INVESTIGATING MST CURRICULUM EXPERIENCED BY ELEVEN-YEAR-OLD POLISH AND ITALIAN PUPILS

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Abstract: In SECURE project, three different types of questionnaires have been designed for 8, 11 and 13 years old pupils’ and their teachers, to collect research data, analyze it and provide recommendations that could initiate a debate on the development and implementation of the curricula of mathematics, science and technology (MST) at European level. Questionnaires are structured with multiple-choice questions and open questions. The number and the type of the items proposed have been adjusted to the age (for learners) or to the subject matter (for teachers) in a way that guarantees the feasibility to fill in all the items in at most one hour. The questionnaires were analyzed and the significant emerging elements were discussed combining the acquired data with relevant information derived from the analysis of the official MST curricula documents. In this contribution a part of the study concerning comparison between Italian and Polish MST curricula experienced by 11 years old pupils is provided with respect to rational, aims and objectives, content, learning activities, teacher role, materials and resources, grouping, location, time, assessment and motivation.

Keywords: curriculum, student interest, teacher thinking

THEORETICAL FRAMEWORK

Research on transnational education surveys has got a long history. Starting from the results of the International Association for the Evaluation of Educational Achievement (IEA) and following previous studies (Heyneman&Stephen, 2004), several recommendations have been issued for the planning of balanced, fruitful survey. Mainly of those related to the procedures and the sampling methods of such work (Cochran, 1977) and to the attention that must be devoted to the framework and to non-sampling errors in the analysis (Lessler,1992).

In a view of performing a cross-country analysis of the curricula, the definition of ‘curriculum’ itself has different meanings in different contexts of the educational research (Beauchamp, 1986; Walker, 2003). There are few substantive distinctions between those meanings (Clements, 2007). To have a global vision of the curriculum, the analysis of the official national documents is not enough, but the investigation of the implemented and perceived curriculum has to be done (Cochran, 1977).

To emphasize this aspect van den Akker (2003) proposed representing the curriculum as a spider web in which the main subjects and aspects of the curriculum are visualized and the curricular research takes place at different levels. Rationale, aims and objectives, content, learning activities, teacher role, materials and resources, grouping, location, time, and assessment are the main items taken into account in this
approach. Within this framework, it is therefore necessary to develop questionnaires and interviews aimed to investigate all the aspects of the curricular spider web at the level of teachers and students (Kuiper et al. Kuiper, Folmer, Ottevanger and Bruning, 2011).

RESEARCH QUESTIONS

The questionnaires developed in the study, were aimed to investigate the elements of the curriculum spider web as perceived by teachers and students. In particular, for the learner questionnaires, five main aspects of the curricular spider web were addressed: learning activities, time, materials assessment and location, and an additional item, “attitude and motivation” was added to research. For each of those aspects, pupils’ answers have been analyzed to investigate their particular perception in ten European countries, taking part in the research and to compare them on a cross-country level. In this contribution, the results for Italian and Polish 11 years old learners are contrasted and compared.

Therefore in the above-mentioned group the research questions have been posed as following:

RQ1. Are students interested and motivated to study mathematics, science and technology (MST)?
RQ2. Which are the learning activities most used in schools?
RQ3. How much time do pupils spend on MST?
RQ4. Which are the learning materials that pupils use in schools?
RQ5. How pupils are assessed?
RQ6. Where do the lessons take place?

INSTRUMENTS AND METHODS

Three different types of questionnaires have been developed to investigate teachers’ and the students’ perceptions of the curriculum: two for students and one for teachers. All of the questionnaires are structured with multiple-choice questions and a few open questions. Questionnaires are composed in sections in accordance to the elements of the curricular spider web.

The questionnaire for the 8 year old students contains 96 multiple-choice questions and one open question, questionnaire for 11 and 13 years old combines 108 multiple-choice questions and 7 open questions and the two questionnaires for teachers have altogether 155 and 138 items for Mathematics and Science/Technology, respectively.

The questionnaire for the 11 years old pupils is structured with 15 items on motivation, 27 on learning activities, 21 on materials and resources, 12 on location, 6 on time, 27 on assessment, and 6 open questions concerning learning activities and one open question regarding additional students’ comments. The number and the type of the items have been adjusted to enable to fill in the entire questionnaire in at most one hour. Student questionnaires were completed in the classroom, while teachers could also fill them in at home. In the framework of the pilot study of the SECURE
project a questionnaire for the 5 year old pupils was also implemented in Italy, however skipped later on in the main study.

SAMPLE

All over Europe, 1425 teachers’ and 8198 pupils’ questionnaires were collected (2666 of 8 years old, 2797 of 11 and 2735 of 13) during the school year 2011-2012. In this paper, the analysis of the Italian and Polish data of the 11 years old pupils is provided and discussed. The choice to address this particular age was driven by the consideration that 11 years old represent a pivotal age around which pupils move from primary to secondary education and start to raise the pupils’ autonomy and critical thinking. Those two particular countries were chosen for the comparison as having specific situation of implementing not one core curriculum, but either following different core curricula at different ages (Poland) or having three different core curricula to be chosen from by decision of a school (Italy). Among ten countries under research, those two seem also to be quite similar as concerning the cultural background and approach to tradition (i.e. also traditional view of teaching and upbringing).

RESULTS AND DATA ANALYSIS

Data analysis as regards the distribution of the students’ replies in each country was done by elaborating the entire collection of questionnaires, discussing significant elements and combining the acquired data with the information coming out of the analysis of the official documents and the data interviews. As example, in Fig. 1 one of those graphs is reported.

Figure 1. Exemplary results are obtained on ‘Materials and resources’ items for 11yo learners in Poland.
From the analysis of those graphs, the following considerations emerge for each one of the involved countries.

As concerning learners’ attitude towards MST subjects, in Poland, students like MST because of topics, activities and teachers. During MST lessons, students mostly listen to the teacher’s explanation and work on their own. Half of the students, in at least half of the lessons had to memorize how to answer questions, both in M and S, and 40% of students do the same in T. Practical activities are more done in ST than in M, however, half of the students do practical activities rarely or never. Work in small groups is more relevant in S and T (18% and 20%, respectively) than for M (10%).

For materials and resources (cf. Fig.1), a vast majority does not use calculators and only less than 17% use computers in at least half of their lessons. Exercise books and textbooks are used in MS by 82% and 94%, respectively while in T by 14% of pupils. The use of everyday life objects in half of the lessons of MST is reported, respectively, by 36%, 52% and 28%. The main way of assessment in M are unexpected tests, in S - planned tests, projects and oral tests and in T - assignments. In MS most of the pupils do not go to different rooms dedicated to the subjects. Whilst for T the use of a specific room is reported by less than one-third of students.

The majority of all MST lessons are provided inside the classroom. Apart from Technology, most of the students agreed they spent a lot of time on MST in school (M50%, S58%, T37%) and on homework (M49%, S53%, T27%).

In Italy, students like MST with no significant differences between the reasons (topics, activities, teacher), while MS have a higher level of agreement (M70%-79%, S77%-84%) than Technology (57%-64%). With a threshold on “half of the lessons”, a mixed picture for the different activities is observed: the prevalent one is “listen to teacher’s explanation” (M89%, S81%, T77%), followed by “work on one’s own” (M68%, S61%, T73%). “Memorize how to answer” is also relevant (M52%, S50%, T41%), while in T, it is exceeded by “do practical activities” (60%). “Work in small groups on a problem” has a very low percentage of agreement (M10%, S14%, T10%). Calculators, computers and video have a very low or null impact (~10%). For MS the most frequently used methods of assessment are planned tests (57%, 57%) and oral tests (57%, 62%). Textbooks are used at least in half of the lessons (M89%, S93%, T66%). Exercise books are frequently used in MS (M59%, S61%), while in T exercise books are used only by 18%, surpassed by various and daily-life materials (60%, 27%). The majority of the lessons are provided inside the classroom (M99%, S83%, T84%). MS are considered as time demanding (75%, 65%), while for T there is no clear indication (50%).

A comparative analysis between the two countries has been conducted by confronting the normalized distributions of the pupils’ answers for each item, using two different representations: a histogram and a radial graph. In the latter, the indicator is obtained assigning to each possible answer (‘never’, ‘few’, ‘some’, ‘almost always’) a weight and thus calculating the weighted mean of the replies on those weights. In Fig.2 and Fig.3 exemplary graphs of the comparison between the distributions of student answers to questions on attitude towards mathematics and science subjects are shown with the use of histograms.

In both countries, Poland and Italy, mathematics is not liked more than the other subjects, but the contents and the learning of mathematics are enjoyed by more of the half of the pupils, with a greater appreciation in Italy (cf. Fig.2). Science is liked by most of the pupils in Italy and Poland equally (cf. Fig.3).
Concerning MST, the ranking of the most appreciated subjects differs from Italy to Poland. In Italy, the most appreciated subject is S (80.3%), followed by M (70.5%) and then T (57.1%). In Poland, although the most appreciated subject is also S (76.3%), Technology (64.1%) is ahead of Mathematics (57.6%). In addition, looking
at the strong positive replies, it emerges that they are more relevant to S in IT than in PL while, vice versa, they are given more frequently in PL, than in IT as concern T.

The main activities done in both during the M class are teacher-centered lectures and work alone. In Italy, the teacher-centered lecture is used more often than in PL, where the work alone is more used. Occasionally, a practical work and students’ presentation of their work are proposed in Italy and Poland, respectively. Small group work is rarely chosen as the classroom activity. Also for S, the most common activities are teacher-centered lectures and working alone. There are small differences between Poland and Italy: in the former, there is more work done alone than in the latter, where the lectures are more teacher-centered. Presentation of the results is more used in Italy than in Poland, where a small group work is done more often. Practical activities are done equally frequently in both countries. In T classes, working alone and memorizing are used equally often in both countries, while teacher-centered lecture, a practical work and presentation of the students’ own results are done more often in Italy. During the T classes more small group work is reported in Poland than in Italy.

For each subject a characteristic distribution of the learning activities emerges, but there are also common elements among the subjects. In Italy, a small group work is almost never used at all. Teacher-centered lectures and working alone are the most frequently proposed activities. Memorizing is a shared and common activity implemented for all of the subjects. In Poland, in addition to the teacher-centered lectures and working alone there is more focus on practical activities.

Figure 4. Exemplary graph on comparison between the distributions of the student replies to items concerning use of materials and resources in mathematics subject in Italy and Poland.
As regards learning materials, there is a high similarity between Poland and Italy in M (cf. Fig.4): calculator, computer and video are never used, everyday examples are used sometimes, textbooks and exercises book are used almost all the time. In S (cf. Fig.5), textbook is the most common material used in both countries, while exercise book is used more frequently in Poland than in Italy. The use of everyday objects is comparable between the two countries, while the use of equipment is more common in Italy even if it is occasional. Calculators and computers are almost never used during S lessons. In T (cf. Fig.6), the distributions between the countries are quite different: in Italy, textbook and equipment are the most often used materials, while in Poland those materials are accompanied by the use of computers and a more extensive use of everyday objects.
In both countries, M lessons usually take place in the non-specific classroom, with the exception of some cases in which M is taught in devoted classes, mainly in Poland. Situation in S is similar to M, but there is a small increase of the percentage of students who’s lectures are held in a devoted room, mainly in Italy. In Italy and Poland the classroom is the main location for T, and in both countries, the percentage related to the devoted classrooms is increased with respect to S and M. In particular, in PL this case is more relevant.

Italian students recognize M and S as more time consuming than the Polish ones, but the time spent doing Mathematics at school is longer than the one devoted for S, while T is considered less time-consuming, especially in Poland.

Italy and Poland have a lot in common with respect to the use of written tests in M, but they differ as concern the second main type of assessment. In Italy, it is the oral interview, while for Poland it is an unexpected test. In S a diversity of ways, in which the teachers assess the students work is observed in Poland, while in Italy it emerges that the central role of the written test and the oral interviews prevails. In Poland, the assessment of projects and tasks are relevant, while in Italy several strategies are frequently used (with the exception of the unexpected test and the evaluation of students presentation).

**DISCUSSION AND CONCLUSION**

A big amount of analogies and differences emerge from the comparison of the results obtained from questionnaires of 11 years old learners in Italy and Poland. The analysis enables to sketch a general picture of MST education at that age in both countries. In particular as concern M, Italian 11 years old students describe it as mainly held in classrooms, using textbooks, or working sometimes alone, mostly listening to the teacher that is able to transmit the passion for math. In Poland, M is done in classrooms, using textbooks and exercise book, working alone and listening to the teacher.

In Italy, S is liked by pupils for what they learn and for the activities held in class; S lessons are mainly held in the classroom, with prevalent use of the textbook and listening to the teacher’s explanation. In Poland, S lectures are also held in the classroom, using textbooks, doing exercises, listening to the teacher and working alone.

In Italy, T is mainly done in the classroom with several type of activities: listening to the teacher, working alone, doing practical works and using textbooks. In Poland, it is done both in non-specific classroom or in a devoted room, working alone or listening to the teacher.

It can be summed-up that despite different curricula, MST education has got a lot in common in Poland and Italy, showing a picture of more passive and traditional teaching, with not much emphasis given to practical work and use of other materials than text books. Furthermore, assessment strategies are also quite similar in both countries, with huge attention paid to written and oral tests. Although the investigation of reasons for such similarities is not in the scope of the current research and needs further studies, the authors would seek for possible explanation among common, traditional approaches to education and upbringing of young generations in both countries.
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