

Artifacts for all and for each, boys and girls in technology schoolbooks: some precaution for the 21st century

Colette Andreucci
UMR P₃ – ADEF
Aix-Marseille Université, IFE, France
colette.andreucci@ens-lyon.fr

M. Chatoney
UMR P₃ – ADEF
Aix-Marseille Université, gestepro, France
m.chatoney@aix-mrs.iufm.fr

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Abstract

For a long time, we have known that only a small part of female students chose technical or industrial carriers. Studies about this question have mainly focused on socio-cultural factors. The specific aspects about academic content remain less studied. We know nothing or very little about the issue of masculinity or femininity underlying knowledge and about material artifact used in teaching technology.

This contribution shows the content evolution of schoolbooks used in technology education and more precisely the neutrality or not of the artifacts that illustrate schoolbooks.

Introduction

Technology education in France is compulsory for all the pupils from 3 to 15 years age. At elementary level (3-11 years) scientific and technological education are associated. Later (for 12-15 years old) technology education becomes a discipline per se. For these two school levels, technology is defined by national curriculums, which specify for each cycle and each level: objectives, competences, contents and the suitable teaching approach. The programs are renovated every ten years according to the educational policy and the social evolutions (new knowledge, discoveries, and evolutions of the references and contents of employments).

In spite of this framework, the sectors and the trades scientific and technological remain deserted by the girls since decades (Robine, 2006; Rosenwald, 2006; Wach, 1992). Many sociological studies showed how the socio-cultural stereotypes reinforce the differences between girls and boys (Mosconi, 1994; Baudelot & Mossuz-Laveau, 2004; Marry, 2004; Duru-Bellat, 2005.). The social norms are built through the activity of the pupils in the process of differentiation from a socio-cultural point of view or socio-professional and socio-economic point of view. Is it possible to identify factors likely to generate or attenuate differentiations in technology?

In GESTEPRO team, several researchers have been interested for many years by the role of technical artifacts in the construction of properties of the physic environment and by their effect on the pupils' learning according to whether they are girls or boys (Andreucci, Brandt Pomares,

Chatoney & Ginestié, 2009; Chatoney & Andreucci, 2009; Ginestié, 2005; Roustan-Jalin, Ben Mim, Dupin, 2002). Does the school reinforce the differentiation between girls and boys? If so, which kind of mechanisms are implicated? For example, does the choice of artifacts which support study in technology education contributes to strengthen the feeling among girls that technology is best suited for boys? In sciences and particularly in biology, we know that the content of textbooks are gendered (Caravita & Al, 2008; Castéras & Al, 2008,). In technology only one book has been designed to answer to questions of gender in the classroom (Sadker, D., Silber, E. S. 2007). In our article the question of gender is studied from the point of view of the artifacts which illustrate the schoolbooks. These artifacts are they no gendered or representative of each gender? A large number of technical objects are used to illustrate the content of the school handbooks. These artifacts are presented alone or in situation of use. The contents of these books change with each new program. Are these evolutions in line with a better balance between objects seen as feminine and those considered masculine? This paper presents two empirical studies involving college (middle school pupils) to inform these issues.

2. Characteristics of the studied schoolbooks

The study carries on four schoolbooks of technology all four published by the same editor (Delagrave). All these four schoolbooks are addressed to pupils of 11-12 years. These 2 factors are constant and not responsible of any observed differences. The number of pages of these four books is also the same, except for the last of them which contains a higher number of pages. By contrast, the manipulated variable refers on the date of publication of these various books as indicated in the table below.

Year of publishing	Titles	Authors	Nb of pages
1986	Technology with the college level 1	Biancotto A & Boye P.	127
1996	Technology 6°	Pawl J, Gaigher G.	127
2000	Tools and concepts - Technology	Pawl J, Gaigher G.	127
2005	Eureka technology! - Technology 6°	Pawl J & Al	159

These various dates correspond to successive stages of the history of technology education which marks the evolution of its knowledge content. Thus, in 1986 technology “takes its first steps” in the sense where the discipline has just been introduced under this name into the programs where it replaces the EMT (manual and technical education). Ten years later, in 1996, the program is modified. It breaks up from now on into four distinct parts: working of materials, electronic construction, marketing of a product and textual information processing. In 2005 the whole of the program of the 11-12 years is reorganized with a focus on the thematic of transport, three activities (design, production, communication) and two central 2 concepts (materials, energy).

3. Procedure of examination and categorization of the artifacts which illustrates technological education in four schoolbooks

3.1 The repertory of technical objects present in the schoolbooks

For each one of these books we carried out an exhaustive inventory of the technical objects being used as illustrations (figurative photographs and drawings). For each handbook a list of all distinct objects was made with their respective occurrence (many times where each object is represented). The results of this first census (table 1) show that the first published schoolbook of technology (in 1986 ie only one year after the implementation of the discipline) was very poor in illustrations: only 32 distinct objects were present in this schoolbook including three artifacts with an occurrence higher than the others: the electronic component (6 times), the computer (5 times) the multi-

meter (5 times). The two following schoolbooks (editions of 1996 and 2000) are, at first sight, rather quantitatively and qualitatively similar in terms of illustrations: the objects most frequently represented are the computer (8 times on both sides) and the electronic component (5 times and 8 times). Finally, it is noted that the most recent handbook (edition of 2005) contains a less number of artifacts and that the thematic of transport is dominant here (19 times the bicycle, 14 times the boat, 12 times the car).

	Number of illustrations	Number of distinct artefacts
Schoolbook 1	55	32
Schoolbook 2	202	120
Schoolbook 3	180	109
Schoolbook 4	164	75

Table 1 – Quantity of illustrations and of objects represented in the various schoolbooks

After elimination of the doubled blooms inside these four repertoires, there are 167 distinct objects which were finally indexed within the examined schoolbooks.

3.2 Categorization of the artifacts by the pupils

• Problems

Obviously, the use of certain objects is preferentially reserved to the women (for example all utensils of make-up) while others (for example utensils of fishing) are primarily intended to the men. However this criterion of the use (or the frequency of the relationship of men and women with such or such object) remains most of the time ambiguous. For example, the car does not have a raison to be gendered taking into account the fact that there are as many drivers of the two sexes. On the other hand, if one looks at the car from the point of view of the sex of the people which conceives it, repairs it, or which reads the specialized car magazines, the relationship with the cars appears wider among men than among women. So, it is difficult to carry out a categorization “a priori” of the artifacts. Furthermore, let us note that contrary to English, in French the name of the objects is itself gendered. Some names are masculine (example: a bicycle, a settee...) and others are feminine (a pan, a dress...). However that does not suppose anything on the kind of their users as testify other examples: a crane, an excavator, a nail varnish, a hair-curler, etc.

On this question, it should anyway take into account the point of view of students as they are the main users of textbooks. So, to clarify how pupils conceive the gendered character of artifacts presented in the schoolbooks of technology, we made a preliminary study.

• Method

98 pupils took part in this study on categorization of artifacts. This sample includes twenty 12 years old boys and twenty boys of 14 years old and twenty-nine girls of each age level. The sample is thus composed of four independent groups of pupils. The task submitted to the pupils (see questionnaire in appendix) consists to indicate if the 167 artifacts (alphabetically listed) are more for boys, or more for girls, or for both. More precisely, pupils received following instructions “*For each quoted object indicates, according to you, if it corresponds rather to an object for the girls (F), rather to an object for the boys (G) or rather to an object as well for the girls as for the boys (F+ G)*”. They must simply put a cross in the ad hoc column (F, G or F+G). A last column (?) is reserved for the unknown objects by pupils. Each pupil thus formulated 167 judgments whose analysis presented below.

4. Data analysis and results

4.1 Distribution of boys' and girls' judgments at each age

The distribution of the various types of judgments inside the four groups (table 2) reveals several significant differences:

Among boys, we observe that the number of artifacts considered as feminine increases with age (174 to 12 years vs 305 to 14 years, $\chi^2 = 38.08$ sign. 001). And the same result applies to the objects considered to be masculine: on 3340 answers 605 answers to 12 years compared with 812 to 14 years ($\chi^2 = 37.69$ sign. 001). The boys thus become more and more discriminators or sensitive to the fact that many technical artifacts are sexually marked.

Among girls, we note no significant evolution according to the age for objects considered to be feminine (442 vs 475, $\chi^2 = 1.13$, NS). On the other hand the number of objects considered as masculine increases considerably between 12 years (626 answers out of 4843) and 14 years (994 answers, $\chi^2 = 102.06$, sign. 001). The sensitivity of girls to the gendered character of the artifacts increases also with age, but in a selective way. For them, the artifacts for boys are increasingly numerous whereas the number of apprehended artifacts as feminine remains stable.

Objects for:	Girls		Boys	
	12 years	14 years	12 years	14 years
	(N= 29)	(N= 29)	(N= 20)	(N= 20)
Girls	442	475	174	305
Boys	625	994	605	812
Two sexes	3220	2826	2188	1944
I do not know the object	541	547	365	274
non-responses	15	11	8	5
Total answers	4843	4843	3340	3340

Table 2 - Distribution of the various types of judgments inside the four groups

This stability can be explained by another important difference between girls and boys at 12 years. Indeed, at this age girls are definitely more numerous (442 answers) than boys (174 answers) to allot to the objects a female connotation. This difference ($\chi^2 = 103.8$ sign. 001) is very clear. We note that at 12 years on average, more than 15 objects are considered to be female by the girls against less than 9 objects among boys. At 14 years, this variation is definitely less important (475 vs 305 answers) and no significant ($\chi^2 = 1.04$ NS). Does the opposite tendency exist for the objects considered as masculine? The answer is yes. At 12 years, the objects are more often regarded as masculine by the boys than by the girls ($\chi^2 = 41.98$, sign. 001). Thus, at this age, the girls judge on average 21.5 objects of the list like masculine against more than 30 objects on average among boys. This tendency persists at 14 years: there are more answers in favor of the masculinity of the objects among boys than girls ($\chi^2 = 16.48$ sign. 001). Furthermore, there is a reinforcement of this phenomenon with age: 34 objects of the list on average at the girls and a little 40 among boys.

However, the majority of the objects remaining considered to be neutral. With the age their number regresses for the girls ($\chi^2 = 68.32$, sign. 001) as among boys ($\chi^2 = 37.77$ sign. 001). But at each age, girls and boys estimate in the same proportion the neutral objects.

Lastly, we note that the objects unknown by pupils are very numerous, proof of the didactic interest of their presence in the schoolbooks. Between 12 and 14 years the number of unknown objects by the girls, remains constant. At 12 years, this number is equivalent for boys and girls. But at 14 years unknown objects are fewer among boys than for girls. So, the girls' acculturation of the artifacts represented in schoolbooks would be also less large.

The non-responses are in very restricted number, showing that students responded to the survey with a great care.

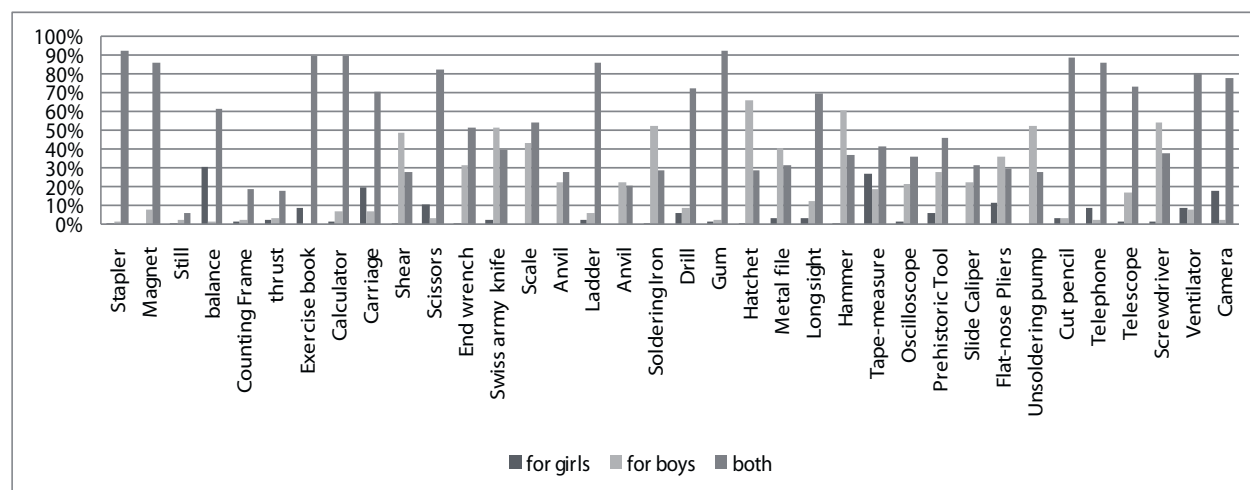
4.2 Categorization of the objects by family

Certain objects produce a strong consensus (C++: higher than 75%) and others a consensus less marked (C+ -: between 50 and 74%). We find only 62 C++ considered to be “mixed” (i.e. not gendered) among the 167 objects subjected to categorization, no object C++ categorized masculine, and only one object C++ categorized feminine (it is the “pair of boots” that pupils represent themselves spontaneously as boots of city and not as professional safety boots). For the objects C+ -, we find 48 artifacts mixed, 17 masculine and 3 female.

For a better legibility, in the following, data are gathered under eight great thematic categories¹: tools and instruments, ITC, transport, electric objects, gears and machines, food, utensils, habitat, plus a category various. We will focus primarily on gendered objects into these various categories

• Tools and instruments

It is found that among the 36 items grouped in this family (see graph 1), many are considered predominantly as “for men” : shear, end wrench, swiss army knife, anvil, ladder, soldering iron, hatchet, hammer, unsoldering pump, Only two artifacts are judged as more feminine than masculine: balance and tape-measure.

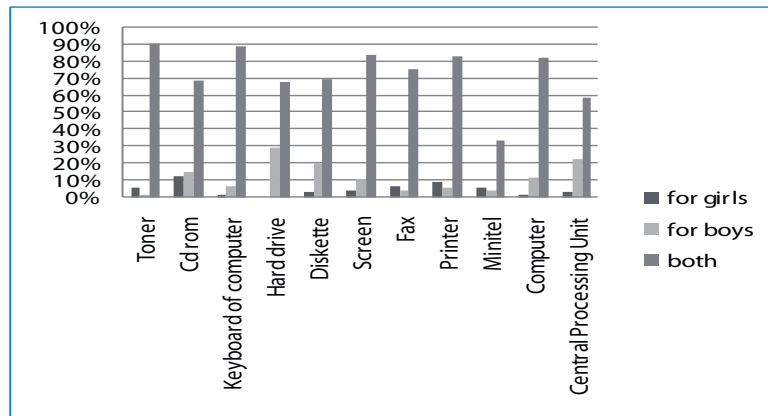


Graph 1: Tools and instruments family

• ITC

The gendered character of ITC objects is less obvious: the majority of gendered responses involve less than 15% of judgments (cf graph 2). ICT objects are mostly considered non-gendered. Only two objects give a difference: The hard drive and the central processing unit are significantly seen to be more masculine.

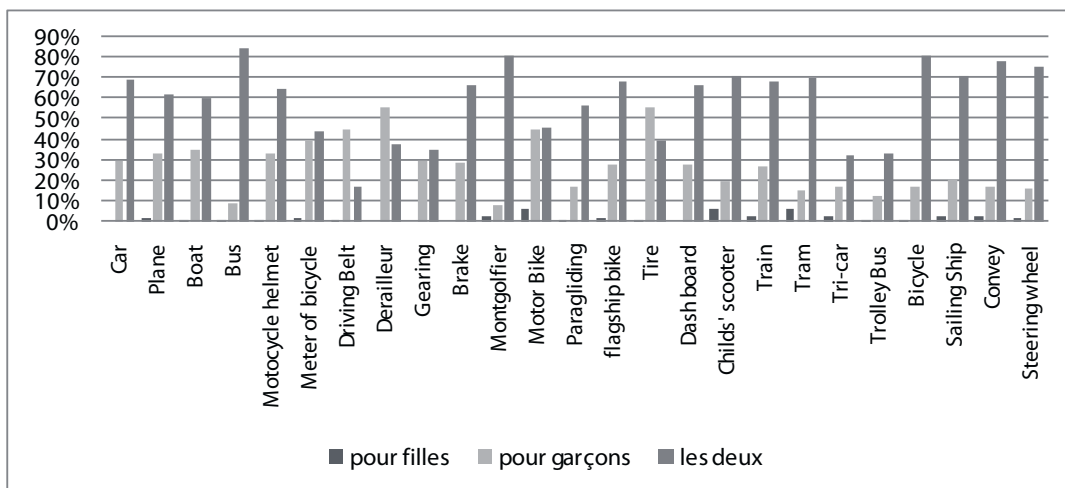
¹ This classification is not entirely relevant because the categories are not exclusive of one another, but it actually helps to organize the presentation of results.



Graph 2: ITC family

• **Transport**

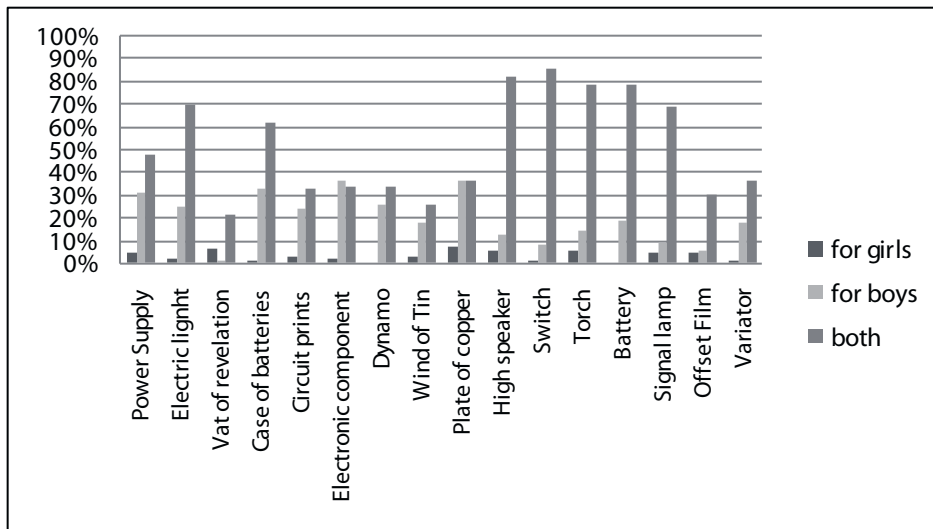
Among the 25 artifacts of this family, 16 are considered non-gendered: car, plane, boat, bus, motorcycle helmet, brake, montgolfier, flagship bike, dash board, tram, child's scooter, train, tram, bicycle, sailing ship, steering wheel. However, it appears clearly (see graph 3) that as a whole, transport systems are systematically estimated nearer to the boys than of the girls.



Graph 3: Objects of Transport family

• **Electric**

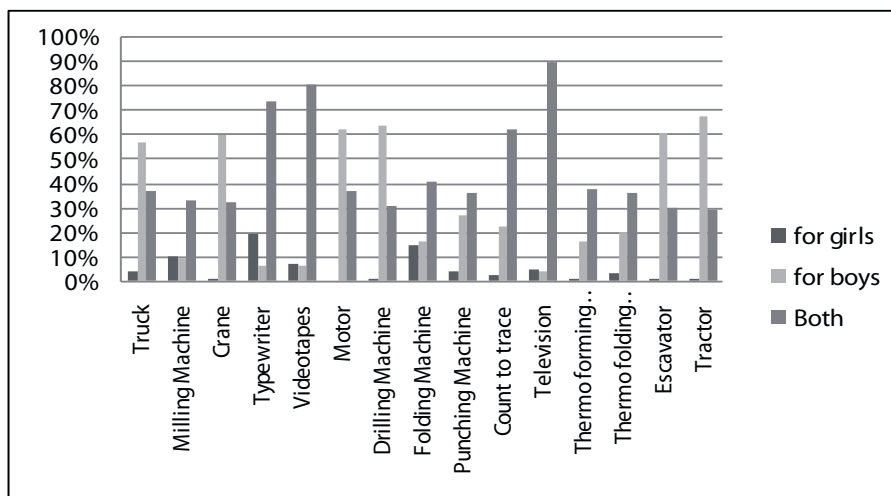
Among the 16 objects grouped here only 7 are massively seen as mixed : electric light, case of batteries, hight speaker, switch, torch, battery, signal lamp. One of them is largely unknown (the offset film). As previously all the others are estimated more for men than for female but in a less proportion.



Graph 4: Electric family

• **Gears and Machines**

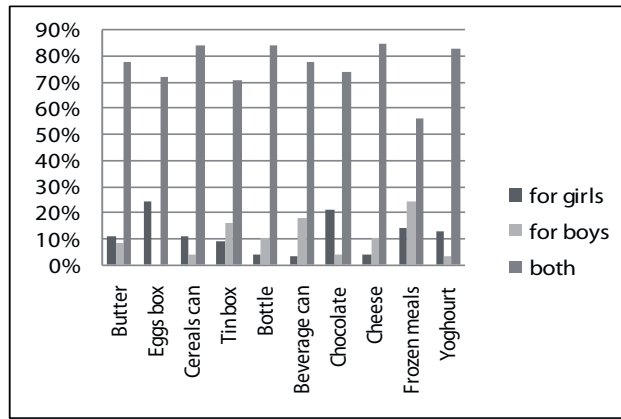
On the 15 objects of this family (see graph 5) four are primarily considered to be mixed: typewriter, videotapes, table to be traced and television. Six are massively judged as masculine: crane, motor, drilling machine, truck, excavator and tractor. The others are less discriminating.



Graph 5: Machine family

• **Food**

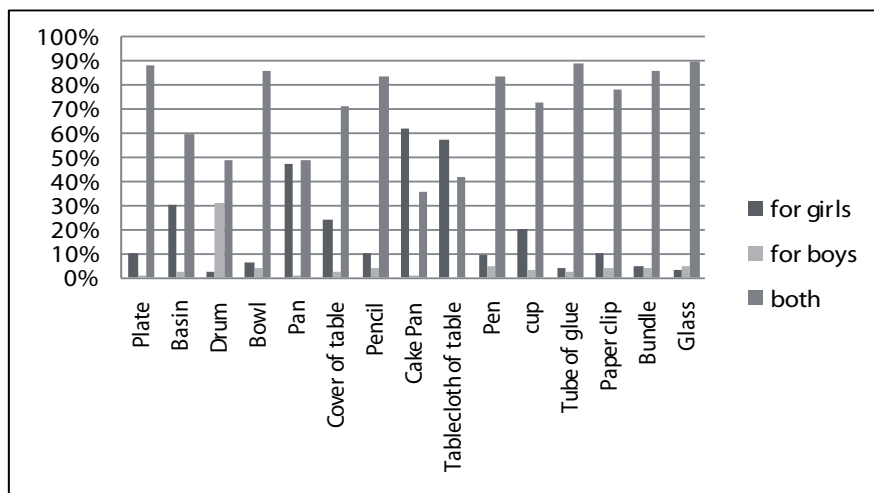
Mixed character of food objects gives a strong consensus. But pupils think that girls are more concerned with the chocolate and eggs boxes and boys by frozen meals, and beverage cans.



Graph 6: Food family

• **Utensil**

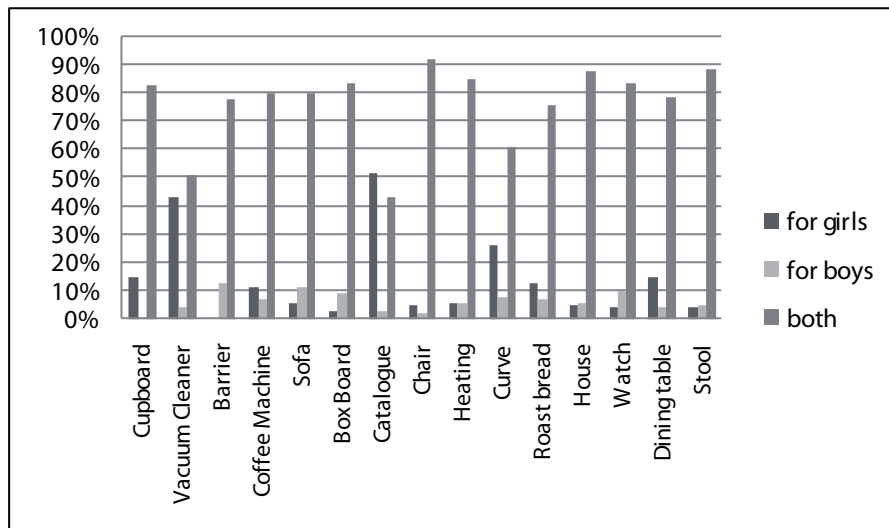
In our list, most utensils are seen as non gendered (see graph 7). However, children think that two of them are typically feminine: cake pan and tablecloth, and in a less proportion the pan (47%). The only utensil to be considered more male than female is the tin (31%).



Graph 7: Utensils family

• **Habitat**

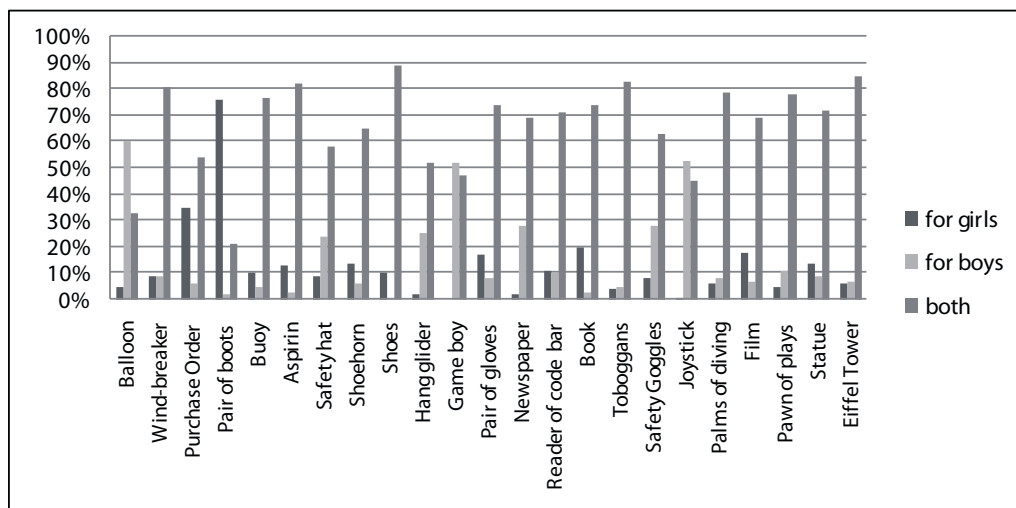
All the objects of this family are mainly mixed (see graph 8). Three objects are classified like definitely more female than male: the catalog (52% female against 3% masculine), the vacuum cleaner (43% female against 4% masculine) and the clothes hanger (26% female against 8% masculine).



Graph 8: Habitat

• Others

In this category, six objects relate to the clothes and professional protections. All of them are largely seen as mixed except for the pair of boots (76% for the girls)². 8 objects belong to the field of the sport and the leisures. 3 of them (balloon, range servant boy and joystick are considered to be more male than female significantly. The others are isolated. We note that among them that the newspaper is rather male (28% against 2%) contrary to the rather female book (20% against 3%). The purchase order is significantly marked female (35% cutter 6%).



Graphic 9: Others

² This result shows the limitations of our study. Indeed it indicates that for students that name evokes city shoes instead of work shoes. But it is a bias in the presentation of objects. The name is often more ambiguous than the image.

5. Temporal evolution of the artifacts represented in the school books

It is noted that only eight objects are co-present in the four successive handbooks (1986, 1996, 2000, 2005): tape-measure, computer, oscilloscope, drilling machine, bicycle, car, slide caliper.

Eight artifacts appear in the last three handbooks: bottle, circuit print, shear, scissors, vice, tire, thermo forming machine, and screwdriver. Four are present in the two last years: house, shoes, square, glass. Nine are present in 1996 and 2005 but absent in 2000: camera, boat, truck, wrench, shifting track of bicycle, drill, high speaker, pawn, and stool.

Finally, 24 objects appear in 2005 for the first time: plane, balance, wind-breaker, bus, meter of bicycle, driving belt, hang glider, gears, brake, toboggan, montgolfier, motor bike, paragliding, pen, dashboard, child's scooter, Eiffel Tower, tractor, train, tram, tri-car, trolley bus, steering wheel. Thus, among them we have a majority of objects which relate to transport, which is coherent with the introduction in 2005 of this topic of study into the curriculum for the 11-12 years. However, we have observed that contrary to what one might have expected, artifacts related to transportation are often seen as masculine. Introducing a specific thematic of knowledge therefore includes the risk to enhance the girls' lack of interest towards technology education.

This introduction of new supports of study goes hand in hand with the disappearance of others artifacts. Among them are many objects related to the field of electronics and mechanics which occupied a dominating place of 1985 to 2005: electronic component, tin reel, soldering iron, milling machine, plate of copper, battery, motor, punching machine. But we note also the disappearance of many heteroclit objects which were charged to show to the pupils the nature and the extent of the cultural dimension of technical environment.. Thus, the first handbooks , gave a broad impression of technology with representatives of many classes of artifacts : furniture (table to be eaten, settee,) means of communication (television, newspaper), food products, tin box, beverage can,...) domestic utensils (pan, tablecloth, basin, cake pan...), computer and calculation tools (cd-rom, hard drive, computer) usual instruments (stapler, watch, torch,...), domestic equipments (vacuum cleaner,...), gears (crane, excavator), toys (joystick, game boy, balloon...) and buildings (statue).

Thus, we see that a certain number of typically male objects disappear (crane, range servant boy, balloon...). The same applies to rare items typically feminine (tablecloth, bathes, cake pan, pan...). In this respect we can consider that the supports of study gain in neutrality in term of gender. We hope that the diversity of the thematic studied at this level succeeds to compensate the loss of variety and richness of study supports involved. This should be the case, at least in part because themes of the habitat and the house automation are introduced just after this level.

Conclusion

Pupils appear sensitive to the gendered character of many technical artifacts and the handbooks of technology refer well to a majority of artifacts perceived like more masculine than feminine. This undoubtedly contributes to reinforce the feeling which the girls have that technology is more appropriate for boys. In addition, we saw that between 12 and 14 years the number of objects regarded as male gendered increases significantly for girls. So this makes our findings even more problematic.

These results should draw the attention of the curriculum designers and the editors of handbooks. The concept of parity should also apply to this question. Indeed if it is difficult to refer only to non gendered objects, it would be advisable to balance the number of objects male and female. Moreover, teachers remain often free to choose their supports of study. So, they would gain with being formed with this question of gender. It is obvious that a topic as that of the house automation which is supposed to interest the girls loses on this level all its interest if it is focused on artifacts such as the garage, the automatic gate rather than on the balneotherapy and the hotplates.

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