European project REPRESENTATION : Modélisation conceptuelle initiale

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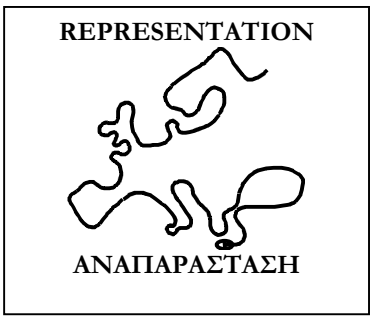
Modélisation conceptuelle initiale



REPRESENTATION CONSORTIUM

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Abstract
The following text aims at proposing an initial conceptual model for the European project REPRESENTATION. First, the global context and objectives of the project are recalled and the link with the preceding work is explicated.
The precise cases that were considered in the different countries are presented, along with the methodology followed. Then, first results of the empirical study about pupils' representations of ICT are presented and discussed. A first cartography of pupils' representation is given. Perspectives for the subsequent work packages are shaped out, notably &bout the uses of concept mapping software.

Keywords: Cross-national comparisons, representations, case studies, qualitative research, concept mapping, Information and Communication Technologies.

CONTENTS

Executive Summary

According to the project's work plan design, tasks addressed in the previous work packages of project REPRESENTATION have aimed at establishing a diagnosis preliminary to an action research scheme. One of the facets of this diagnosis, reported in this deliverable, was to explore pupils' "representations" of ICT within a case-study framework. In effect, it was necessary to guide the consortium in

- Formulating and re-formulating of research questions,
- Designing an appropriate action plan for the next phases of the project (intervention phase)
- Informing the project tool development of the pupils' aggregate perception of ICT.

A co-ordinated empirical work has therefore been led in six countries, with the aim of getting an insight of pupils' representations regarding ICT (both declarative and procedural). A common protocol was defined. According to it, the pupils of one classroom in each country (fourth and fifth graders) were to be asked to draw a computer, to label its parts and to write short texts about computer uses. Then six pupils were to be interviewed in each classroom and a collective work realised.

This scheme was globally respected. But the tasks had to be adapted to the particular practice of each school and teacher. Two partners deviated from the initial framework. Depending on the class habits, interviews could not take place in Greece, and were replaced by an enrichment of the collective work. The UK contribution to the data collection also included another protocol relying on a spider-mapping task. Spider-mapping or indeed any type of linked drawings are a means to depict related or unrelated thoughts and produce something more concrete from which the initial ideas can be developed, or the methods of linkage considered).

Analysing those drawings and texts, produced in response to a simple request, has given interesting information. Representations are at the same time rather similar (children tend to focus on the external parts of computers) and rather contrasted with respect to the activities led in the classrooms or at home.

What appears from ICT representations seems to be much affected by the task proposed to pupils. The representations themselves are influenced by the school context, the use of a computer at home and in school and, probably, the gender.

Introduction: Project Overall Objectives and Aim of this Report

Project REPRESENTATION aims at developing a cartography of pupils' representations regarding Information and Communication Technologies (ICT). This project builds upon a threefold assumption embedded in both theory and practice:

- The tools and applications of recent technological development, if they are to be integrated in our teaching/learning practices, require investigation in terms of the representations they generate in our perceptions
- Teaching with or about ICT requires a different conceptual framework from that applied in traditional teaching practices (both in terms of acquisition and transfer of knowledge)
- Learning, and cost effectiveness in the development of learning materials, can be achieved more effectively if teachers and software developers take into account the emerging new modes of users' representations and their transmission.[1]

The project "is being conducted in order to deepen our understanding on the role of ICT concepts, products, components and processes play in the shaping of representations, both in terms of emergence and evolution, in young pupils. The new knowledge to be generated in the frame of the REPRESENTATION project is to, besides help teachers to adjust their teaching, provide a resource frame for software designers and developers so as to facilitate their efforts in creating more efficient learning and teaching tools"[2].

In a first phase (WP 2), a state of the art was established, leading to deliverable A 01 (Baron & al, 1999). This deliverable notably showed the interest of conceptual

[1] REPRESENTATION, DeliverableA01: Représentations, modèles et modélisations; implications sur les stratégies éducatives et sur les processus d'apprentissage: syntèse bibliographique, p. 9

[2] REPRESENTATION, DeliverableA01, p. 10

mapping tools and concluded to the need to lead an action research scheme. As is documented in this deliverable: "A general hypothesis embedded in the REPRESENTATION project is that the process of making tacit knowledge explicit facilitates learning. This hypothesis however is not operational and, therefore, cannot be easily confirmed or invalidated. While the hypothesis defines a general orientation, it leaves freedom of choice for diverse activities with computers to be conducted within an 'ecological environment'. Such a research context is not compatible with, and can not be addressed in the frame of experimental research designs. Action research techniques and methods seem indeed to be more appropriate to respond to the demands of such a hypothesis. This approach permits the proper attention to be given to *contextual issues*, and notably *pupils' activities* and *performances* or products"[3] .

Then, another work package (WP3), leading notably to deliverable A 02 (Somekh & al, 1999), was devoted to the study of the situation of ICT in European schools. This deliverable stressed the diversity of the situations between the different countries and provided a general description of all the 30 participating schools, situated in their context.

The next work package (WP4) had several objectives: study the users' needs (leading to deliverable A 03), do a first diagnostic of pupils' representations of ICT, study the issues of teacher training, precise the methodology of the action research to be led in the next work packages, establish an initial conceptual model.
This work package ended "the preliminary diagnostic phase" of the project, beginning with WP2 and WP3; its main aim was to prepare the "intervention phase", the heart of the project, that must be implemented in the period between September 1999 to June 2000.

The present deliverable is the third one reporting the work realised in this work package. The first one (A 03) focused upon the user's needs and the training of teachers. The second one (A 04, Kikis-Papadakis & al, 1999) was addressing issues

[3] REPRESENTATION, DeliverableA01, p. 90

of methodology regarding empirical research. This deliverable deals with an exploratory investigation into children's representation of ICT and with the elaboration of an initial conceptual model.

As stated in Deliverable A 04 (3.4) the approach by which REPRESENTATION is addressing this exploratory investigation is through the collection of empirical evidence from a selective subgroup of the participating groups of schools (named 'group A' in this deliverable). The commitment of this group in a longitudinal perspective (within the project's time frame of activities will allow the research team to study the evolution of ICT representations (both in terms of formation and re-formation).

This preliminary investigation was led in six classes in the spring of 1999. This report is devoted to the presentation of the first findings of this investigation.

Chapter 1: Methodological Context

The project deliverable A 04 has set precise lines to be followed and set up a case study orientation. In effect the project, from its initial conception, called for comparative analyses of cases.

In the context of this project Case Studies are investigated at three levels:

a. The national contexts
b. A set of schools within each of the six national contexts represented in the project, those being Denmark, France, Greece, Netherlands, Spain and United Kingdom.
c. The individual schools, 30 in total, that are participating in the project. A descriptive analysis of these contexts has been presented in the project's Deliverable A02 "Analyse comparative des usages des NTIC dans l'école primaire européenne".

This case–oriented method was "expected to stimulate a rich dialogue between ideas –such as the concept of mental representation and its educational implications– and practical evidence. Because of the flexibility they allow in approaching social reality, case–oriented methods do not restrict or constrain the examination of evidence. They do not force researchers to view casual conditions as opponents in the struggle to explain variation. Rather, they provide a basis for examining how conditions combine in different ways and in different contexts to produce different outcomes"[4].

The main purpose of the tasks reported here was to get an initial picture of pupils' representations about ICT. Therefore, a preliminary very important task was to design a common conceptual framework for collecting data. This framework was

[4] Representation, Deliverable A04, p. 16

defined by a special task force[5] that met twice and communicated via electronic mail.

1.1. Framework for collecting data

It has often been reported in the literature that children's views of computer technology are influenced by variables such as gender, age, and the use of computer in home or school environment. That is why contrasted cases have been selected. The granularity of observation has been the school, with a focus on particular classes. It was decided to select one class per country, belonging to the schools chosen for the project investigation (group A), with a focus on children aged around 10, allowing however for slight variations.
The choice of relying on a combination of drawings, text writing and interviews as a research tool has been made very early. This choice could in effect lead to rich data and allow for rich interpretations.

The canvas for getting data (see Annex 1) can be summarised as follow.

- Each pupil of the chosen class was to be asked to draw on a sheet of paper a computer and to produce a legend giving the name of the different parts.
- Then, each pupil was to produce a short text (naturally in his mother tongue) on the theme "*What is for me the usefulness of a computer*".
- On the basis of this first production, six pupils were to be selected in each class and interviewed.
- In a second time, the class was asked to produce a short collective work about what computers might bring in the future, under the supervision of the teachers. The process was realised by the way of the teacher's choice.

Selecting six children for further analyses was to be done according to the following criteria:

[5] This task force, that met twice in Paris, mainly communicated through e-mail, both internally and with other partners; it gathered participants from Belgium, Catalonia, France, Greece, United Kingdom.

- Try to represent the different pupil profiles as seen in the classroom, taking into account the variables suggested in the canvas.
- In case of doubt, try to obtain typical profiles in order to represent the typical, normative pupil of that class and socio-economic context.
- But avoid including extreme cases, such as pupils with special education needs (because their profiles are far beyond the possibilities of our research).

Before realising the interviews, both the pictures and the texts were to be analysed according to a specific grid (see Annex 1, section 3.2). After that, one report per child selected was to be written, describing his/her mental representation about technology as seen in the picture and the text, as well as in the interview (cf. Annex 1).
All the data were transmitted through First Class and a comparative analysis was led in INRP.

It is important to stress again here that the aim of this diagnostic phase only aimed at capturing an initial picture of pupils' representations of ICT all around Europe. Of course, in the context of this preliminary study, it should not be considered that any differences between countries could be proved; neither should it be considered that there is a country consistency, since there is only one class per country.

1.2. Work actually done in the schools

The chosen scheme was globally respected. However, in accordance with the principles of action research (cf. deliverable A04), in some cases, ecological validity made it necessary to adapt the tasks to the particular practice of each school and teacher. Two partners deviated from the initial framework. Depending on the class habits, interviews could not take place in Greece, and were replaced by a class discussion. The UK contribution to the data collection also included another protocol that is developed hereafter.

The special protocol used in UK, relying on a spider-mapping task, has been set up in order to obtain richer data. Spider-mapping or indeed any type of linked drawings are a means to depict related or unrelated thoughts and produce something more concrete from which the initial ideas can be developed, or the methods of linkage considered. A simple version is a linked list, which can then be developed into a concept-map.

The rationale for using spider maps can be found in the works of Tony Buzan (Buzan, 1995), following his research into note taking techniques[6]. Comparing several techniques for taking notes during a lecture, he found that writing only key words lead to more remembrance. With this result and other research, he suggested a new method for taking notes, using only key words and images, what he called mind maps (as brief and interesting for the eye as possible). These mind maps appear to be used in many different ways other than just taking notes.

The common feature here is "map" which captures the need to depict ideas or thoughts spatially and graphically rather than textually using connected prose. In the UK the term 'Spider Map' is sometimes used when teaching pupils because the idea of a spider with a central body and lots of radiating legs is intuitive and easily grasped. Occasionally these are used to represent concrete physical entities - e.g. parts of a computer or computer network. But when developed fully, they can also be used to map abstract relationships or cognitive processes, which can then be called concept-maps, but this terminology would not generally be used in the primary classroom.

There are no requirements to meet a fixed design or style for such drawings, as this tends to be more a matter of personal choice. Individual creativity is the key to the process. Therefore, limits placed on the structure in this way would be inappropriate. Drawing competence consequently is not such an issue; indeed spending too long perfecting graphical components can inhibit the creative process,

[6] Mind map FAQ, world.std.com/-emagic/mindmap.html.

and prevent the use of concept mapping or indeed spider maps as a brainstorming tool.

Consequently, the corresponding cases slightly vary. The products are therefore not strictly comparable, even if they are very informative and provide a strong basis for giving an initial picture and establishing a diagnosis.
A short description of the different cases is given below.

1.3. Short description of the cases[7]

1.3.1. Denmark

Located in Copenhagen, the Hellig Kors Skole is an urban Folkeskole (Primary and lower secondary school) with 70 per cent bilingual pupils. The total number of pupils is 450. The school has 50 teachers, 20 normal classes and seven classes with special education. There are 16-17 pupils in the normal classes and 5 pupils in the special education classes.

At the Hellig Kors Skole, educational vision or mission is to make attending school fun and educational. The pupils have to become professionally competent in order to do well in the Danish society, and the school is putting a lot of work into ICT integration. The teachers have attended courses in pedagogy and ICT. However, the teacher of the selected class has never been involved in a real ICT project together with the pupils.

The 19 pupils of the selected class do not have access to computers in their own classroom but move to a special computer room when working with ICT. The pupils have used the computer for writing stories and poems, for arithmetic, and together with special educational software. When having a supply teacher the pupils are often allowed to use the computer for games and Internet. A “Computer Café” is arranged for the pupils between 9 and 12 years once a week.

[7] The data in the following section are mainly extracted from the annexed national contributions.

The parents of the pupils were informed about the Representation project through the newsletter of the class (in the next newsletter we will ask the parents for their permission to let us use the photos taken in the classroom). Their class teacher had told the pupils about the project, and the researcher was introduced as a multimedia producer interested in the activities of the pupils' brains when working with a computer.

Each pupil of the chosen class were asked to draw a computer and to write the names of the different parts of the computer supplied with a short text on the theme: "What is for me the usefulness of a computer?" When drawing the pupils have been sitting in their own classroom without any computers as models. The computers on the paper have been drawn according to the pupils' conceptions of a computer. Afterwards six pupils were selected for an interview. While the selected pupils were interviewed one by one in another classroom the class teacher introduced a collective work on the issue: "What might computers bring in the future?"

The class teacher was the main actor, introducing the exercises and selecting the pupils for interviews. Most of the pupils wanted to be interviewed. Afterwards, the class teacher took part in analysing the process and the outcome of the collective work on computers in the future.

The selected class participated in the Representation project from 8 a.m. to 1 p.m., interrupted by two breaks. One and a half hour for the introduction and drawing and writing on the theme "What is for me the usefulness of a computer?" and two and a half hour for the collective work on computers in the future.

1.3.2. France

The Henri Wallon school is an elementary school situated in Valenton in the suburbs of Paris. There are several different ethnic groups within the school, with a percentage of pupils of foreign origin that is higher than 35 per cent. 25 per cent of pupils are asked to 'repeat a year' at 'cycle 2' (age 6 - 8) rather than progressing with their age group to the next class, and pupils are grouped into classes by age.

Henri Wallon school takes as its principal educational mission the improvement of written and spoken language and arithmetic. The necessity to develop citizenship has recently been reinforced. ICT play a secondary role, but teachers and pupils focus their attention on ICT. The school as a whole has elaborated rules for ICT usage, and also a development plan for the future.

At Henri Wallon school, pupils do not have access to computers in their own classroom but move to a special computer room (where the 17 computers the school owns are grouped) when working with ICT. During these sessions, a teacher in charge of ICT supervises the pupils. The class selected for this phase of the REPRESENTATION project (pupils aged around 10) is separated into two groups that go to the computer room one hour a week. Computers are mainly used for French and mathematics exercises, or for other content domain relevant to the class curriculum. The software used was programmed by the teacher himself. Pupils also work at the school journal with Presswork. The school is connected to Internet, but this year, no related activity has occurred, in part because of a too slow access to the net.

Each pupil of the chosen class was asked to draw a computer and to write the names of its different parts. Later, they were asked to produce a short text on the theme: "What is for me the usefulness of a computer?" When drawing and writing the pupils have been sitting in their own classroom without any computers as models. The computers on the paper have been drawn according to the pupils' conceptions of a computer. The whole session lasted no more than 45 minutes. Afterwards eight pupils were selected for an interview by the whole research team in collaboration with the teacher in charge of ICT. This choice has been determined following a preliminary analysis of the drawings and of the texts (with an attempt at balancing the choice among genres, school achievement, and the possession of computer at home). Finally seven children (one girl was absent the day of the interview) were interviewed one by one.

For the collective work, eighteen pupils (13 of this class and 5 of another class) responded to the question: "In your opinion, what might the computer bring during the future years?" They have to think about it individually, then every pupil having a proposition could communicate it to the rest of the class and answer the questions of his/her fellows. At the end of each proposition the whole class had to vote for it (see French part in Annex 4).

1.3.3. Greece

The research activities took place in a classroom of the 6th Primary School of Rethymno. Information about the school can be found in the earlier report on the schools participating in the project[8]. This is an urban school located in the centre of Rethymno town. 12 pupils have foreign origin (Albanian, 1 Bulgarian and Ukraine 2). There are 24 teaching staff. Among them, 21 are class teachers; one is a foreign language teacher; one an athletics teacher; and one a music teacher. The total number of pupils is 350, and the total number of classes is 18, three per grade.

It should be mentioned here that by the time this research took place no computers were installed in the 6th Primary School of Rethymno. Nevertheless, the school is going to have its own computer room by the beginning of the next school year. It will be equipped with 12 computers, a local area network and Internet access. The pupils are well informed on this prospect and as we were told by the teacher are eagerly waiting to work with computers.

The pupils were asked to produce, within the limits of a school-hour (about 50 min.), a drawing of a computer and a short text about the usefulness of the computer in two A4 white sheets of paper. All pupils responded enthusiastically to the tasks.
The texts and the drawings were collected by the teacher and the researcher during the break. A third research activity was also planned, namely the conduction of interviews with individual pupils (six in total). The teacher, however, suggested that this is a very uncommon practice in everyday school life and it would be closer to pupils' experiences if a class discussion was organised instead. The teacher also

[8] Deliverable A 03.

stressed that it would be difficult to choose some pupils for interviews given the willingness and enthusiasm of all of them to participate in the activities. Given the above it was decided to proceed with the class discussion.

The classroom discussion was arranged to take place two days later because it was decided that a thorough examination of pupils' drawings and texts would help better design and direct the classroom discussion. It was agreed with the teacher that this discussion would be tape-recorded. The pupils were also informed and agreed. The classroom discussion was designed to provide us with data about pupils' computer experiences and their views regarding the usefulness of computers in school teaching and learning. The actual discussion lasted about 40 min.

1.3.4. Netherlands

The St. Jan School is situated in the Western parts of Amsterdam in the middle of an early 20th century quarter. The school has a Catholic board. As only few children are part of the actual Roman-Catholic church the school pays attention to all kinds of religious identities. The school has 210 pupils divided into 10 groups. The ethnic background is diverse: 54 Moroccan pupils, 41 Surinam, 33 Turkish, 30 Dutch, and the rest of the pupils have 10 different nationalities. The school has 19 teachers, a janitor, a special needs co-ordinator (Senco), an ICT-co-ordinator, and a responsible person for confirmation classes (catechist). Hardly any pupils repeat years. Although the system is based on frontal teaching, differentiation is paid attention to, both in classroom and via special programmes done by the Senco.

The mission of the St. Jan School focuses on co-operation between pupils, and between the teacher and the pupils. The increase of self-confidence of the children and their progress in learning is realised by offering the right incentives of entering the proximal zones of development (Vygotsky), thus creating tailor-made education, within a clear structure and organisation. At the background lies the vision that children should be given enough 'luggage' to go on and to keep on developing themselves: 'learning to learn' and 'life-long learning' are the statements here. ICT is seen as part of the mission and vision: it should contribute to them.

The selected group has two female teachers, one of them, teaching the group for about 1,5 day a week, is also the ICT-co-ordinator of the school. The 21 pupils of this group have access to two Personal Computers in their classroom. These are used for educational software, both for drill & practice and remedial purposes, and for word processing. Right outside the classroom in the corridor are 15 Network Computers next to each other. The NC's are primarily used for Internet-based communication or WWW-browsing, both for learning and for fun. Also word processing and courseware is used. In addition (Java) games are played.

The pupils had been told about the project by their teacher the day before. A letter for parents was provided with information about the project, and a request to be allowed to use image and text materials for the purposes of the project.

These pupils were asking by their teacher to draw a computer and to write down the different parts of the computer (two computer were present in the classroom). After that the teacher introduced the short text (but there had some problems of translation (see Annex Netherlands).
For the collective work, the teacher asked the pupils (except the six chosen for the interview) to form 7 groups of 3 and distributed the themes over the groups (see Annex 4).

1.3.5. Spain (Catalonia)

The Avenç School is an urban primary school in a typical middle-class neighbourhood in Barcelona. The total number of pupils is 430. The school has 50 teachers-three often acting at the same time as head-teacher, secretary and assistant head teacher-, and18 classes plus 6 of pre-school education. 10% of the pupils are considered to be pupils with special education needs but they are integrated in the normal classes with their corresponding age counterparts.

Most children are native Catalan speakers. Their parents belong to the urban middle class, being most of them professionals or small firm's owners, mainly in the services sector or in city commerce. Less than 5% of the pupils' parents were born

outside Catalonia and only 1% abroad. As usual, the majority of the families live in the neighbourhood.

A lot of emphasis is placed on the educational applications of ICT. Pupils are introduced to computers in the first class. There are currently two dedicated ICT classrooms. The school was connected to the Internet two years ago by the government (PIE), but they acknowledge that only e-mail facilities are used -and exclusively by the older pupils and by teachers, of course.

The teacher responsible for this class is also the ICT co-ordinator at the school. However, the teacher of the selected class has never been involved in a real ICT project together with the pupils. There are only three classes with computers inside the classroom -the ones corresponding to the older pupils. The selected pupils have had only a very introductory session to the Internet during this academic year, but as a matter of fact they haven't used it. These pupils tend to use the ICT classrooms for exercises in maths and language, as well as for game playing with edutainment software, always under the supervision of the ICT co-ordinator. -

The day of the activities[9], the researcher attended the morning session and was introduced as a colleague teacher interested in learning more about pupils' views about ICT. During the morning session, the researcher acted in fact as a teacher assistant, helping the teacher to carry out the normal activities in maths, social sciences and language. After the morning break, the teacher asked every pupil to draw a computer and to write the names of the different parts of the computer supplied with a short text on the theme: "What is for me the usefulness of a computer?". This activity was carried out during one hour and a half. It is important to take into account that there are no computers in the classroom.

[9] Permission was obtained form the school council to ask pupils to participate in this project. The ICT co-ordinator, who is at the same time the teacher responsible for the selected class, was informed about REPRESENTATION some six months ago. One week before the activities, she was trained by the researcher following the guidelines.

In the afternoon session six pupils were selected for an interview with the researcher. While the selected pupils were interviewed one by one in another classroom the class teacher introduced a collective work on the issue: "What might computers bring in the future?". The afternoon session lasted for two hours, as usual. The teacher accepted the guidelines provided by REPRESENTATION. She was asked to participate in the analysis of the pupils' drawings and texts and her contributions proved to be invaluable. It is important to mention the fact that after the first hour of acting like a teacher assistant the researcher was seen more as a part of the class than as a foreigner. The interviews were audio-recorded. The discussion was video-recorded by the teacher.

Six pupils were interviewed for 30 minutes each. An interview scheme were used for notes combined with a tape-recorder. Pupils appear with their real names[10].

1.3.6. United Kingdom (England)

Northowram County Primary School caters for pupils aged 3 to 11. It serves the village of Northowram, four kilometres from Halifax, and the surrounding rural area. The school is both well situated and modern in structure (new buildings were opened in 1978 and extended in 1996). Pupils at the school come from families living either in privately owned houses or a small estate of council houses. Most pupils come from English-speaking homes, and there are only six pupils of minority ethnic origin in the school. Pupils' attainment upon entry to the school overall is average with a significant minority above average. The current number on roll is 325, of whom 159 are boys and 166 are girls. There are 49 pupils on the register of special educational needs, of whom three are Statemented. The school's Ofsted inspection report of 1998 points out (para. 33, p. 13) that, at 15 per cent and under one per cent respectively, these figures are below the national average.

The development plan of this school is effective for supporting school improvement and provides a firmly base for the raising of standards, which includes the improvement of the quality of teaching in information technology. Whilst there is

[10] Unfortunately, the authors received the Spanish contribution too late for fully take into account the rich data it contains. Nevertheless the full report is included in annex 4

some direct teaching of ICT it is the policy of the school that much of information technology is taught through other subjects.

The school has a variety of equipment for Information Technology in addition to computers and printers, and they include controllable robots, a digital camera and control box. There is at least one computer and printer in each classroom and a machine with a CD drive is used in the library. The types of computers used by the pupils are 13 Acorns in classrooms with printers. One in Library with CD-ROM and Printer (A7000).

All the pupils use ICT for a minimum of 20 minutes per week. There is at least one computer and printer in each classroom and a machine with a CD drive is used in the library. The current focus is on Logo activities, including the use of the Roma, data handling and Hyperstudio. Pendown, Data Suite, HyperStudio and CD-ROMs are popular with the pupils.
32 pupils from Year 5, a single class grouping in this school, participated in this phase of the study. The teacher has agreed to work with the REPRESENTATION project along with the ICT co-ordinator who is a Year 2 class teacher. They are both competent computer users.
After an introduction by the researcher (10 mins), the pupils were asked to draw a spider type map showing different types and uses of computers in their world (10mins) and to make a list of ideas/words generated from this activity (10 mins). Then they had to draw and label a large drawing of a computer system (10 mins), and write for ten minutes about the usefulness of computer systems in our lives.

Chapter 2: Results about Pupils' ICT Representations

Before presenting results, it should be reminded that the objective of this empirical work has only been to establish an initial cartography of children's representations of ICT. We'll first present preliminary remarks about the different methods that have been used to capture children's representations. Then findings will be classified under three headings: ICT objects, ICT functions or uses, ICT users.

2.1. Preliminary remarks

The collection of data seems to have posed no major problem, the pupils being willing to discuss the topics and to express themselves.

Greek data is particularly expressive as regards this positive attitude, both in the collective work and in the text. Indeed, the adjectives used are only from a positive valence (e.g.: clever, important, and useful).

Many data have been collected in the different countries. They constitute a rich material that could be submitted to many in-depth analyses (notably when one works on the correspondence, for individual pupils, between drawings, texts and interviews). These in-depth analyses have not been performed for several types of reasons. First, the aim of this phase of project REPRESENTATION was only to establish an initial image of pupils' representations of ICT. Second, there was only a very limited amount of time available before the end of the school year (all the more as there was some delay in the completion of the previous tasks). Except for two countries (France and United Kingdom), the data available for the comparison between countries concern only the six children selected for the interview. Therefore, only an exploratory analysis has been performed, that has been considered as sufficient for preparing the subsequent work packages.

The data was collected through four media, drawing (every country), spider-mapping (UK only), short texts (every countries), collective work (except in UK) and interviews (except in Greece). The following section tries to highlight how

differently each approach has contributed to the initial picture of pupils' ICT representation that will be presented afterward[11].

2.1.1. Drawings

The drawings appear to give very interesting clues as regards the ICT representation of the pupils. Although roughly similar as regards aesthetic features, they show considerable variations in their components. This leads one to think that the differences in drawing abilities cannot be the sole explanatory factor. Relating this variations to the data obtained during the interviews, whenever possible, gave a good insight upon what pupils know or not, consider as important or as unimportant, use or do not use. Drawings are very efficient at giving insight upon the representation of hardware. Through the very simple index of number of computer parts depicted, this representation happen to be either very complete in children often confronted with computers (particularly at school), or very poor for some of the least exposed ones. Besides, drawings confirm some of the hypotheses that could be formulated concerning the use of ICT. For example, any physical device such as wiring is not relevant and thus may be neglected. What come at the first plan are the parts that are subject to children's activities.

2.1.2. Texts

The texts collected (that have all been written in the children's mother tongue) show considerable variations from one country to the others, but are relatively homogeneous within a same school. For instance, in France they are rather short, and generally poor as well from the content point of view as from the vocabulary used. There are very few adjectives and a very limited range of verbs and nouns. At the opposite, the English pupils produced texts that were rather long and rich. The shortcoming of the language production approach in order to inquire representations, noticed in Deliverable A 01, is thus partially confirmed. Particularly writing have proven to be difficult for the children of lowest school achievement. However, a glance at the French pupils' production indicates that this

[11] Due to the late communication of the Spanish annex, its content could not be considered in the present deliverable (see contribution in annex). However, it is worth noting that it does not conflict with what is written below.

approach could be improved to obtain richer data, particularly with an enrichment of the writing assignment comparable to the one introduced in the English data. It is nevertheless important to note that the poverty of the vocabulary is also reflected in the drawings and in the interviews. On the other side, some pupils appear to have very strong technical knowledge, and the associated vocabulary (see NL and UK Annexes). These differences in the extent to which pupils are able to label objects are no doubt influential for learning, at least about ICT themselves.

2.1.3. Spider maps

Spider maps obtained in the UK school must be analysed in the light of the particular protocol used. They show that drawings of this kind capture a wide variety of ICT related activities. They also demonstrate the diversity of both ICT and computers in a worldwide setting. For instance many show worldwide communication and interaction between business and social functionality. At the lowest level, games predominate. Spider maps nevertheless hardly capture procedural representations.

2.1.4. Interviews

The interviews, as defined in the framework, have provided a confirmatory data upon drawings interpretation. They sometimes allowed enriching our comprehension of the drawing (see below for the French case). For example, they proved that some missing components (as wires) although not having been represented, were known. This usually did not invalidate the interpretation of drawings but rather suggested that only components that are functionally important for pupils are inserted in the depictions. Interviews also permitted to undergo the language difficulties pupils faced with when writing the text. However, it appeared that the procedural component (mention of actions that may be performed within the ICT domain, or explication of how systems function) is very underrepresented in what has been extracted using the defined grid for the interviews.

2.1.5. Collective work

Collective works, as it was conceived in the initial methodological canvas, was aimed at better exploring the imaginative part of the representational space.

Whenever they were performed, they demonstrated a strong involvement of children regarding ICT, with again a very positive and confident attitude toward computers. They also revealed important gaps in children knowledge of computer technology, since some classes described as imaginary some devices that already exist (cf. French and Greek Annexes). The imagined devices were often attributed human characteristics. In this context, altogether, the collective works have particularly highlighted how important children find it to develop a language-based mode of interaction with computers. Denmark and Netherlands contributions are very exemplary here. It is worth notifying that the interaction that pupils wish is usually an asymmetric one, where computers are expected to respond to their request in spite of having any initiative.

The remaining of this section presents some preliminary findings that emerge from the data collected. The data has been questioned according to a three dimensional axis comprising ICT objects, ICT functions, and ICT actors. The results of this will be presented correspondingly.

2.2. The ICT objects

By ICT object, it will be meant here any piece of hardware or software. The hardware is quite easily decomposable into components, from the whole system to each of its part, or even to the microcircuits and electronic components (although the later level certainly is not relevant here). As regards software, such an analysis is harder, and the granularity of the analysis itself is problematic. In this preliminary work, only the level of applications and files has been considered. It must however be kept in mind that software components (command, windows, controls, etc) would be worth investigating.

On the whole, French pupils mentioned very few objects pertaining to the word of computers, on both hardware and software sides. The poverty of ICT objects present in the representational space emerges from all data gathered (language based methods, or picture based ones as well). Procedures, programs are hardly mentioned, and when they are, the vocabulary is not the appropriate one. The

actions that may be performed with the objects are in very limited set, and are often described with an approximate wording. Even games that seem to have a first plan role in children representation of ICT are very few to be mentioned in French data. At the opposite, English and Netherlanders are able to mention many possible uses of ICT, and brands or program names are very current.

Whereas discrete uses (e.g. playing music, cf. UK Annex) are represented in spider map data, they do not often appear in other countries (neither in the texts nor in the drawings of computer systems) except when imagination is called for, i.e. in the collective work.
On the whole, pupils seem to have perceived both hardware and software as reliable. There is indeed almost no dysfunction mentioned, with only some references to the millennium bug.

2.2.1. Hardware

The concept of hard disk is almost absent in the data collected in France (see also below, the storage function). The CPU does not have a central role in the machine, and is not always represented (and never named appropriately). It is used only to insert floppies and CD-ROMs. The component that is considered to "think" is the screen (see typically French annex: Rachid), and this can be seen in the fact that the few represented cables converge to it. The concept of "computer" seems to include only the parts that the children regularly interact with: screen-keyboard-mouse (e.g. Hakima). Danishes drawings and interviews give the same impression. The size of the screen is sometimes a little exaggerated (for example as regards the size of the keyboard) whereas that of the CPU tends to be diminished. This confirms their relative importance.

Among all the countries, three categories of keyboards (non-exclusive) were found in the drawings: the grid-like ones, the ones that depict particular keys, and the one representing the numeric pad. It appears that when characters are represented on the keys, they are almost always rearranged according to the alphabetic scheme, more usual for children. These large differences between drawings might uncover

differing modes of interaction with the computer, and this idea might be further investigated.

Although in Greece the school had no computer at the time the data was collected, and the pupils had rarely a computer at home, CPUs are represented very often. In Netherlands data, the CPU also appears often[12], but it does not seem that the children perceive its central role better than in the others schools. One of the drawings of computer systems is particularly talkative about how the UK pupils investigated here are more knowledgeable about computing: In the English annex, one can find a pupil who drew the circuitry inside the CPU. Although it is an imaginary one (the pupil is aware of that) this proves how rich her representation is.
As regards what allows one to connect to another computer, there is almost no trace of awareness in the data collected, except in the spider-mapping task (see below). Modems are out of the representational space of pupils, but this might be in part because of the fact that computers drawn are mostly those that can be found at school. The cables that could represent a LAN also never appeared, but this is in no way surprising since wires that are even more visible are neglected. Although the PC's are often networked, the pupils do not see the device for connecting to the Intranet or to the Internet.

Mice are the most often connected (either to the keyboard, to the screen, or to the CPU). The depiction of the cable might be related to the fact that it is a small object that would be hard to identify without the cable property. Another interpretation is that the mouse cable (and particularly its length) places a limitation on what can be done with the mouse itself.
Printers are sometimes represented in the drawings (see Annex 3 grids from France and United Kingdom).

As regards multimedia facilities, there are again many differences among the schools. Whereas loudspeakers and CD-ROMs as well are scarcely drawn in

[12] Note that according to Netherlands annex, computers were available to children sight during the drawing task.

France, they are very often represented in the data from other countries. Here, it might be considered that sound and CD-ROMs are often associated (in the interviews) with games. Is there a relation between the importance of game in the pupil representational space and the depiction of multimedia components? Greek report points out the plausibility of such a relation between the sound facilities and gaming.

Most UK pupils drew computers with "multimedia" capabilities, as is shown by the presence of microphones, loudspeakers, CD-ROMs etc. Other peripherals were also included, notably digital cameras and scanners, and were shown as being connected to the main computer.

The microphone that is present in one Danish drawing and in one Netherlander drawing never appears in French drawings. Its scarcity in the spontaneous expression of the representations of the pupils contrasts with their willingness to have computers interacting with them through language. But it is true that this equipment is not everywhere present and may be rarely used.

The analysis of spider maps in UK shows that generally multiple uses of computers are represented - computers are most commonly linked to systems or networks. The interconnection between the various computers is normally represented as pencil lines on the drawing. The drawings all have a central “hub” computer from which the network radiates. More sophisticated ones also have links directly between computers on the periphery. Almost all have drawn a computer box, screen and keyboard as part of the spider-map. Discrete use of computers is also represented i.e. toys, cars, funfairs, banks and supermarkets. Children appear to have grasped how many elements of modern life are controlled by computer systems.

2.2.2. Software

In French data, elements revealing Operating Systems appear in only two drawings. Apart from this, games and educational software (although they represent only the software used in their school) are often depicted or talked about. In French pupils,

the vocabulary related to software that is used is very poor, revealing little conceptual knowledge in this area. However, the class investigated has a low level (and was quite well chosen, since it brings very interesting insight on the deficiency of ICT representation in poor socio-economic environment), with many pupils having difficulties even simply with the French language. The analysis of the data show the importance of owning a computer at home (or knowing someone who does…). In the social milieu investigated here, the environment cannot provide the children with complementary knowledge about computer. As a result, they only consider the software they are confronted with at school.

As regards United Kingdom, the analysis of spider maps show that any types of software application are represented, chiefly generic types - word-processing, drawing etc. Some of these are labelled with text, others are identifiable from the drawings; the pupils have drawn the screens and nodes (links) carefully so applications can be identified by logo or typical graphical representation for that software or in some cases the operating system also. Some students have concentrated on specialised environments (e.g. computer games), thus showing a detailed knowledge of this area.

In between these two extremes, the pupils from other countries have diverse knowledge of computer programs. Drawing and writing tools are very often present in the data, naturally after the games that occupy an important place in children ICT representation.

Starting from these very global results, two questions could be now further addressed

- Does the concept of operating system already exist in the population investigated?
- Are the pupils able to classify the software they actually use according to adults' categories (word processors, spreadsheet, database manager, integrate suits, educational software)?

2.3. The ICT functions and uses

In our approach of ICT representations, it also appeared interesting to describe what functions of ICT are used and/or perceived by pupils. Four functions have been considered: learning, looking for information, playing, and communicating.

Indeed, these functions are not independent. For instance playing has a social role that results in communicating, but it can also lead children to acquiring new knowledge. Consequently playing may have a learning function. Conversely, learning with certain tools may be entertaining, as was pointed by many children during their interview or within their text. Looking for information can aim at finding help for learning as well as for playing. Thus the different functions have been explored independently only for theoretical concerns.

2.3.1. Learning

In all the school investigated this function is in a good place in the texts, probably reflecting the context in which data was collected, and children attempts to meet the researcher expectations. But it must be noted that the references to school context are rather frequent in the drawings of children having no computer at home. The drawings of the Catalan pupils are very significant in this respect (see Anna's drawing compared to Mireia's one).

Many French pupils draw a screen that displays the educational software they are confronted with at school, but it is no doubt related to the fact that they do not experience ICT in other contexts. French pupils perceive the computer as a helping device for schoolwork.

At the opposite, Greek children have no experience at all in learning with computers (except one of them). Yet, they place the learning function at a good rank both in their text and in the collective discussion. However the essential meaning of learning seems to be rather different from the one intended by French: learning is more of getting new information, whereas French pupils meant more practising already acquired knowledge.

The French pupils investigated here seem to have developed a representation of the computer as a mean of being taught in spite of as a mean to actively learn with. The computer trains them, providing them with exercises.

2.3.2. Looking for information

This function is at the first plan in Netherlands and UK data, whereas it is almost absent in the French one. Gathering information on Internet is very important to Netherlanders either for compensating lacks of knowledge ("when the teacher does not know") or for satisfying personal hobbies (fan clubs). Many UK pupils knew about the Internet and could broadly describe what it is for. Few presented data that suggested they had "hands-on" experience of using the Internet, either at school or at home, but many expressed a desire to use the Internet. On the contrary, Greece report highlights that there is no such importance to data gathering in the aim of learning, but it is possibly due to Greek teachers traditionally providing pupils with the whole information needed to learn.

2.3.3. Playing

Games appear to be an essential component within the representational space of many pupils.

Some pupils do not mention games in their text; unfortunately, none of them were interviewed (in the French data). It could be further inquired whether the absence of this reference to games relates to the experience children have with ICT. Naturally, other children place game in first position (within the text content, or during the interview).

The social function of playing games (i.e. playing together, exchanging games software or game devices) is rarely revealed in the data.

Interestingly, Greek data appear to give a secondary importance to the game. Although Greek pupils have little (if no) experience with computers and particularly Internet, their interest is high. Among the UK pupils games also showed up with considerable significance. Pupils most often identified specific games and referred to them by name, indeed this specificity was so marked that it was possible to sometimes identify what brand of computer the pupil had at home through the

software which had been "bundled" with the computer itself. This marked awareness of game and program specific knowledge suggests that many pupils' representations of computers are intimately tied to their personal experiences and usage.

2.3.4. Communicating

Here we refer to communicating through ICT, and not face to face communication about ICT. This could also be interesting to investigate, but the data collected according to the framework of WP4 does not give many evidence of this).

French and Catalan pupils do not refer to this communicative function of ICT but exceptionally, and then it is the writing tools that are evoked more than the on-line ones. Interestingly, the few French children that wrote or talk about Internet see it as a mean of communicating and not as a mean to search information, or to entertain. The mailing and dialogue functions of Internet are privileged. As already mentioned, the social aspect of games (having fun with other children, exchanging games, moving to others' place) is rare in pupils. UK pupils also refer to the communicative functions and many had grasped the idea of using computers to send information (e-mail) between remote sites.

2.4. The ICT users

The question addressed here is whether pupils give any evidence of having an implicit definition of ICT users.

Pupils hardly ever represented themselves in their drawing (see the Greek report) and consequently, it is difficult to have an insight of the way they represent themselves as ICT users. However, in the rare case where they represent themselves (see Danish annex, Rudi, and Spanish annex, Anna and Mireia), they often appear relatively small compared to the computer. Other studies (cf. Levin & Barry, 1997) have interpreted this size disproportion as revealing a feeling of lack of power as regards technologies. It is however worthy noting that this feeling is nevertheless associated with a positive attitude that appears in the smiling faces represented.

From the few data collected, no other users especially appear to be highly associated with ICT. Pupils sometimes only evoke their parents using computers within their workplace. It could be interesting to investigate whether some professions are systematically associated with the use of computers, or with the use of certain kind of software.

In relation with the social function described before, it could be wondered whether there is a sense of an Internet community at least in some pupils? Indeed ICT appear to be a mean to join groups (see for instance the communication with fan clubs in French, Danish, or Greek data). It seems however that the feeling of pertaining to such groups cannot be asserted from the rare evidence of groups in the data.

The data collected are by no means sufficient to reveal if pupils have any representation of differences within the computing word (for instance the opposition Mac/PC). There are a few makes that appeared in some children data, but it seems that these occurrences were not related to any particular variable.

Chapter 3: Discussion on Key Issues

Analysing drawings and texts produced in response to a simple request has given interesting information. They confirm that representations are at the time rather similar (e.g. children focusing on the external parts of computers) and rather contrasted with respect to the activities led in the classrooms.

What appear from ICT representations seems to be much affected by the task proposed to pupils. The representations themselves are influenced by the school context, the use of a computer at home and in school and, probably, the gender. More precisely, even if samples are rather small, we may propose a summary of key findings specific to each country. Then, we will discuss methodological issues.

3.1. Summary of the key points specific to each country

3.1.1. Denmark

Danish data provide an interesting example of gender differences, since girls placed the communicating (particularly through writing on word processors) and learning functions in first position within their text, whereas the central role for boys (both in drawing and texts) is given to entertainment.

Denmark is also a good example of how using computers in other contexts can be important in the representations that emerge upon ICT. Only one child (Didi) did not give any multimedia facility to the computer she drew, and it is intriguing to note that she cannot attend the computer café sessions as do her fellows (see Danish annex). It is worth noting that the pupils' representations are rather detailed as regards ICT object and ICT functions that are perceived.

The picture emerging from the collective work stresses computer help in daily life. Entertainment is present in collective productions, but to a lesser extent than in personal works.

3.1.2. France

The school investigated in France is in a particularly difficult area. This context can explain that representations of ICT be rather poor in French data. Low language competencies (related to this difficult context) make it hard to explore the representations apart from using drawing interpretations. In this school, most pupils do not have computers at home, and remarkably, some pupils qualify as computer what would expected to be classified as games.

School ICT activity has a particularly strong impact on these children's representation since they have almost no other experience of ICT. Here, the specificity of Henri Wallon School appears in the representation of computers helping schoolwork. Materials and programs are almost unknown: the essential part often is not represented, and even the vocabulary misses to describe one's own actions with computers.
Internet is not particularly present (contrary to Greece for example).

3.1.3. Greece

Greek data corroborate what has been said about hardware objects in the representational space of French pupils. Children from less favoured social classes have incomplete representation of what constitutes a computer. The Greek case confirms that school practice affect the representation of the functions of ICT. Learning with computer was difficult to represent for these particular children since they had not experienced it. Contrary to French children, most Greek children included multimedia accessories in their drawing, giving them the status of a necessary part of computers.

The pupils of the Greek class expect a lot from Internet, and are numerous to express interest for Internet, albeit the information gathering and entertaining function are not the predominant ones for them. Internet is so invested that even playing game appears to have little importance for these pupils.

3.1.4. Netherlands

Finding information through Internet is the major theme that can be found in Netherlanders' data. The availability of networked computers seems to have provided pupils with rich experience of communicating and gathering with ICT. Particularly the gathering function of ICT found here and the way it is expressed by the children demonstrate how the aim of learning to learn is effectively and efficiently implemented in this school.

Consequently, the Netherlands pupils investigated here seem to have a quite complete knowledge of hardware and to be knowledgeable also as regards networking functions. The extensive use of emailing in the teaching program might have been of great benefit for the richness of the representation about this functionality.

3.1.5. Spain (Catalonia)

These pupils have a rather limited experience of ICT, compared to pupils considered in U.K, Denmark and Netherlands, notably in relation to the Internet. Almost no drawings or comments associate computers with the Internet. In the cases where this association is made, it seems to be caused by the existence of Internet connections at home.

All the pupils seem to differentiate clearly between computers and game consoles, the former being more powerful and allowing a variety of uses.
The presence of computers at home, mainly when parental advice and involvement are seen, seems to be a determinant in the way in which pupils represent computers. Only pupils with computers at home can depict the different parts of a computer.
In general, pupils with almost no contact with ICT at home tend to have a more infantile representation. Inversely, pupils that see how their parents use the computer on a daily basis tend to insist on ICT as tools for work.

As a conclusion, it could be stated that these pupils' representations are more influenced by the uses they see in the adult world –mainly at home– than by the

uses in which these pupils are directly involved at school due to their limited experience.

3.1.6. United Kingdom (England)

UK pupils expressed rather rich knowledge about both ICT objects and ICT functions. These pupils seem to have a high awareness of the importance of computers in their life, and in the life of every people. Many of the UK pupils appear to have grasped the underlying concepts of networks, both local and global, and were happy to connect computers together with pencil lines. The diversity of the nodes was also surprising, some showed business, offices and banks, whilst others also included hospitals and shops. UK pupils demonstrated through their spider mapping that they had noticed computers functioning in a wide variety of social and organisational contexts, and knew that in some way these computers were connected. To qualify this finding, it must also be stated that no pupils showed any real understanding of the underlying technology of networks: specific knowledge about cables, modems, and network cards etc., was notably absent.

A sharp division amongst the pupils who had computers in their home environment and those who did not was also noticeable. Those who had a computer (rather than a games console or system) were far more likely to name software, including operating systems (Windows 95 and 98 were most often mentioned), and add manufacturer specific labels and logos to their drawings. A tentative conclusion of this data set is that pupils identify closely with machines they have at home, and represent these computers in quite specific ways. The UK pupils are from a school with an above average socio-economic profile, and the school does make efforts to give every pupil a chance to use ICT on a regular basis. This was clearly a significant factor affecting the pupils' representations of both a computer and a computer system.

3.2. Methodological issues

Within the frame of this exploratory phase, it must be remarked that the data collected so far certainly present important biases. For instance, some computers

were in sight of the pupils during the session in several, but not all, schools. Although the text assignment was rather specified in the canvas, some preparatory activities took place in some of the schools whereas the assignment was only presented as such in others. As a result, some school appeared to have more knowledgeable children. For example, whereas the NL pupils seem to be very comparable to the UK ones as regards their knowledge about network functions and about hardware, they did not demonstrate the same awareness of the importance of computer in everyday life. Interpreting this difference would however be risky, since the tasks used were not quite the same. The methodology used in UK might have brought to light some elements of the children' representations that would not have emerged otherwise.

However, despite inconstancies of methodological homogeneity, having collected several forms of evidence upon representations in each class allowed us some comparisons between countries and schools. These comparisons, when keeping in mind the differences in methodologies are quite informative.
Still, it appears that the data collected do not allow an access to fine-grained ICT objects; the reality of children as ICT users hardly appears. Although the representational space that emerged from the spider mapping activity is quite complete about ICT objects and functions, even this method also gave little insight in ICT use and fails to capture procedural representations.

The procedural component notably, that was expected hardest to uncover (cf. Deliverable A 01), does not either much appear in both interviews and texts.
Among the countries where they have been carried out, the interviews however proved to give an interesting confirmation of what could be asserted from drawings. They also permitted to undergo the language difficulties pupils faced with when writing the text. But they gave no data about the way computers work.
Thus, a complementary research action has been set up in one of the schools pertaining to the French network (Victor Hugo school in Créteil), in order to test whether other interview scheme could give more information about procedural representation, and notably on the way computers or e-mail works

The 29th of June, the last day before French summer holidays for primary students, three interviews were led with groups of three pupils about electronic mails and related topics, trying to engage pupils to describe what happen when they send or receive e-mails.

The results emerging from the transcription of these interviews must be taken with caution. They however provide some interesting hints.

- The description of email is closely related to the real use pupils have at home or in the classroom. For example, some pupils only mention the possibility to write to students of another class.
- The students are unable to provide explanations about the way information is sent to another place. Some of them can evoke some notions, *network*, *site*, *connection*, *and subscription*… without really being aware of their meaning. For example, one says that a network is like a "battery full of energy".
- Concerning the task of sending an e-mail, pupils can only mention the different actions they have to do according to the software they use.
- Much confusion can be remarked between the notions of e-mail, Internet, web site, and so on. No one has a clear understanding of the relationships between these notions. For example, one pupil says: "…the e-mail, that is the address, Internet these are sites, these are information". For another one: "the mail, one receives messages that somebody sends to us and Internet one sees everything".

Thus, pupils are conscious of the tasks they perform and can speak about them in enumerating the successive actions they do but have absolutely no idea of the underlying procedures.
The previous findings render improbable that drawings and text should bring new elements. In fact, time has probably come to develop other methods.

Propositions of Action

In deliverable A04, it was proposed to select a set of common questions/activities across Europe. Several examples were given:

- Use of e-mail: ask pupils to draw concept maps of what happens when e-mail is sent. Children will be interviewed to allow elaboration of the concept maps.
- Saving data: ask pupils to elaborate what they do when they finish their work on the computer. What happens to the work they produced? Interview pupils while doing the task.
- The Internet: ask pupils to draw everything they can think of regarding the Internet.

Those tracks need to be followed in the next work package, with different methods (and notably interviews, that have proved liable to produce rich data).
One central idea would now be to have children draw concept maps in every country. This implies two important things.

First, a common tool is needed for that. It can be the REPRESENTATION tool, provided it is sufficiently robust by the beginning of the school year. This condition of robustness is in effect very essential for a classroom setting. Would this condition not be fulfilled, K-12 Inspiration would be a convenient choice. This issue will have to be debated in the next consortium meeting in Huddersfield in September 1999

Second, teachers have to be trained, according to the lines of deliverable A03. Teachers have an important role to play in imagining pertinent activities for classroom use. A possibility could be to invent, collaboratively with teachers, templates for children to use them on precise issues.

References

Baron G-L, Bruillard E and Dansac, C. (January 1999)- Representation: first Deliverable.

Buzan, Tony (1995). - The MindMap book. - 2 ed. - London: BBC Books.

Bruner, Jerome. S (1966). – Toward a theory of instruction. – Cambridge (Mass): Harvard University Press. - 176 p.

Dewey, John (1998). – Experience and education. – West Lafayette (Ind.): Kappa Delta Phi. …)

Gardner, Howard (1980). - Gribouillages et dessins d'enfants. Leur signification. Pierre Mardaga, Bruxelles. - 320p.

Jonassen, David & Henning, Philip (1999). - Mental Models: Knowledge in the Head and Knowledge in the World. - Educational Technology/ May-June 1999 - p. 37-42.

Kikis-Papadakis Kathy and Pedro Francesc. - Élaboration de l'approche méthodologique concernant les études de cas. Deliverable A 04. - 92 p.

Levin, Barbara. & Barry, Sean M.(1997) – Children's views of technology: the role of age, gender and school setting. – Jl of computing in childhood education (1997), 8 (4), pp. 267-290.

McAleese Ray (1994). - A Theoretical view on concept mapping. - *ALT*, 2,2, pp. 38-48.

Miles, M.B. & Huberman, A.M. - Qualitative data analysis. - Newbury Park, CA: Sage Trouver les références exactes

Pasquier Dominique. & Jouët Josiane, coord. (1999) - Les jeunes et l'écran. - Réseaux, 17 n° 92-93. - Paris: CNET/ Hermes, 478 p.

Perriault Jacques et al. (1983).- Pratiques et représentations de l'ordinateur et du téléphone chez les enfants de 6 à 12 ans- Deux études de cas.- Paris, Ministère de l'industrie et de la recherche/INRP. 216 p.

Turkle Sherry (1986).- Les Enfants de l'ordinateur (computers and the human spirit).- Paris, Simon and Schuster : Denoël (Presence de la science), 318 p.

Somekh, Bridget, Kikis-Padadakis, Kathy and Freedman, H (March 1999). - A comparative analysis of ICT in European primary schools. Deliverable A 02. - 249 p.

APPENDICES

ANNEX I

Framework for Collecting empirical Data about Pupils representations (for wp4 & deliverableA05) 9 Avril 1999

The following aims at guiding the REPRESENTATION researchers to undertake empirical study of WP 4.

1. Subjects investigated

One class by country, belonging to the school chosen for the project investigation (Group A). It should be a class of children aged 10. No need to worry about its configuration since our main focus is on the validation of the research tools and procedures.

- Each pupil of the chosen class will be asked to draw on a sheet of paper a computer and to produce a legend giving the name of the different parts.
- Then, each pupil will be invited to produce a short text on the theme "*What is for me the usefulness of a computer*".
- On the basis of this first production, six pupils will be selected in each class and interviewed.
- If it is possible, the whole class might be asked, in a second time, to produce a short collective work about what computers might bring in the future, under the supervision of the teachers. The process will be realised by the way of the teacher's choice (it should be interesting to see if ICT proposed for this action).

2. Considerations of methodology

Talk openly to the teacher responsible for this class and ask for his/her co-operation. Help him/her to understand clearly what we intend to do. It is teachers that should propose exercises to students.

In order to give coherence to the task, try that the teacher introduces the two exercises (drawing with legend and short text) in the same day or hour.

Let the teacher some time (say, two days) to analyse the results of these two exercises. Then talk to him/her in order to obtain his first impression and evaluation regarding how children regard technology –i.e., how they mentally represent

technology. Decide with him/her which six children could be selected for further analyses. We could propose to take into account the following criteria:

- Try to represent the different pupil profiles as seen in the classroom, taking into account the variables suggested in the canvas below.
- In case of doubt, try to obtain typical profiles in order to represent the typical, normative pupil of that class and socio-economic context.
- But avoid the possibility of including extreme cases, such as pupils with special education needs (because their profiles are far beyond the possibilities of our research).

Before conducting the interviews, analyse both the pictures and the texts according to the proposed grid (see below). Whenever possible, scan both the six pictures and texts.

Write one report per child, describing his/her mental representation about technology as seen in the picture and the text, as well as in the interview (some 3 pages per child).

For the collective work, prepare the discussion with the teacher. But again, let him/her to conduct the discussion and do not interfere. Attend the discussion and take notes about the contents, views and representations shared. If there appears to be an outcome out of the discussion, such as a text or a picture, take it with you. If possible take digital pictures.

Write a final report on how this class sees technology. Pay special attention to the results of the final discussion. Provide the detailed results of the grid.

Send all the reports to the INRP.

3. Proposed tools

3.1. Canvas for the pupil's interview

Time per pupil: about 30 mn

1 - Objective data

- Age of the child, gender, brothers and sisters… parents' work, etc. (Maybe the teacher already has some of these data and can provide them to the researcher).
- Their favourite hobbies
- Do they have one or several game consoles?
- Computer at home?

Yes: How long (< 1 year, >2 years…), (multimedia, scanner, Internet…)

Who is using it mostly: him, his parents, brothers and sisters, what do they do with (work, domestic, home work, games, Internet…)

Pupil's practice: What (games, home work, edutainment, Internet –for what-, others…), time, (sometimes/everyday…), alone/with parents, brothers/sisters, friends (age)?

No: practice in other places (relatives, friends…)? If yes, same questions than "at home"

2 - About activities at school

- Practise on the computer before this year? If Yes, what?…
- Practise on the computer this year?

No: would they like to practice, for what?…

Yes: do they enjoy your activities on computer this year? What did he prefer?… What would he like to do?, help in school work…

Self evaluation in the level of competencies, does the pupil help his friends or is he helped?…

3 - About drawings and texts

Starting from the drawings of children, ask some questions to let the pupils complete and show his/ her technical representations of functions of the

computer. Eventually, ask some definitions of: computer, informatics, software, Internet, CD-ROM…

Starting from the texts of pupils (and eventually from the collective work), ask some questions to better understand what has been written by the pupil (in the text "what computer is useful to me").

3.2. Grids to help the researchers to collect data from the excerpts and make some generalisations.

1 - Grid for the pictures

This grid should be applied to each picture and a general table of results will be added to the final report. For example, answer the following questions:

- How is the picture: in colour, b/w
- How many parts are depicted. Which parts are these (screen, mouse, etc.)
- Are they connected via cable
- What can be seen on the screen
- Is anybody working on it or wandering around it. Who is he and what is he doing
- Comments: is there anything worth to notice

2 - Grid for the texts

For example:

- How many words and sentences
- List up to ten significant names (English equivalents) used in the text
- List up to ten significant adjectives used in the text
- List up to ten significant verbs used in the text
- Synthesise the main argument in one sentence.

3 - Grid for the discussion

For example, answer the following questions:

- Is the topic perceived as relevant by the majority

- List up to ten significant names (English equivalents) used during the discussion
- List up to ten significant adjectives used during the discussion
- List up to ten significant verbs used during the discussion
- Synthesise the main argument in one sentence.

- Comment the atmosphere during the discussion and its evolution

ANNEX II

Coding Scheme for Drawings

25/06/99

	Pupil ID		
	Class		
	Grade		
	Age		
	Genre	(M/F)	
Achievement	School level	(hi/med/lo)	
	Drawing competency	(hi/med/lo)	Criterion to be asked to the teacher, proposed for further control during WP7, if drawings are to be used.
	Writing competency	(hi/med/lo)	Criterion to be asked to the teacher, proposed for further control during WP7, if texts are to be used.
	Has a computer	(y/n)	
	Color	(y/n)	
Computer components represented	Screen (S)	Display	Signal whether the screen displays a game (g), a word processor (wp), a specific computer-assisted learning software (l), an operating system (os), or other (else)
		linked to	To what element(s) is connected this component, use the abbreviations in the head row, N for no connection
		label	Value: y (for yes) if the label is the most commonly used for this component (in adults) or n (for no) if there is no label at all, otherwise, give an English translation of the label employed
	Computer Box (C)	y/n	
		linked to	If the CPU is not the main source (or destination) for cables, signal to what element(s) it is connected this component, use the abbreviations in the head row, N for no connection
		label	Value: y (for yes) if the label is the most commonly used for this component (in adults) or n (for no) if there is no label at all, otherwise, give an English translation of the label employed
	Keyboard (K)	y/n	
		linked to	(same as for screen)
		label	(same as for screen)
		form	Describe with letters what is represented on the keyboard: g for a simple grid, k when some keys may be differentiated (ex. space bar, return key, function keys), n when a numeric pad is drawn, (non exclusive criteria)… Comment anything else worthy noting
	Mouse (M)	y/n	
		linked to	See above
		label	See above
	Loudspeaker(s) (L)	y/n	
		linked to	
		label	
	Printer (P)	y/n	
		linked to	
		label	

	CD-ROM Drive	y/n	
		linked to	
		label	
	Floppy Drive	y/n	
		label	
	Others		Signal any game related component (ex : joystick), information storing element (ex: zip), or communicating element (ex. modem).
Texts	Names	Software	if any legend names a software, give its name
		Hardware	If any commercial mark is signaled, give its name in this column
Other elements	Person		If someone is represented in the drawing, signal who is (s)he along with the legend associated
	Things		If something else is represented in the drawing, describe it shortly, eventually with its label.
Special comments	On the colors used		Comment here any use of color that seems interesting
	On the size		Comment here any discrepancy between the size of the different elements (respective to each other or to the reality)

ANNEX III

National Data for Drawings

How to read the national grids for pupils'drawings

National grids are available in **Excel sheets**. Each chart is shared in several parts, and displayed in one, two or 4 paper sheets as shown below; each paper sheet corresponds to one excel sheet.

U.K.:

1-4	2-4
3-4	4-4

File name: GridUK.xls

FR:

1-2	**2-2**

File name: GridFR.xls

DK, NL:

1/2
2/2

File names: GridNL.xls, GridDK.xls

ANNEX IV