the factors of the pupil's social background and the weak or strong framing implemented during the pedagogic communication in the classroom in regard to didactic knowledge management. When school mathematics centre on highlighting the esoteric mathematical domain, while paying little attention to utilising an everyday frame of reference that is familiar to the pupils, and when an attempt is made to transmit a large amount of mathematical knowledge (F++ of pace), then those who benefit are pupils from middle and higher social strata who are mostly familiar with the approach to theoretical and abstract concepts (Apple, 2000; Bernstein, 1991, 1996; Cooper, 2002; Dowling, 2002). The same can occur in the case in which, within the didactic interactive communicative relationship, the pupils are granted the freedom to act on their own in order to discover and acquire school knowledge primarily through their own efforts (Bernstein, 1991, 1996).

INQUIRING QUESTIONS – METHODOLOGY

In this paper we will explore the following research questions:

What choices do the curricula of 1982 and 2003 offer in regard to the kind of mathematical knowledge that is selected to be taught and the pace at which it will be presented upon the pupils' entry in Greek Primary School?

What differences emerge from the comparative study of the curricula of 1982 and 2003 in regard to the shaping of the didactic communicative context for the teaching of school mathematics?

Our research sources are the printed educational materials for mathematics that correspond to the 1st school trimester of first grade of Primary School and which were produced in order to implement the curriculum of 1982 (henceforth C1982) and the curriculum of 2003 (henceforth C2003). This material includes the Pupil's Book, the Teacher's Book and – only in the case of C2003 – the Pupil's Exercise Book. It should be noted that in Greek compulsory education the school year is divided into three trimesters, with the first one extending from 11 September, when lessons begin, to 10 December. The range of each subject to be taught during the school trimesters is defined by the Teacher's Books, which offer the educator teaching guidelines according to which a schedule can be drawn up for the didactic management of school knowledge.

We approached our research through the method of Content Analysis, using the sentence as our unit of analysis. The sentence includes that part of the text's content that corresponds to *"a given semantic meaning"* (Neves & Morais, 2001, p. 244).

That is to say, it transcends the grammatical rationale in approaching a text, since each unit of analysis may contain two or more phrases, the use of which produces a specific, comprehensive and clear message of mathematical knowledge. The various sentences that were located were then classified by the researchers into the different categories of analysis which emerged after the examination of the research material and taken into account in the event that there was agreement between at least two out of three judges (Vamvoukas, 1990).

In the assessment of the kind of school mathematics being taught, three cases of Instructional Discourse emerged.

ID_F-: This case involves the solving of simple exercises, such as, for example, the correspondence between children and a number of pencils. Here, mathematical knowledge is connected to the public domain (Dowling, 2002), which includes familiar and known objects that are related to the pupils' daily lives.

ID_F+: In this case the activities focus on basic mathematical elements of a specific nature which are linked to the solving of exercises or problems and which require simple mathematical operations. These activities are drawn from the esoteric domain of school mathematics (Dowling, 2002), as in the following example (Lemonidis et.al., 2006a, No. A, p. 51):

> "Apostolos has 4 marbles. Ernest gave him 3 more. How many marbles does Apostolos have now?"

ID_F++: This case comprises compound exercises/activities involving the esoteric domain of mathematics through which we attempt to assess or evaluate the pupils' prior knowledge. Moreover, this ID case includes problems whose solving demands compound logical elaborations, as in the following example (Lemonidis et al., 2006a, No. B, p. 48):

> "There were 5 cars in the parking lot. At noon, another 6 came and parked there. In the evening, three of the cars left. How many cars were left in the parking lot?"

Moreover, in order to assess the development of the ID which is promoted in the cases of the C1982 and the C2003, we will study the instructions contained in the Teacher's Book and thus determine the mathematical knowledge to be taught to 6-year-old pupils during the 1st school trimester. Finally, we will present the proposed method of didactic management of the school knowledge in question (selection of pedagogic-didactic communication).

Through the study of our research material (Teacher's Books), the following three analysis categories emerged in terms of the intention to form the official communicative interactive pupil-teacher relationship (Regulative Discourse) and, hence, the hierarchical relations within the classroom environment (Neves & Morais, 2001, p. 232-233):

RD_F-: Here, the emphasis is placed on the greatest possible degree of autonomy and participation on the part of the pupil in the educational process in terms of solving problems or undertaking independent projects in order to approach school knowledge. In this case, a teaching theory seems to be promoted which focuses mainly on the acquirer.

RD_F+: In this case a teaching theory is promoted which, despite being focused on the teacher, demands the pupil's participation in the didactic act in order to be effective. Indeed, the way in which the pupils participate in the teaching is determined by the guiding instructions given by the teacher.

RD_F++: Here, the emphasis is placed on the teacher's role as a director. This gives shape to a teaching theory that focuses exclusively on the transmitter. The teacher's authority is considerable and is expressed in an explicit way.

RESULTS – DISCUSSION

Table 1 presents the school mathematics which, according to the Teacher's Book of the C1982 and the C2003, should be taught during the 1st school trimester to 6-year-old pupils (first grade of Primary School). From studying the data in Table 1, it emerges that in the case of the C1982 a gradual, unhurried introduction of the pupils to the content of school mathematics is attempted. That is to say, in the case of the C1982, the teaching of school mathematics during the 1st trimester of the first grade was carried out at a slow pace (F- pacing) (Bernstein, 1996). Conversely, in the case of the C2003, an attempt is made to impart more mathematical knowledge and to introduce the pupils, as early as the 1st trimester, into the abstract and esoteric domain of the discipline of school mathematics (Dowling, 2002). In order to achieve this, the teaching pace of this particular knowledge is faster than that of the C1982 (F++ pacing). Moreover, in the case of the C2003, the aim is to teach, during the 1st school trimester, numbers 1-20, which in fact covers a large part of the entire first grade curriculum according to the C1982 (Ministry of Education, 1982). It should be noted here that, following the reform of the compulsory education curricula that took place in 2003, school knowledge has become increasingly demanding compared to the past, since difficult mathematical concepts from the secondary school curriculum have been moved to the last two grades of Primary School (CTCF, 2003, 3987-4008). Furthermore, part of the first grade curriculum has been moved to Kindergarten. This involves the teaching of basic mathematical concepts, as well as familiarising children with the process of counting (CTCF, 2003, 4317-4319). Therefore, it appears that in the case of the curricula of 2003 regarding compulsory education, the school knowledge that is taught is more in quantity and of a greater level of difficulty compared to the past (C1982), a fact that shapes a strong framing of pace. Nevertheless, Bernstein (1991, 1996) pointed out that the successful acquisition of school knowledge by the pupil depends, to a large extent, on the weak framing of pace; on the creation, in other words, of the conditions of learning that give the pupil the necessary time to approach, process and acquire the new knowledge. The creation of pedagogic practices based on a strong framing of pace favours only pupils that have access to a second pedagogic context outside school, i.e. a second chance to approach and process knowledge which is offered to pupils by their family at home (Bernstein, 1991).

C1982	C2003
• Pre-mathematical and basic mathematical concepts • Numbers 1-5 and introduction to addition.	• Orientation in space, geometrical shapes, comparison/assessment of quantities. • Numbers up to 5: addition and analysis of numbers up to 5. • Addition and analysis of numbers 6-10. • Numbers 10-20 and Coins up to 10.

Table 1: Type and presentation sequence of school mathematics knowledge

Table 2 presents the didactic choices of a communicative nature which the teacher is requested to observe in each teaching unit. From studying the data in Table 2, it emerges that, in the case of the C1982, the construction of mathematical knowledge follows two main hierarchical stages (Apostolikas et. al., 2002): The first refers to the teaching/presentation of the new mathematical topic by the teacher. The second stage is related to the solving of exercises which are included in the Pupil's Book and aspire to help the pupils assimilate mathematical knowledge. In the case of the C2003, the process of presenting and elaborating mathematical knowledge occurs in a more complex way compared to the C1982. In particular, teaching begins at the stage of "orientation and elicitation" of new knowledge. Here, the teacher tries, by creating the appropriate teaching situations, to have the pupils themselves discover the knowledge. The stages of presenting and assimilating mathematical knowledge in the C2003 are the same as in the C1982. The new didactic action, compared to the past, is the effort to extend school mathematics to other cognitive situations. This is supported by the proposal to carry out cross thematic approaches, through which the teacher will attempt to link facets of mathematical knowledge to the content of other subjects in the curriculum. This last stage, according to the authors of the new educational material, is believed to contribute to the successful comprehension of mathematical knowledge by the pupils (Lemonidis et al., 2006b).

Didactic actions	C1982	C2003
Orientation and elicitation		X
Activities for the presentation and discovery of mathematical knowledge (Formalisation of new knowledge)	X	X
Projects & exercises for the application and assimilation of mathematical knowledge	X	X
Extent of new mathematical knowledge		X

Table 2: Didactic actions towards the construction of mathematical knowledge

From studying our research material, we have located 1311 sentences, which can be classified as follows: in the case of the C1982 there are 439 units of analysis (33.5%), while in that of the C2003 there are 872 units of analysis (66.5%).

Table 3 presents the classification of the units of analysis that refer to the type of mathematical knowledge that is contained in the mathematics textbooks used by first graders during the 1st school trimester. That is to say, it is an examination of the ID in terms of the extent to which knowledge is selected towards the formation of school mathematics either from the esoteric domain of school mathematics or from the public domain of the pupils (Dowling, 2002). From studying the data in Table 3, it emerges that the textbooks under examination differ in terms of their choices in shaping the ID, which concerns the type of knowledge ($p<0,01$). In particular, during the 1st school trimester, according to the C1982, mathematical knowledge is presented and developed mainly through exercises and activities drawn from the pupils' experiences and familiar everyday world (64.8%), i.e. from the public domain (Dowling, 2002). Conversely, in the case of the C2003, even though mathematical knowledge is approached using elements from the public domain at a rate of 35.6%, an effort is made from the outset to introduce the pupils to abstract mathematical knowledge (F+ 62.2%).

	ID_F-	**ID_F+**	**ID_F++**	**Total**
C1982 (%)	162 (64.8)	83 (33.2)	5 (2.0)	250 (100)
C2003 (%)	226 (35.6)	395 (62.2)	14 (2.2)	635 (100)

Table 3: Sentences according to the type of mathematical knowledge

Table 4 shows the classification of the sentences that were located in the Teacher's Book during the 1st school trimester and which refer to didactic recommendations to the teacher towards shaping the RD, i.e. defining hierarchical relations and pedagogic communication during the didactic interaction between teacher and pupils.

	RD_F-	**RD_F+**	**RD_F++**	**Total**
C1982 (%)	49 (25.9)	107 (56.6)	33 (17.5)	189 (100)
C2003 (%)	112 (47.3)	103 (43.4)	22 (9.3)	237 (100)

Table 4: Sentences that define the didactic interactive relations between teacher and pupils during the 1st school trimester in first grade mathematics curricula

From studying the data in Table 4, it emerges that the curricula under examination differ in terms of the hierarchical interactive relations that are promoted during the 1st school trimester of the first grade, and particularly in relation to the didactic communication between teacher and pupils ($p<0.01$). Specifically, in the case of the C1982, the teacher is the strong factor that defines the way in which school mathematics will be taught (F++ 17.5%, with a total rate of positive framing at 74.1%). However, the didactic recommendations contained in the Teacher's Book for the greater part of the mathematics curriculum ask of the educator to guide the pupils in order for them to participate as actors in the educational process (F+ of the RD at 56.6%). Moreover, a significant finding is that, compared to the period prior to the C1982 during which a teacher-centered way of teaching was prevalent, it can be seen in 25.9% of the activities included in the C1982 that the approach to and elaboration of mathematical knowledge requires self-activated learning on the part of the pupils. Furthermore, in the majority of the didactic recommendations of the Teacher's Book of the C2003, the educators are asked to create, as early as the 1st school trimester, the suitable conditions for the pupils' self-activation. Thus, the pupils will be able to work either individually or in groups towards discovering knowledge in an experiential way (F- 47.3%). Nevertheless, we must take into account that mathematical knowledge in the C2003 compared to the C1982 is more complex and focuses on a larger curriculum which is mostly drawn from the esoteric abstract domain of mathematics. Also, carrying out the exercises/activities listed in the C2003 demands of pupils a greater degree of independence than in the past, a fact which perhaps favours children that come from privileged social backgrounds. The reason for this is that certain pupils may possess the necessary cultural capital (Bourdieu & Passeron, 1977) that allows them to handle theoretical mathematical knowledge with greater facility, given that they are orientated towards abstract meanings and have been socialised into taking initiatives and working independently, traits that are linked as much to the discovery and elaboration of knowledge as to the utilisation of this knowledge in order to tackle different social situations (Apple, 2000; Bernstein, 1991, 1996; Cooper, 2002; De Abreu & Cline, 2003; Dowling, 2002).

CONCLUSIONS

From the study of and comparative approach to school mathematics in the cases of the C1982 and the C2003, we arrive at the following conclusions:

- In regard to the way in which the didactic communicative approach to the C2003 is shaped, two new elements are introduced: The emphasis is placed on taking initiatives on the part of the pupils and an attempt is made to bring them in contact in an experiential way with the new knowledge they are to acquire. Moreover, an effort is made to utilise the new mathematical knowledge within the context of other disciplines and courses in the first grade of Primary School curriculum.

- During the 1st school trimester of the first grade, in the case of the C1982, a slow pace is selected for the presentation of mathematical knowledge (F- pacing). Conversely, in the case of the C2003, a fast pace is selected for the presentation of mathematical knowledge (F++ pacing), which is drawn chiefly from the esoteric domain of mathematics.

- In the case of the C1982, during the 1st school trimester, the Instruction Discourse is shaped by the selection and utilisation of knowledge that is familiar to the pupils (F- 64.8% of selection), since the goal was to gradually and unhurriedly transport them to the internal theoretical field of mathematical knowledge (Apostolikas et al., 2002). Conversely, in the case of the C2003, the Instructional Discourse is shaped by selecting exercises/activities which are drawn mainly from the esoteric mathematical domain (F+ 62.2% of selection).

- The Regulative Discourse in the case of the C1982 is shaped in a way which renders discernible the hierarchical relations in the educational process (RD: F+ 56.6% and F++ 17.5%). In the case of C2003, despite the fact that during the 1st school trimester a significant part of the curriculum requires the expression of didactic strategies through which the teacher's guiding/hierarchical role is distinguished (F+ 43.4% of the RD), an attempt is made to give pupils the space needed in order for them to approach mathematical knowledge in an experiential way (F- 47.3% of the R.D.).

The above observations give rise to important research questions regarding the social strata that benefit from the specific choices that shape contemporary school mathematics, as these choices are expressed in C2003.

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