

THE SECURE PROJECT RESEARCHES SCIENCE CURRICULA AND TEACHERS' AND LEARNERS' OPINIONS ON SCIENCE EDUCATION

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Introduction

Based on scientific research, the Science Education Curriculum Research consortium will make a number of recommendations to policy makers who have an impact on curriculum development as well as on teacher education. These recommendations address the question how the interest in Math, Science, Technology and (MST) can be enhanced among youngsters and in particular their future teachers, whilst at the same time optimizing the preparatory learning of those pupils. Having reached half-time of the project duration, this article gives an overview of the objectives, goals and the intermediate outcomes of the SECURE-project.

Objectives

The specific objective of the SECURE project is to provide relevant and rigorous research data and translate them **into** recommendations that contribute to the debate among policy makers on science curricula and their objectives : balancing the needs between training future scientists and broader societal needs.

The SECURE research focuses on 5, 8, 11 and 13 years old learners, their science curriculum and their teachers. These selection of those ages is guided by the aim to bridge the gaps between kindergarten, primary school and middle school and acknowledges that early-aged MST learning experiences of learners are important for their future perceptions of the role of science in society.

For the curriculum analysis, we refer to the typology of curriculum representations, built on the work by Goodlad (1979, see also van den Akker, 2003) which is especially useful in the analysis of the processes and the outcomes of curricula. The table below shows 6 different representations of a curriculum. The distinction of forms emphasizes the different layers of the curriculum concept and demonstrates the often substantial discrepancies between the various forms.

Intended	Ideal	Vision (rationale or basic philosophy underlying a curriculum)
	Formal/written	Intentions as specified in curriculum documents and/or materials
Implemented	Perceived	Curriculum as interpreted by its users (especially teachers)
	Operational	Actual process of teaching and learning (also: curriculum in action)
Attained	Experiential	Learning experiences as perceived by learners
	Learned	Resulting learning outcomes of learners

Table: Curriculum representations

To ensure a profound view on the MST-curriculum in its different levels, the research focuses on:

- The formal intended MST-curriculum by comparing written MST curricula in the 10 participating EU countries (**AT, BE, NL, SI, IT, SW, CY, UK, GE, PL**). It was decided to focus on mathematics, technology (technics), and (natural) sciences (restricted to biology, chemistry and physics, physical geography).
- The implemented MST-curriculum which takes in to account the perceptions of teachers who put the curricula into practice in the day-to-day class-activities.
- The attained experiential curriculum which focuses on the learning experiences of the pupils, the final and most important recipients of the MST-curriculum

Procedures and previewed results

The project partnership splits all the work into work packages. Partners are spread as to have competences in all fields necessary: primarily on the research itself, but also in dissemination and management. The figure below shows not only the interdependencies between work packages, but that the research is set up by WP3 (research design & analysis), WP4 (school data administration) and WP5 (curriculum data administration) coordinating **particular tasks** in 10 countries, and **WP3** again for analysis of the results. **The overall scientific coordination is performed by WP2**. These are the heart of the research of SECURE. WP1 deals with management and WP6 with dissemination.

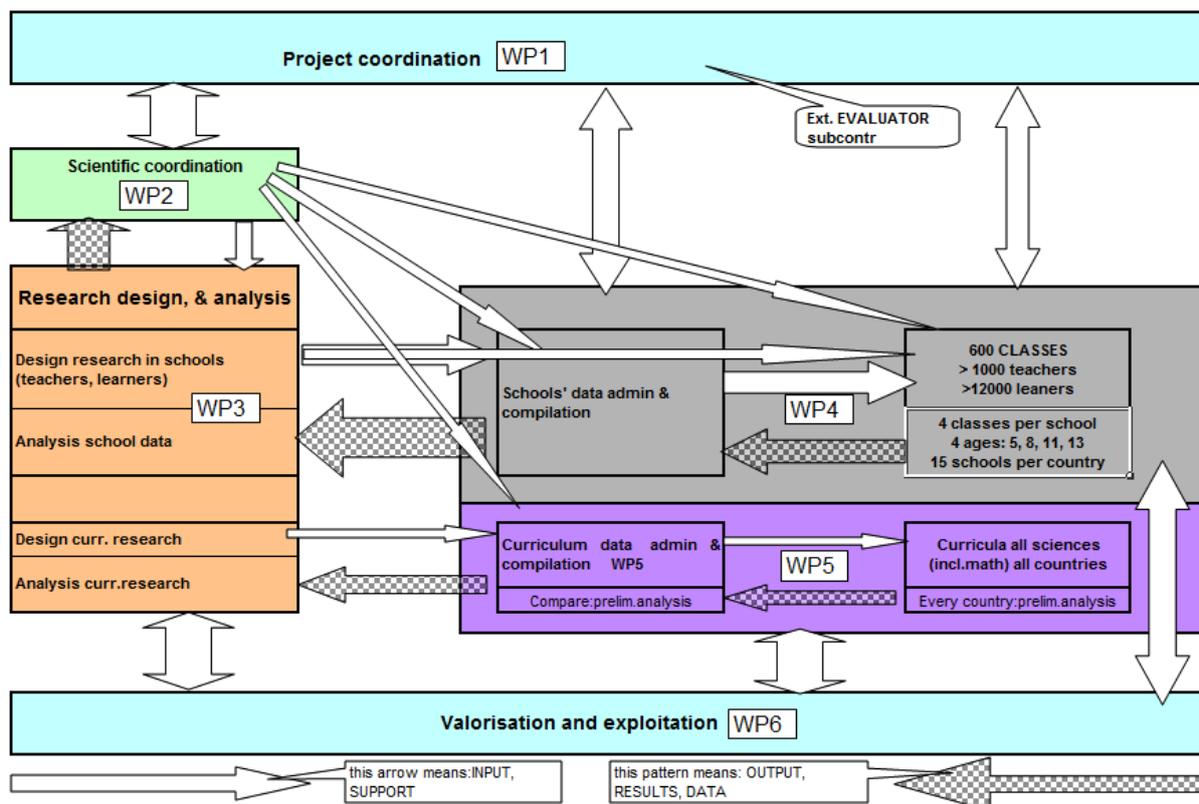


Fig. 1 SECURE: interdependencies of work packages

The research framework is set up by SLO (Studiecentrum LeerplanOntwikkeling, Enschede, NL) and is constructed upon the "Curriculum Spider Web" (Van den Akker, 2003), which depicts 10 fields that built up curricula: the rationale (vision, mission), aims & objectives of curricula, content, how

learning activities take place, the role of the teacher, materials and resources used, grouping (with whom learning takes place), location, time and assessment.

In each participating country, 15 schools, **each** being a set of 4 classes, of each age group are selected. This means 150 school units, some 600 classes, all together about 1000 teachers and approximately 10000 learners.

Research instruments for the intended formal written curricula

The most common MST curriculum document of all disciplines in a country (Macro level or sub-macro level) are screened according to the designed curriculum screening instrument, covering all 10 fields of the curriculum spider web. The documents used have different origins but need to be official or at least authorized. The curriculum screening instrument consist out of two formats:

- the “format1” level, which gives , in a descriptive way all information on the documents themselves.
- The “format 2” level on the other hand gives in depth answers to questions about the content of the curriculum document, relating to all 10 fields, as the spider web indicates. Each country produces in this way an extended and descriptive summary of all curricula of about 40-50 pages. All of them have basically the same content.

This phase is finished and is the first basic result of SECURE. The relevant information is now ready for comparative cross-country analysis by SLO.

Research instruments for the implemented (teachers) and attained (learners) curricula

To get information on the perceptions of people involved in these curricula, SLO developed draft questionnaires for all ages of learners (except 5 years old) and the teachers using the curriculum documents mentioned above. The questionnaires are grounded on existing scientific literature on science education and science curriculum reform. (e.g. Atkin & Black, 2003; Black & Atkin, 1996; van den Akker, 1998). Existing instruments from previous relevant studies such as Alting (2003), Bennett, Gräsel, Parchmann and Waddington (2005), van Driel, Bulte & Verloop (2006), van Langen, 1995) – and teacher and/or pupil questionnaires used in the Relevance Of Science Education (ROSE) study (Schreiner & Sjøberg, 2004), TIMSS (1995, 1999, 2003, 2007), and PISA (2000, 2003, 2006, 2009) have all been used as a starting point for the development. Other useful sources for instruments development and use could be research instruments developed/applied by SECURE partners, including those instruments currently being used as part of a comprehensive evaluation study on new context-based science curricula in Dutch Senior Secondary school (Kuiper, Folmer, Ottevanger & Bruning, 2009, 2010). The draft versions of questionnaires and interview guidelines have been piloted in the Netherlands, Italy and Germany. Based on feedback from the pilot definite versions were developed.

After intensive discussions the questionnaires were adapted by the “design and analysis” work group of SECURE and made slightly more flexible, looking for a suitable equilibrium between reaching the goals of getting information on teachers’ and learners’ perceptions in their given educational system and relevance for the research itself. This was possible since the results of the questionnaires did not need to be analyzed in a comparative way, but are used to generate a country-specific information on the perceptions of teachers and experiences of learners of the visited school-units.

Some information on the questionnaires:

- The teacher questionnaire is split in two parts: one for the mathematics teacher (176 questions), and one for the technology/science(s) teachers (more than 180 questions). It was asked to fill out only questions relating to the discipline given in the same class that was questioned (if disciplines are integrated or if teachers teach several disciplines the advice was that all relevant questions need to be filled out). The bundle contains 23 pages and it takes about 1 hour to fill in.
- The questionnaires for the 13 year olds were rather complex because in most project partner countries learners get several disciplines given by several different teachers. The questionnaire contains about 234 questions.
- The 11 year olds got almost the same questionnaire. However,- in countries where integrated science is taught for that age, the number of questions could be slightly reduced. It resulted in 13 pages of questions.
- The 8 years old got a reduced questionnaire, not covering some of the 10 fields of the spider diagram, i.e.: the rationale (vision, mission), aims & objectives of curricula, the role of the teacher. It was judged that for those fields it would be too hard for learners of that age to give adequate answers to questions. Still 111 questions are posed, 5 pages of work.
- The 5 years old learners is a different story. After some preliminary piloting of very simple questionnaires with a limited group of 5 years old, it was recognized that it would be extremely difficult to get relevant answers from them. Hence there is no questionnaire for 5 years old within SECURE. However, SECURE will attempt to carry out some basic research on different strategies to get answers to questions from these youngsters. This will be considered as a side research, hopefully at least coming with some ideas on how to get scientifically relevant data from 5 years old in general.
- All questionnaires were very extensively discussed, question by question by members of the design and analysis group. During these discussions very different opinions and perceptions on education and educational systems occurred. Nevertheless the group agreed on the set of questions put forward. The spider web framework upon which everybody agreed was very helpful for reaching such agreement.
- All answers to all questions must be analyzed. Almost all countries will enter the data manually in Excel files, the templates of which are put available by the work package leader. This Excel is screened by work package 4. Apart from questionnaires, SECURE also decided to gain additional information on teachers' and learners' perceptions by organizing interviews as follows:
 - 6 out of 15 classes of each age were selected per country to interview all teachers of all disciplines covered by the research. Such an interview takes typically approx. 45 minutes.
 - In these 6 classes of age 8, 11, 13, a set of 4 learners (2 girls and 2 boys) randomly chosen were also subject to an interview. These last about 35-40 minutes each.
 - SLO provided guidelines for these interviews, again, discussed in depth by research and analysis team. All partners will report on the results of the interviews according to a certain format. Key ideas of this format are:
 - additional information must be gathered
 - the information should be in line with the questionnaires, following the spider

web framework

- the report should contain a summary of all interviews of the same kind (horizontally)
 - the report should mention relevant and clear quotes of the people being interviewed as examples of how ideas are expressed.
- The final version of the instrument that will be used to analyze the summaries provided by 10 countries provide is being developed and is in its final stage.

Since no other means were left, the only way of getting information of 5 years old was by interviewing them, like the other classes, 2 girls and 2 boys, but of all 15 classes involved. The interview covers only two fields of the spider web. These also takes usually little more than 30 minutes.

The target group for results are all people bearing responsibility for science education, including Fibonacci participants, since the ages match the target learners of the Fibonacci project perfectly.

Outcomes halfway the project (April 2012)

Outcomes are related mainly to tools that are developed to do the research:

- a "Curriculum screening instrument" (CSI) that enables the partners to summarize the desired information on all curricula in a workable format, ready for comparative study of all curricula
- questionnaires for 8, 11 and 13 years old students
- questionnaires for teachers of primary education and lower secondary, teaching either integrated or separate MST disciplines
- interview guidelines for interviews with 8,11, 13 years old students that should reveal additional and complementary information
- interview guidelines for teachers of all ages (same goals as above)
- interview guidelines for interviews of the 5 year old learners.

Other outcomes are situated on the practical procedures to carry out such projects: translations, lists of contacts of stake holders, financial issues and management strategy.

Timing

The SECURE project is halfway now. Outcomes are tested research tools and mainly procedures for carrying out the research. During January 2012 and September 2012 data are gathered in the schools and summarised. First results are expected in a year.

On June 3-6, 2013 an international expert group will be invited to Antwerp to study the results and give feedback in several ways:

- study the results
- study the conclusions and forthcoming recommendations
- report if, in their opinion, the results are also valid in their home country.

The final conference of SECURE will take place in Leuven in the third week of September 2013.

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- TIMSS (1995, 1999, 2003, 2007), and PISA (2000, 2003, 2006, 2009)

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