# Categorisation of technical objects in French middle school

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Résumé : In this article we present exploratory research carried out in order to understand how students (from 12 to 14 years old) relate to technical objects. In this article we present exploratory research carried out in order to understand how students (from 12 to 14 years old) relate to technical objects. It uses technical objects that are part of everyday life and mediated reality. A questionnaire was administered to 57 students in French classes. The questionnaire was composed of three parts: 1) the detection of technical characteristics of objects; 2) the ability to create relationships between objects; and 3) the direct use of technical objects and personal interest in sciences and technology. The results show the complexity of the relationship with technical objects and the need for an educational mediated intervention of design and technology education.

Mots-clés : artefact, technical object, categorisation, learning, technological education.

The "categorisation of real world objects is a fundamental adaptive behaviour that allows man to reduce the complexity of the physical and social environment by organising it" (Bideaud & Houdé, 1989, p.88). According to several authors (Barsalou, 1987; Reyna & Brainerd, 1995; Smith, 1995), primary organization of our knowledge is not stable and abstract, hierarchical, or taxonomic, but is thematic and located, flexible and linked to contexts, experience and purpose of our actions. To understand the classification of artefacts, a first step to consider is the distinction between living beings and non-living things (Inagaki & Hatano, 1996; Kalish, 1998). Kalénine, Garnier, Bouisson and Bonthoux (2007) shows that the search for common functions generates progress in the categorisation of artefacts but not in the categorisation of natural objects. Furthermore, Rhodes and Gelman (2009) show how artefact categories as more conventionalised and the perceptual properties are essential (Gelman & Wellman, 1991). According to Malt and Sloman (2007) the elements for the categorisation are: physical features, current function, original function intended by the creator, category membership intended by the creator and features having a particular causal status with respect to other features. French research has particularly focused on the concept of a technical object (Akrich, 1987; Andreucci & Ginestié, 2002; Cazenobe, 1987; Séris, 1994, Sigault, 1990). Understanding the characteristics of technical objects becomes necessary for a more conscious relationship with the world around us. Indeed, as suggested by Ineke, Sonneveld, De Vries (2012), understanding the nature of technical artefacts is a relevant part of technological literacy. In French literature, specific research has been conducted to understand the relationship between objects and organization of technical knowledge of students. One area of exploration is the cognitive implications derived by their social use that lead children to construct the socio-technical properties before the scientific ones (Andreucci, 2003; Andreucci & Roux, 1992; Cannard *et al*., 2006; Impedovo, Andreucci, Ginestié, 2015). For example, the study of Andreucci and Ginestiè (2002) provides evidence of middle school pupils' limited meaning of the notion of a technical object. This relationship is influenced both by a cognitive dimension and by the learning process.

## Aim of this exploratory study

In the continuity of previous references, our study is part of a project on the categorization and learning the technical artifacts (Impedovo, Andreucci, Delserieys-Pedregosa, Coiffard, Ginestié, 2015).Here the purpose is to highlight new questions before the development of a large scale survey, aimed to contribute to the debate around Technological curriculum and design of objects and their impact on social and work environments. In this way we wanted to explore three new aspects related to: 1) General understanding of technical characteristics of objects; 2) Ability to make relationships between natural and artefactual objects; and, 3) Personal and direct use of technical objects.

## Participants

The participants were 57 students aged between 12-14 years of age drawn from two different classes in two different schools. Technology education in France is compulsory for all the pupils from 3 to 15 years of age. Specifically, at elementary level (3-11 years) scientific and technological education is associated with guiding the children in the discovery of the world in which they live. Later, for 12-15 year old students, technology education becomes a full school subject, oriented to convey the existence of technical objects and the social organisations that produce and use them.

## Methodology

Usually the categorisation of objects is carried out in small workshops with a limited number of objects and subjects or directly face-to-face between the subject and the researcher. In this research, it was decided to use the questionnaire as a pilot for future extensive research with a larger number of subjects and objects. We use a questionnaire with mainly closed questions, a method designed to collect information on the variables under investigation. In line with our research objectives, the questionnaire was composed in three sections and 18 questions, organised as follows: 1) Part I: detection of technical characteristics of objects (five questions); 2) Part II: ability to create relationships between objects (ten questions); 3) Part III: direct use of technical objects and personal interest in the technical and scientific (three questions). The specific questions for each part have been developed in a process of tuning between research interests, the literature on artefacts and adaptation to the generic didactic objectives of the curriculum of the French Technological Education in middle school. To improve the understanding of the students, it was decided to use images. The questionnaires were administered manually to students in classes in a paper version, directly by the teacher after school activities. After the data collection, we have proceeded to the analysis of the data, with a qualitative analysis of the responses due to the limited number of participants.

## Results

*Part I: Detection of technical characteristics:* In this first section we asked the participants to identify and assign technical characteristics (Not an object or Object; Living, Not living or Virtual) to a list of items that included technical objects but also animated and natural entities.

| Item | Not an object | % | Item | An object | % |
|---|---|---|---|---|---|
| 1 | Salad | 90 | 1 | Bike | 90 |
| 2 | Volcano | 88 | 2 | Scarf | 86 |
| 3 | Tulip | 84 | 3 | Sheet of paper | 74 |
| 4 | Boiled egg | 76 | 4 | Train | 54 |
| 5 | Nuclear power plant | 70 | | | |
| 6 | Milk Cow | 70 | | | |
| 7 | Jam | 66 | | | |
| 8 | Plane tree leaf | 66 | | | |
| 9 | Home | 58 | | | |
| 10 | Submarine | 58 | | | |
| 11 | Bird's nest | 50 | | | |
| 12 | Uranium | 49 | | | |

Table 1: Items classed as Not an object or Object

| Item | Not living | % | Item | Living | % | Item | Virtual | % |
|---|---|---|---|---|---|---|---|---|
| 1 | Wig | 98 | 1 | Flu virus | 90 | 1 | Avatar | 96 |
| 2 | Snowman | 94 | 2 | Coral | 90 | 2 | Cartoon | 92 |
| 3 | Frozen fish | 84 | 3 | Bacterium | 84 | | | |
| 4 | Talking doll | 74 | 4 | Hair | 62 | | | |
| 5 | Robot | 64 | | | | | | |
| 6 | Nails | 48 | | | | | | |
| 7 | Smileys | 46 | | | | | | |

Table 2: Items classed as Living, Not living or Virtual

In the first question we asked the participant to identify if the item, at various levels of familiarity, is or is not an object. The results show that for the majority of students there is a consensus of over 50% on the collocation of the items for the category Not an object or Object. In Table 1we present the items ranked in order of High to Low % for each category. From this result in Table 1, we see a gradation in the attribution of category object and not an object: 1) for some items, the students are almost unanimous in their collocation, for example Salad and Bike reach 90% of agreement in their collocation; 2) for some items the consensus is intermediate, for example the train is placed as an object for 54%, for 34% as not an object and for 12% they don't know; 3) finally for other items there is more dispersion in the consensus. For example, Uranium finds a less clear collocation indicated by 49% as not an object; 15% an Object, and for the last 36% they do not know.

From Table 2, we find that most students know that virus, coral, bacteria are part of the living world. However, we note that membership of the living organic attributes such as Hair or Nails are much less evident. The first is considered by 62% to be living and by 30% non-living; vice versa the Nail is considered by 48% to be living and by 36% a non-living thing. Instead Avatar for 96% of all students is considering as Virtual. In general from Table 1 and 2 we can see that the classification becomes more uncertain for objects less tied to the prototype of their category or more distant from common experience. Also, if we consider technical object as anything that has undergone a transformation of human origin (Rabardel, 1995), these first results show that students have a narrow view of the concept of object.

*Part II: the Ability to create Relationships between Objects:* In this second part, we examine the classification of different items and examine the possible relationships between them, considering that knowledge is organized. In each task six images were

presented, which included a representative picture and a tag with its name. In the results (Table 3) we present only the most frequent combination proposed by the students.

| N. | Group of images | Combination with the high occurrence | % |
|---|---|---|---|
| 1 | Dragonflies, vulture, helicopter, airplane, hang-glider and Windmill | Helicopter, airplane, hang-glider | 26 |
| 2 | Corkscrew, swing, nutcracker, elbow articulation, scissors, wheelbarrow | Corkscrew, nutcracker, scissors | 40 |
| 3 | Sun, thermal power, food products, nuclear power plant, hydraulic power, firewood | Hydraulic power, thermal power plant, nuclear power plant | 53 |
| 4 | Mobile phone, radio device, X-ray image, bat, microwave oven, satellite transmission | Mobile phone, radio devise, satellite transmission | 39 |
| 5 | Sheep, silk worms, cotton field, flax field, automatic power loom, cashmere scarf | Sheep, cotton field, silkworms | 14 |
| 6 | Plastic container, metal canned food, paper bag, glass bottles, carton packaging, cream jars | Plastic container, metal canned food, glass bottles | 18 |
| 7 | Block of butter, cheese, jar of jam, cow, bottle of milk, slice of bread | Butter, cheese, milk | 39 |
| 8 | Flashlight, bedside lamp, flashlight, streetlight, gas-discharge lamp, candle | Flashlight, bedside lamp, hand lamp, streetlight, gas-discharge lamp, candle | 21 |
| 9 | Electrical sander, washing machine, flat iron, vacuum cleaner, electric stove, electric drill | Washing machine, iron, vacuum cleaner | 20 |
| 10 | Wasp's nest, teepee, igloo, straw hut, termite mound, nest of weaver birds | Teepee, igloo, straw house | 51 |

Table 3: Classification of different items

From this second part of the questionnaire, we see that the students show certain flexibility in the categorisation of data, considering that they do not use the same systematic indices to perform their grouping. In general, a functional and contextual categorisation is more activated by the students.

*Part III: Use of technology and personal perception:* in this section, we have developed three questions related to different aspects: 1) the time that students spend using some technological object related to the school and house contexts for formal and informal learning; 2) the importance of learning a technology subject; 3) generic students' interest in scientific and technological subjects. Table 4 provides a summary of the main results for the three questions.

| Item | > 2hours use | % | Item | Motivation in learning Technological subject | % | Item | Interest | % |
|---|---|---|---|---|---|---|---|---|
| 1 | Smartphone | 36 | 1 | Discovery of reality | 65 | 1 | Technology | 40 |

Table 4: Use of technology and interests

Regarding the first question it appears that the use of the smartphone is the most common (more than two hours per day for 36% of students and at least one hour for 27% of them) followed by the use of the internet (2 hours by day for 23% of subjects and between 30 minutes and one hour for 50% of them. From the second question, the awareness of the importance of science literacy as an opportunity for the discovery of reality (65%) was the majority choice. The link between the study of technological objects and future professional choices remains relatively low (26% of answers). From this, it appears that student do not realise the importance of technical and scientific training for their professional future. Finally, we asked the students to indicate their interest in scientific and

technological disciplines. The analysis shows that the most interesting for them was thus ranked: 1) greatest interest was in technology; 2) average interest was for physics and chemistry; biology, geology and astronomy; 3) lowest interest, computer science.

## Conclusion

This paper takes into consideration the technical object by the subjective experience of students between 12 and 14 years. This first study is exploratory in purpose. The results concern a limited population of students and need to be tested with a larger sample. The follow up of the research will consist of a survey with students from 11 to 15 years old. It aims to shed light on how children apprehend some aspects of their current material environment according to their age, gender, socio-cultural environment to which they belong, and urban or rural area where they reside. The questionnaire will be developed for this purpose in two versions, one for the younger children (11-12 ages) and the second, a full version for the older students (13-15 ages). It will be in an electronic format and completed online with the software *Sphinx*. The online version allows us to deal with an extensive number of participants and facilitates an initial automatic data analysis. Also, the use of images and the use of only closed questions will save time and facilitate its online completion by students.

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