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# Children, multimedia content and technological artefacts: An exploratory study using text analysis tools

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## An exploratory study using text analysis tools

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### Abstract

**Purpose** – This paper aims to investigate the user experience of young people with video content accessed through different technological artefacts.

**Design/methodology/approach** – To this purpose, an essay has been assigned to the pupils of two lower secondary school classes (mean age 12 years) to know their diverse types of usage of multimedia content in their everyday lives. These compositions have been analysed using a plurality of text analysis tools to find out both the preferred artefacts and their mutual relationships.

**Findings** – The results are here presented giving emphasis to qualitative and methodological aspects.

**Practical implications** – The analysis is to be intended as a preliminary field research study mainly oriented to testing the visualization power of the selected technical tools, primarily network text analysis, in the context of children exposure to video content made available by today's information and communication technologies.

**Originality/value** – The originality of the paper is characterized by methods used to analyse quantitative data derived from textual compositions of children.

**Keywords** ICT, User experience, Content analysis, Children, Network text analysis, Tag clouds

**Paper type** Research paper

### 1. Introduction

The use of technological artefacts by children has always been one of the most important subjects in many fields: information science, pedagogy, psychology and, more generally, social sciences. However, before the beginning of the third millennium, most of the studies on this topic were directly connected to some types of educational or developmental processes because, in most cases, children had had no constant and pervasive contact with technological tools (such as laptop computer, mobile phone, personal computer, etc.) in their daily lives. The advent of the Internet in the 90s and, starting from the third millennium, the production of many and different devices to be constantly connected to the Internet (particularly smartphone, tablet and laptop) and the development of software, apps and websites to share personal experiences and activities

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(e.g. social networking sites and online gaming) has profoundly changed the social contexts in which children live: family, school and social life environments.

Thanks to a relevant cultural change in the pervasive use of the Web in every life moment of parents and, more generally, in family, Web artefacts became more and more familiar to children and increasingly used in their daily life moments. Furthermore, thanks to the important change at a usability level, such as the passage from the mouse to the touchscreen interface (Mcknight and Cassidy, 2010; Abdul-Aziz, 2013), the use of those technological artefacts has become more and more familiar to children, as it adapts to their patterns of world exploration, principally based on direct touch, due to their yet weak motor skills, and not on the mediation of some device (such as in the case of the mouse).

The pervasive use of the Web and the changes determined by the ONline life on the OFFline one have been differently treated by authors, which we could associate to two different currents. On the one hand, there are scholars who deal with this topic more at the clinical level, trying to understand which factors determine the so-called Internet addiction (Young, 1998; Andreassen *et al.*, 2012) or, more cautiously, a problematic Internet use (Caplan, 2010). On the other hand, there are those who deal with this topic from a developmental, social and cultural point of view and are more interested on the positive use of the Internet, trying to determine which factors allow a positive integration of the Web artefacts in daily life activities (Ellison *et al.*, 2007; Mazzoni and Iannone, 2014). The first perspective, from the point of view of Ekbia and Nardi (2012), can be defined as inverse instrumentality, in which Web technologies can operate a process of objectification of users. In other words, this process makes people lose their sense of self-directedness and provokes a passive and uncontrolled approach to technology. The second perspective, by contrast, moves from the construct of functional organ (Kaptelinin, 2006; Frozzi and Mazzoni, 2011) by means of which Leont'ev (1972) describes an artificial tool fully integrated in human behaviour and cognition to become an extended part of human biology.

According to Vygotsky's and Leont'ev's idea that technology changes the way of thinking and behaving, Marci (2012) through an eye-tracker study showed that digital natives (Prensky, 2001) accomplish their computer-based tasks in a different way than digital immigrants (i.e. people born before 2000). They are much more prone to multitasking and they feel to have been "drown for technology" much more often than their older counterparts have. Internet has become for them a functional organ completely embedded in their lives. However, we could ask whether the life of a digital native of 11 or 12 years is so much full of digital devices or there are also many other "technologies" that contrast Internet primacy.

As most of the previous studies have focused their attention on adolescents, emerging adults and adults, there are few studies on the use of technological artefacts by children. Therefore, the aim of this exploratory study is to understand which types of technological artefacts children use in their everyday lives, not only at school, but in general during all the day. To achieve our scope, we propose the use of network text analysis (NTA), a type of analysis which is experiencing an increasing interest in many fields of inquiry and proved to be very helpful and effective to analyse the school compositions that children wrote in class on their usage of technological devices during the day. Tag clouds are also used in this study as a preliminary representation tool.

## 2. KidLab Media Research and KidLab School Pilot

In the framework of scenario analysis and in the field of media convergence, the original methodology KidLab Media Research was developed in Fondazione Ugo Bordoni (FUB), focusing on the characterization of the use of video content on multiple platforms by the younger members of the population through experimental investigations. KidLab Media Research, which is related to scenario engineering (Nicolò and Sapio, 1999), can be regarded as a multidisciplinary research environment that fosters the study of the behaviour of younger generations related to new media content accessible through mobile phones, tablets, digital television and the network.

A number of studies concentrated on the effect of media over the relationship parents-children (Rideout and Hamel, 2006), whereas other studies underlined the effects of television over children (Byron, 2008; American Academy of Pediatrics Clinical Report, 2008). In-depth studies investigated two related aspects:

(1) the physiological side to delineate changes in kids' behaviours imputable to a heavy exposure to television and, more in general, media content (Millwood Hargrave and Livingstone, 2006); and

(2) the social side to research changes in spoken language among young people influenced by television (National Literacy Trust, 2008).

The KidLab School Pilot project is a first step towards this direction. Its main objectives are the exploration of dynamics of adoption and use, attitudes and cultural patterns, user profiles, purchase intentions and consumptions, psychological and social risks. KidLab School Pilot involves the comprehensive institute (primary and lower secondary school) "Giorgio Perlasca" in Rome (Italy) through the interaction with teachers and pupils.

A set of specific tools were developed for the field research, taking into consideration the peculiar characteristics of younger audiences and of the school setting. The integration of qualitative and quantitative methods will provide greater consistence to results (Giaoutzi and Sapio, 2013).

Here follows a list of the adopted research tools:

- group interview with the class (focus group);
- guided face-to-face administration of questionnaires to pupils;
- administration of individual questionnaires to pupils in the classroom;
- preparation of individual essays in the classroom;
- preparation of individual drawings in the classroom;
- role playing (stories, simulations, guided games) in the classroom; and
- administration of individual questionnaires to parents at home.

The data collection tools focus on:

- exploring the effective use by children of various technological modalities now available to access video content, distinguishing as many different technologies and devices as possible;
- investigating the system of preferences of these different technologies, identifying the children's priorities of intentions;

- estimating the average times of the different modes of use, appropriately aggregated to facilitate the formulation of the estimates; and
- identifying the types of video content building up the children's media diet.

The functional blocks of KidLab are shown in Figure 1.

Figure 2 introduces the research domains relevant to KidLab.

In the first phase of the field study, a qualitative methodological approach was adopted to explore the phenomenon under consideration, while building hypotheses to understand the point of view of the young users, their behaviours, their emotions and their needs. A focus group was held, which involved the pupils of a third-year class of the primary school in May 2011. Moreover, a questionnaire was prepared to analyse quantitatively the phenomenon of video consumption by children. It was administered to pupils in the classroom by their teachers. It covered general information about the children, technology preferences and usage, usage times, availability of technologies in the household and in the child's room, video content preferences, motivations, social viewing modalities, social network subscriptions, multitasking and other activities. First results of this pre-testing, from both qualitative and quantitative analysis, were presented by Sapio *et al.* (2012a). A focus group had also been held in April 2011, involving the pupils of class IC (lower secondary school) and results of which can be found in the article by Sapio *et al.* (2012b). Also the already mentioned questionnaire was administered to the pupils of this class: the results built the first annual data set of a three-year longitudinal study.

The second-year data set for this study was collected in 2012, administering the same questionnaire to the same pupils (class IIC), within the larger KidLab School Pilot campaign carried out in the same year in the "Giorgio Perlasca" Institute, which

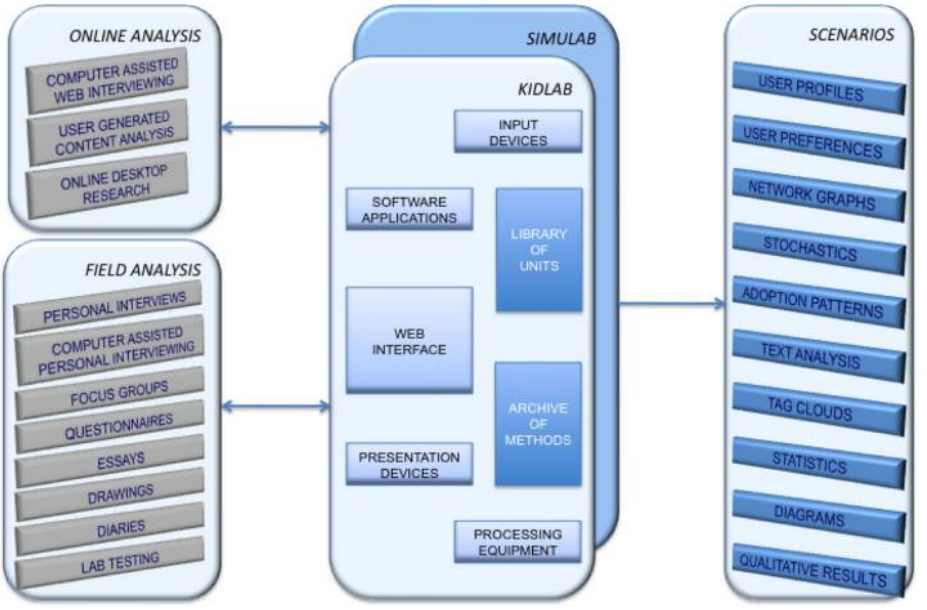


**Figure 1.**
KidLab functional blocks

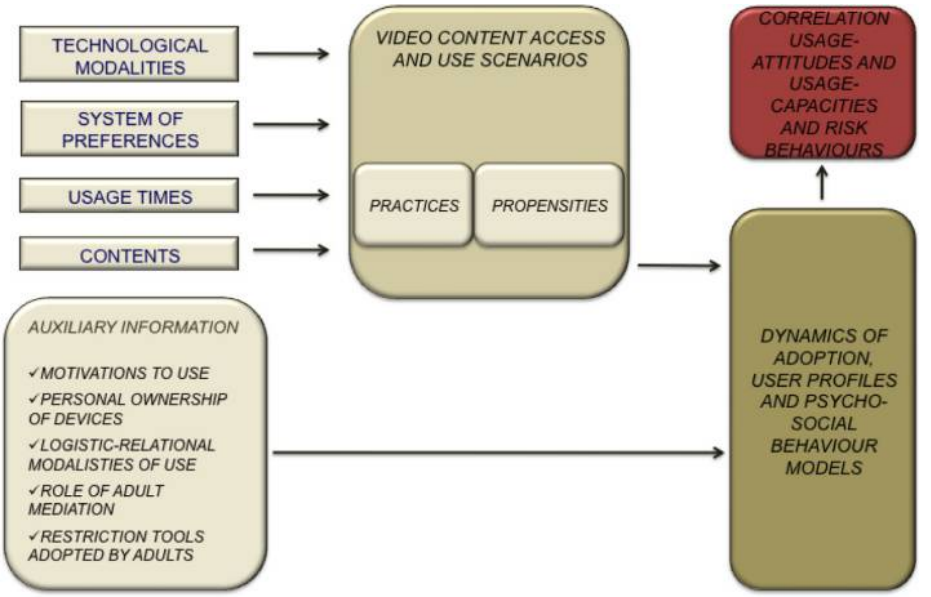


**Figure 2.**
KidLab research questions and outputs

involved 135 children ranging from 6 to 13 years old. The quantitative analysis relevant to this larger field research is shown in the article by Mazzolini *et al.* (2013).

The third-year data set for the above-mentioned longitudinal study was gathered in June 2013 by administering the same questionnaire to the pupils of class IIIC, that is, again, to the same pupils a year later. The overall results of this study can be found in the article by Nicolò *et al.* (2014).

## 3. An exploratory study

In May 2014, an essay was assigned to students of two lower secondary school classes of the "Giorgio Perlasca" Institute: IB (nine males and four females) and IC (ten males and nine females), i.e. two first-year classes of the lower secondary school. The mean age of these 32 pupils was approximately 12 years. Class IC was a "class 2.0" due to its larger use of new technologies for education purposes (mainly interactive multimedia boards): this peculiarity might explain some of the differences between classes highlighted in the following.

The extended title of this composition, whose analysis is the object of the present paper, was:

> I write about my videotechnological day: from morning when you wake up until night when you go to sleep, describe the moments when you use video communication and video game equipment, such as television, computer and mobile phones. Needs, expectations, difficulties, joys and disappointments.

Some tips that could help the students write their essays were available too, that is:

> Describe what video equipment you use, how much you like them, how much time you spend to watch videos via the different technologies and in what hours of the day this happens. Say what video technologies are present in your home and which of them are in your room and tell the people with whom you watch videos. Explain also what video content and programs you prefer.

> Furthermore, you may explain for what reasons you like to watch videos. If you want, please tell your user experience about the technologies which are present in your classroom, such as the interactive multimedia board (IWB). Eventually, say if you sometimes go to the cinema.

The elements in the essay title were derived from the analysis of collective interviews and guided questionnaires administered to several classes in the same school.

The most significant variables in the children's questionnaire were:

- *Knowledge of technology*: Two options ("I know", "I don't know").
- *Technology preference*: Five-step Likert scale (from "I like it very much" to "I don't like it at all").
- *Usage of technology*: Two options ("I use", "I don't use").
- *Usage time*: Hours and minutes spent using technologies in a school day and during holidays.
- *Knowledge of technology in the house*: Two options ("I know", "I don't know").
- *Availability of technology in the household and in the child's room*: Two options ("I have it", "I don't have it").
- *Video content preferences*: Five-step Likert scale (from "I like it very much" to "I don't like it at all").
- *Fruition of different contents*: Two options ("I watch", "I don't watch").
- *Motivations*: Choice from a list of motivations to use new technologies.
- *Social viewing modalities*: Two options for each question ("Yes", "No").
- *Social network subscription*: Two options ("Yes", "No").
- *Multitasking*: Three-step Likert scale (from "never" to "often").
- *Other activities (to read, to listen to music or/and radio, etc.)*: Two options ("Yes", "No").

### *3.1 Tag clouds*

A first visual representation of the textual content of children's compositions is provided by tag clouds. They are a text-based visual depiction of tags (or words), typically used to display the relative tag frequency, popularity or importance by font size (Lee *et al.* 2010). In our study, tag clouds are used as a visualization tool to extract macro information, before proceeding with more sophisticated analysis.

Figure 3 presents a global tag cloud considering all of the children's compositions, whereas Figure 4 highlights the most repeated words by boys and girls.

### *3.2 From content analysis to NTA*

As data are represented by words written by children in a class school composition, we decided to analyse these qualitative data by integrating two types of analysis: content analysis (CA) and social network analysis (SNA). There are already several examples of an integration between CA and SNA, especially as regards the study of ontology (Hoser *et al.*, 2006) and the semantic aspect of a network (Gaggioli *et al.*, 2013). NTA, i.e. the SNA applied to qualitative data such as those collected in this study, focuses the attention on the relations between the lemmas (keywords) derived by the CA applied to the children. The purpose of this methodology is to explore the nature of the relationships between words to have a different and deeper understanding that goes beyond the simple

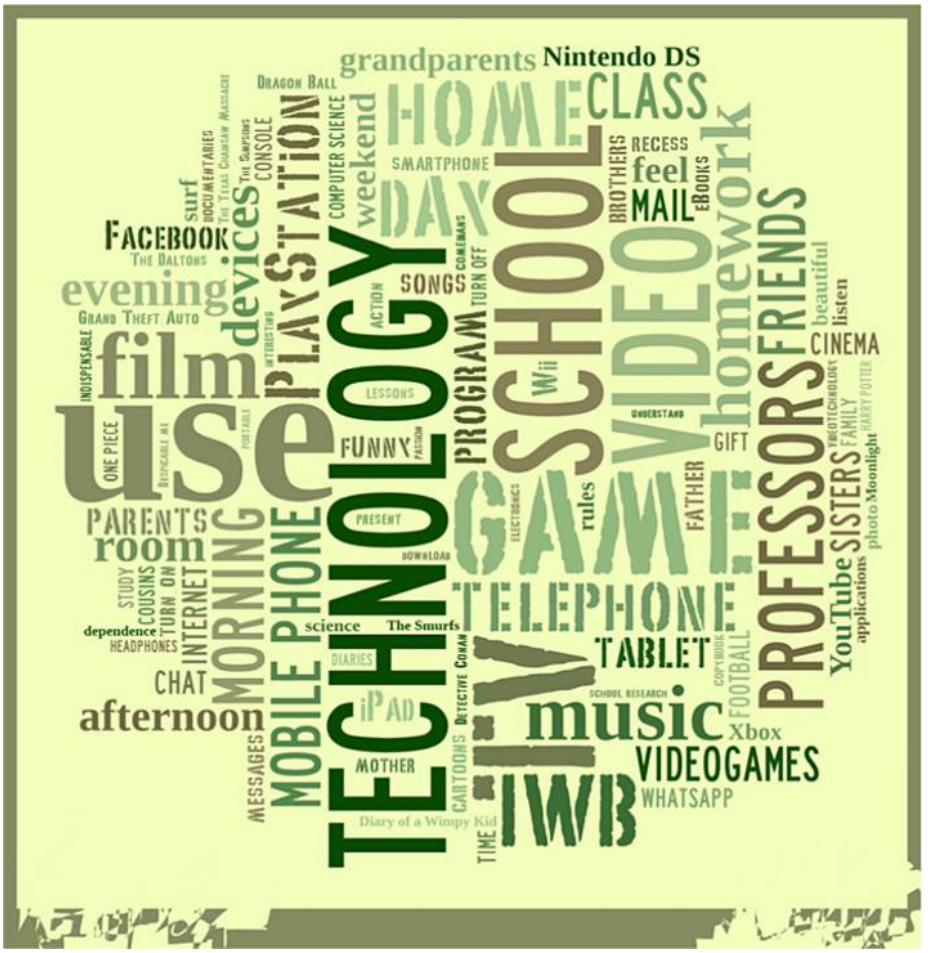


**Figure 3.**
Tag clouds with words in all compositions

numerical data of SNA. In particular, NTA focuses on the ability to understand what are the central and peripheral arguments of a speech, the strengths and weaknesses of a message or conversation, which arguments are more or less central in real or virtual conversations about a topic, etc. Thus, understanding human social representations characterizing a given topic is one of the most interesting and promising field of application of the NTA (Gaggioli *et al.*, 2013).

Abric's perspective (Abric, 1989) on social representations is particularly interesting to understand the relevance of NTA in this field. Abric theorizes social representations as characterized by a double system:

- The central system, i.e. the core of the representation, that is socially fixed, as it is linked to historic, sociological and ideological conditions. This system specifies the fundamental elements around which representations are generated, and constitutes the social and collective basis of the representations, which defines the

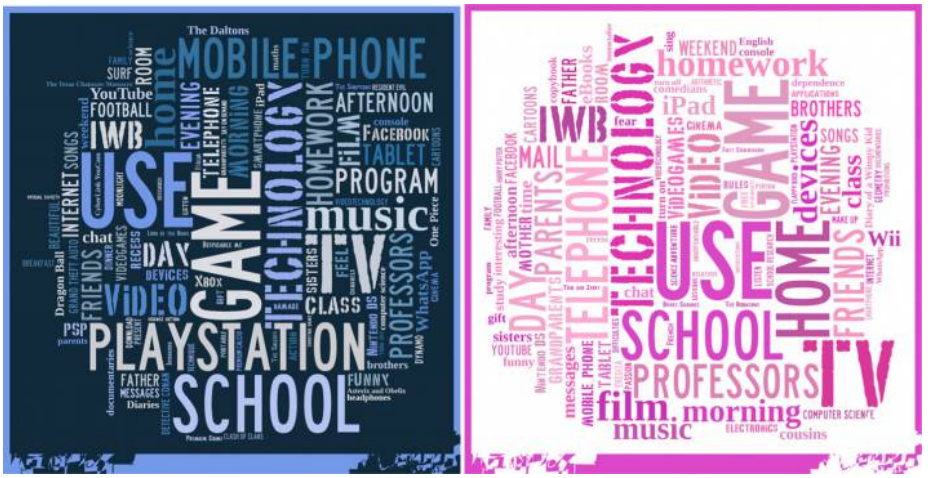


**Figure 4.**
Tag clouds with words in compositions by boys (left) and girls (right)

degree of consensus and homogeneity of a group, independently of each individual. In other terms, those elements on which all members of a specific culture agree characterize the central system of a social representation.

- The peripheral system, by contrast, depends on the characteristics of the individuals and the context in which they are positioned. Therefore, such a system differentiates within members of a particular culture depending on specific situations and everyday experiences. The peripheral system is essential to identify changes and transformations underway in the representations, which indicate their evolution and likely future modifications.

Therefore, the richness and variety of individual experiences and the evolution of everyday practices determine the mutability and flexibility of a social representation, while its stability and rigidity depend on the core, strongly linked to the value systems shared by the members of the group. Thus, representation's evolution will begin from changes on its peripheral and less central elements, and a transformation of the central nucleus would indeed bring about a modification in the structure and the totality of the representation. Therefore, we can presume that the change and evolution of a representation will only be superficial if it comes about through the modification of the meaning, or the nature, of the peripheral elements, while the involvement of the core would radically alter the representation itself.

The exploratory study here described starts from children compositions to have a representation of their "technological day" and, particularly, of the relevance that different technological artefacts have in their lives. To analyse our data, we proceeded as follows. First, we have taken together all the essays of pupils of the same class and divided them by gender. Therefore, we have four different data sets:

(1) the females of a first class;

(2) the males of the same class;

(3) the females of a second class; and

(4) the males of the same class.

By means of T-LAB software, we have carried on a CA on each data set to take over the keywords (lemmas), i.e. the words more frequently written by children in their school compositions. After this step, we have focused our attention on the co-occurrence matrix of the keywords (Figure 5), i.e. a square matrix (lemmas × lemmas) that shows keywords that are more likely to appear together in the children's sentences (Gaggioli *et al.*, 2013).

The co-occurrence matrix is similar to the adjacency matrix normally used to represent numerically the data of SNA, and it is therefore very simple to save this matrix and open it by a SNA software (Figure 6) such as NetMiner (the software we use in this study).

*3.3 NTA applied to children school compositions*

Now, for the explorative proposal of this study, we will present and describe the analysis made on each of the two classes (IB and IC), by separating boys from girls. So we will analyse if, concerning the technological use during the day:

- there are some differences between the two classes, maybe determined by a class culture suggested by teachers; and
- there are some differences between girls and boys in the type of technology used.

The SNA analyses that we will present are: the graph of neighbourhood analysis representing the network of relations between the selected keywords, in which the centrality of each word (i.e. its relevance in the children's essays) is visualized; and the graph of the eigenvector centrality representing the most central (relevant) words in the children's essays, i.e. the more a keyword is co-occurrent with keywords characterized by high relevance, the more it becomes relevant. Weighted scores are assigned to nodes based on connections to all other nodes.

We start with the description of the girls of the class IB (Figure 7).

The graph on the left represents the network of co-occurrences between words where the dimensions of keywords represent their frequencies (centrality or relevance). To select the most relevant keywords, we have defined a co-occurrence baseline of three, i.e. that only keywords with at least three co-occurrences have been selected. The arrows between words represent the sense of the co-occurrence, i.e. which keyword appears before the other. The graph on the right (Figure 7) represents the most central (relevant) keywords. By looking at the graph on the left, we can see that the core of the girls' compositions of class IB is focused on seven most relevant keywords: use, mobile phone, see, TV, technology, instrument, devices (the order is based on the degree centrality index, i.e. the frequency of co-occurrence in terms of the number of links incident upon a node).

At a more deeper level, by looking at the eigenvector centrality (right), we can observe that the most relevant aspect of the technological use for girls of class IB during a day is the mobile phone use.

The score near each keyword represents its centrality, i.e. its relevance with respect to the other keywords.

Differently from the previous class, the compositions of the girls of class IC (Figure 8) are focalized on four keywords: watch, computer, use and TV (left). However, the eigenvector centrality (right) shows that the most relevant technological use of the girls in this class is "watch TV".

Now we can analyse the boys of class IB (Figure 9).

For them, the most relevant keywords resulting from text compositions are, in order, computer, play, use, see, mobile phone and PlayStation.

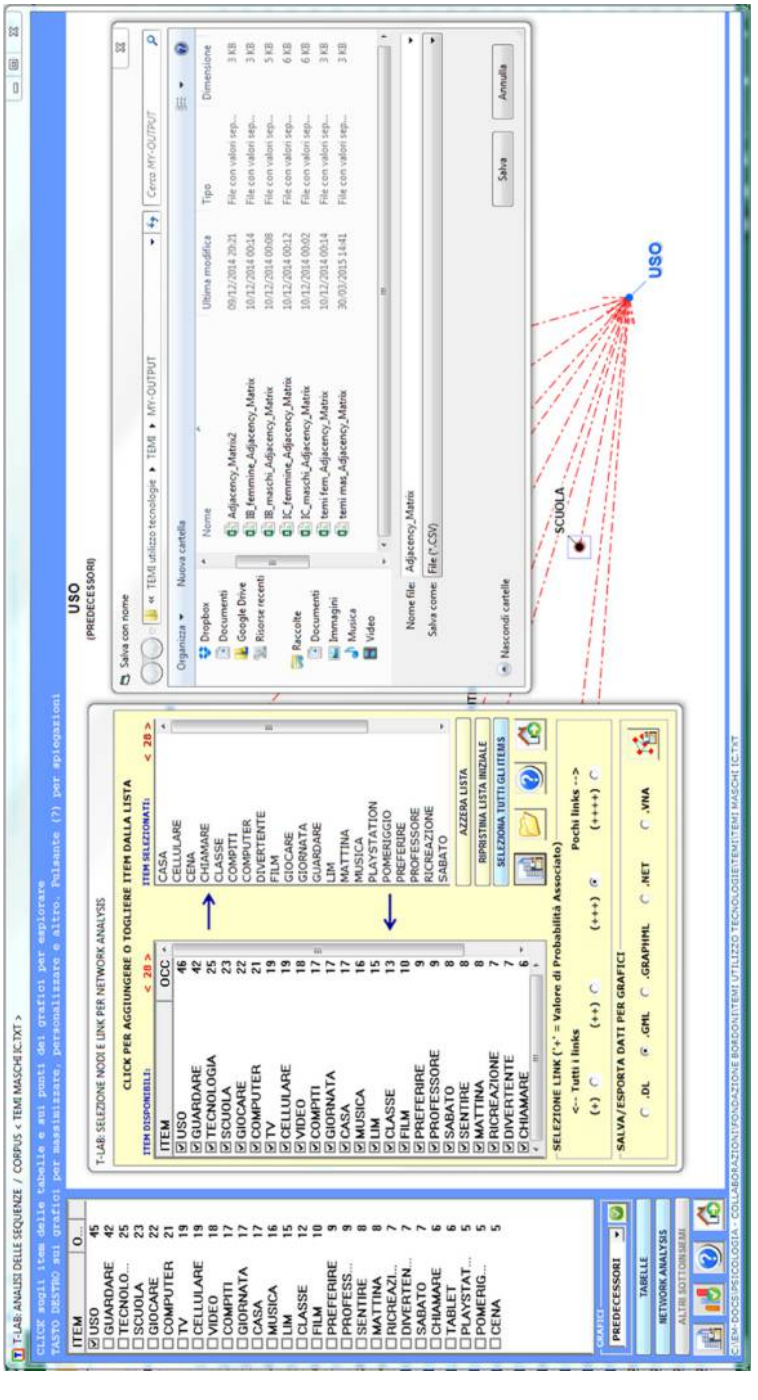


**Figure 5.**
Keywords derived by means of T-Lab and the download of the adjacency matrix to carry out the social network analysis to textual relational data (i.e. network text analysis)

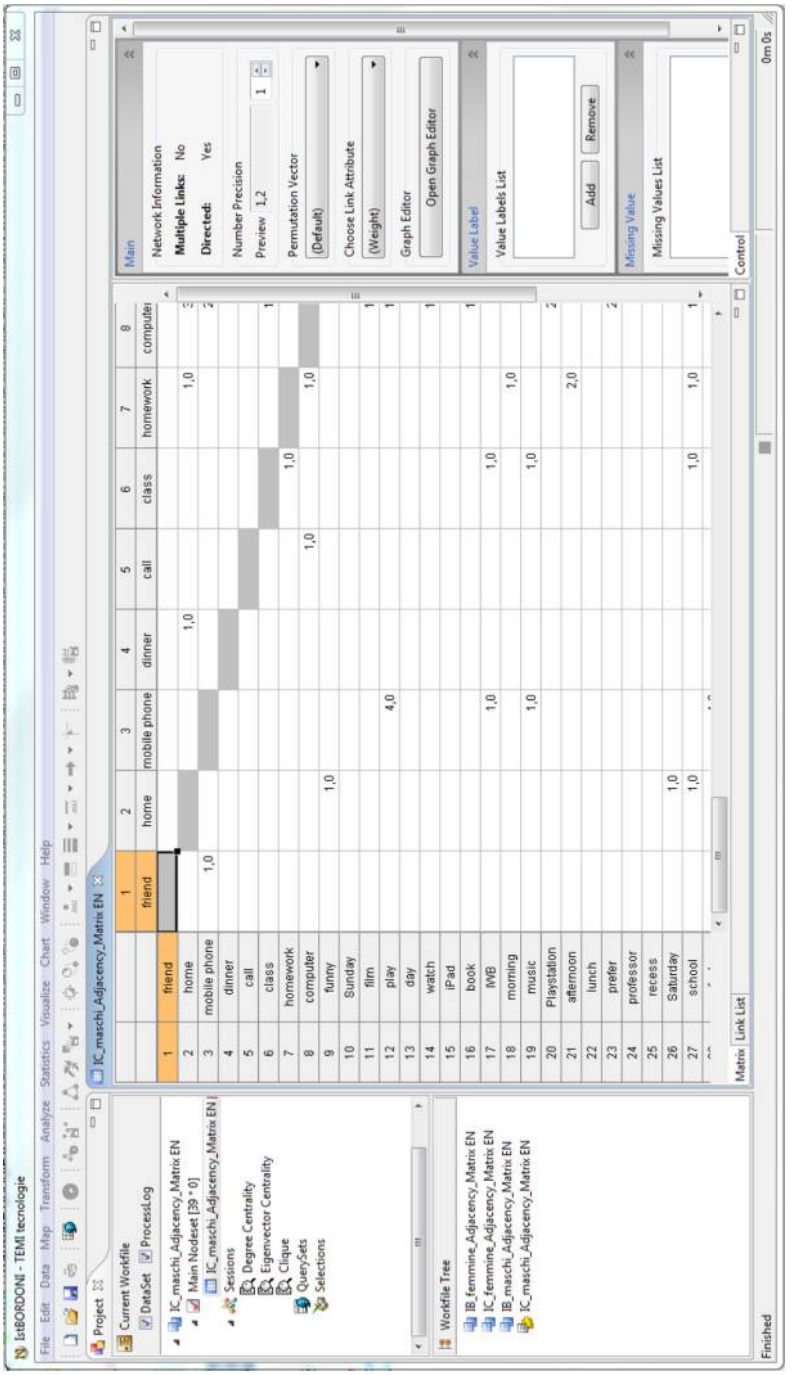

**Figure 6.**
View of the adjacency matrix opened with NetMiner: the values in the intersections between rows and columns represent the strength of co-occurrence between the keyword in row and that in column (the diagonal is empty)

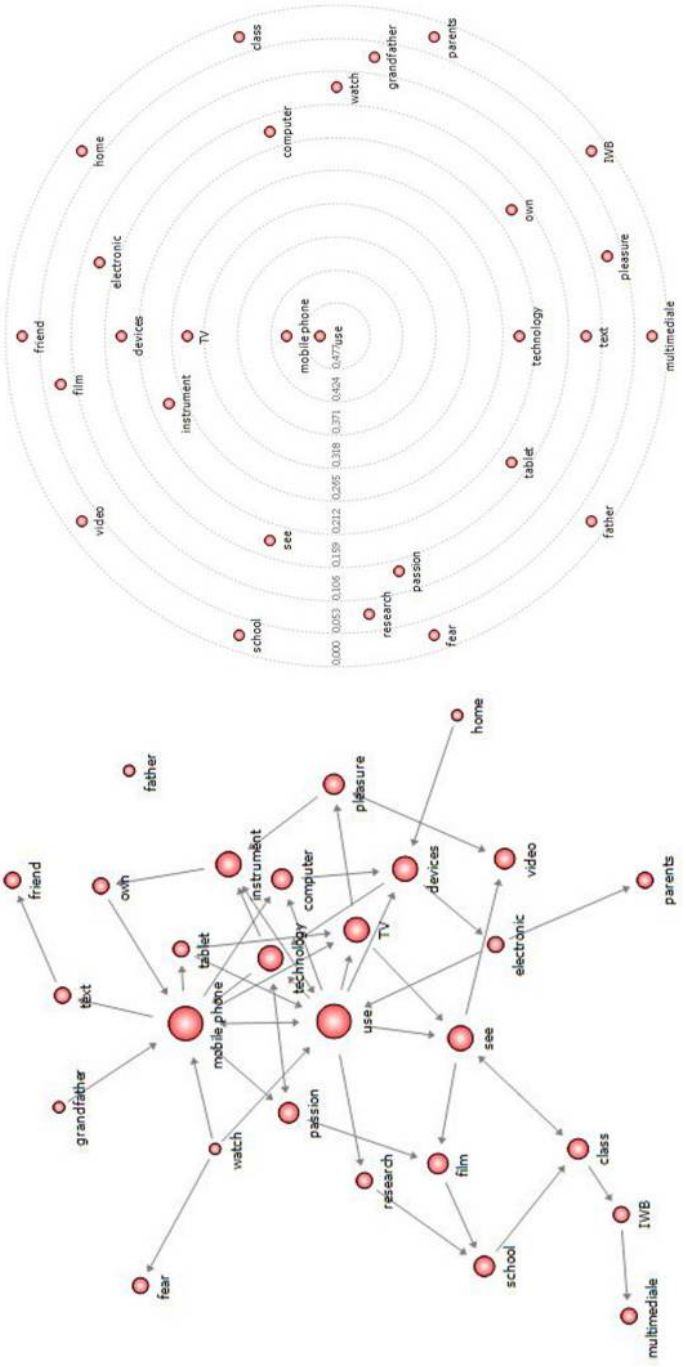


**Figure 7.**
Neighbourhood graph (left) and eigenvector centrality graph (right) of the keywords derived by the compositions of the girls of class IB

It is clear that, compared with what has been seen for girls, for boys, the use of technology to play becomes more relevant, and that is confirmed by the eigenvector centrality in which play and PlayStation are the most central keywords.

Moreover, the group characterized by the boys of class IC (Figure 10) shows three very central keywords (watch, use and computer) followed by other seven but less important keywords (TV, technology, school, play, homework, mobile phone and home).

The eigenvector centrality shows that for this group, the most relevant action is using technology to watch TV and film.

Finally, taking together the two classes, we take into consideration the differences between male and female children as regards media use, to verify each stereotyping choice determined by gender. The graphs in Figure 11 represent the eigenvector centrality of females (left) and males (right) in the two classes considered in this study.

The graphs show quite clearly that watching TV is the first media activity involving children (both males and females) of the analysed primary school, even though in male children, many other devices (computer, mobile phone, PlayStation, tablet) seem to be more relevant than in female children.

## 4. Further considerations

The results of the analysis allow us to highlight that, even though digital devices play a relevant role in children's everyday life (as the same children describe in their compositions and revealed by NTA), the most used (and central) device is the TV. Nothing new, we might say, as we are speaking about children of primary school. However, many studies (Ha *et al.*, 2006; Weinstein and Lejoyeux, 2010; O'Keeffe and Clarke-Pearson, 2011; King *et al.*, 2012) have underlined the always increasing use of digital artefacts, such as tablet and smartphone, in children and adolescents, and the danger of a kind of addiction for those devices. Our results seem to give a more relaxed representation, even though each "new" technological artefact at the beginning has represented a danger for the human world: press, radio, television, computer, Internet and so on.

Boyd (2014) and Turkle (2013) have already widely analysed the controversial relation between humans and digital devices, particularly in children and teens. Nevertheless, we have to always remember that technologies are constructed to support human activities and they are the technological side of functional organs (Leont'ev, 1981; Frozzi and Mazzoni, 2011) characterized by human abilities (sometimes deficient) and technologies (improving humans' capabilities or helping them to obtain the abilities lost). We cannot imagine, today, a world without Internet (and digital technologies to be connected); however, we have also to imagine a world in which Internet is a technological artefact that supports and sustains human abilities and competences, but without constantly substituting them. For children, it is important to develop kind of abilities (such as calculate, orientation in natural settings, search for information, develop social capital, etc.) that we risk to lose due to a constant substitution of digital artefacts to our human abilities. Being a digital native does not mean automatically to be a heavy user of Web artefacts; more simply, they were born in a world in which these artefacts were already existent, but to the left of other technological artefacts that have withstood the test of time and still permeate our culture. By following the results of this exploratory study, TV is clearly one of the most important and relevant technological artefacts in children's lives, while radio seems to disappear.

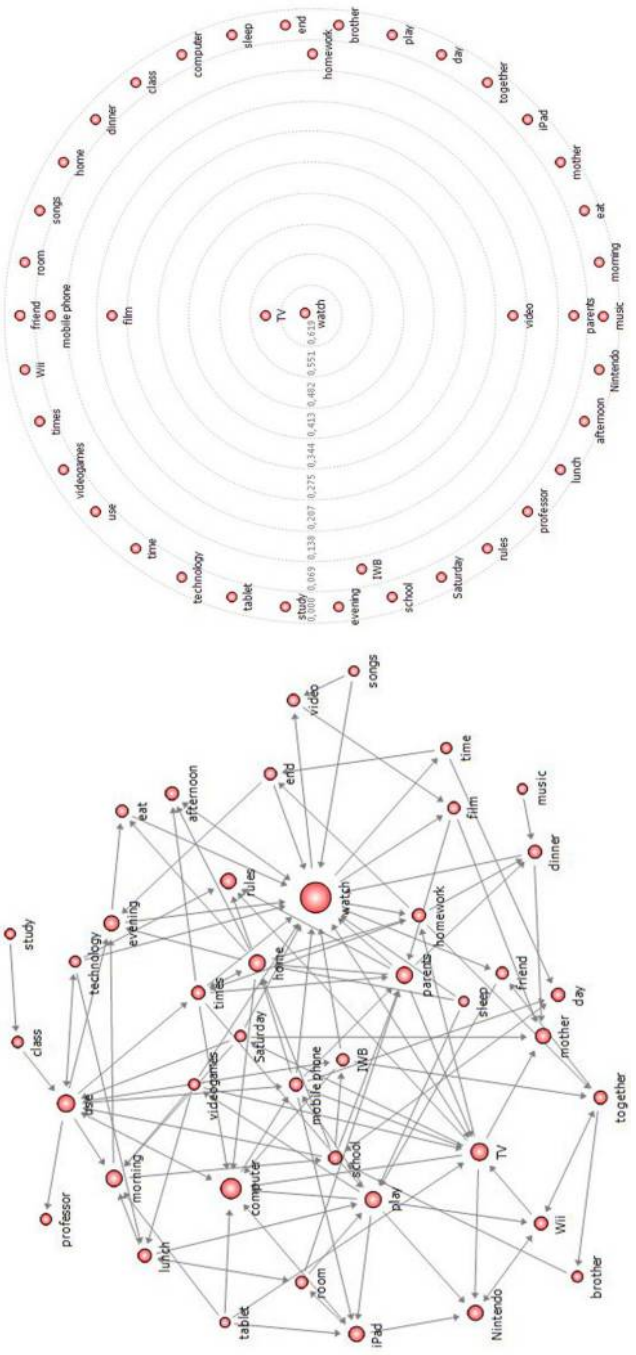


**Figure 8.**
Neighbourhood graph (left) and eigenvector centrality graph (right) of the keywords derived by the compositions of the girls of class IC

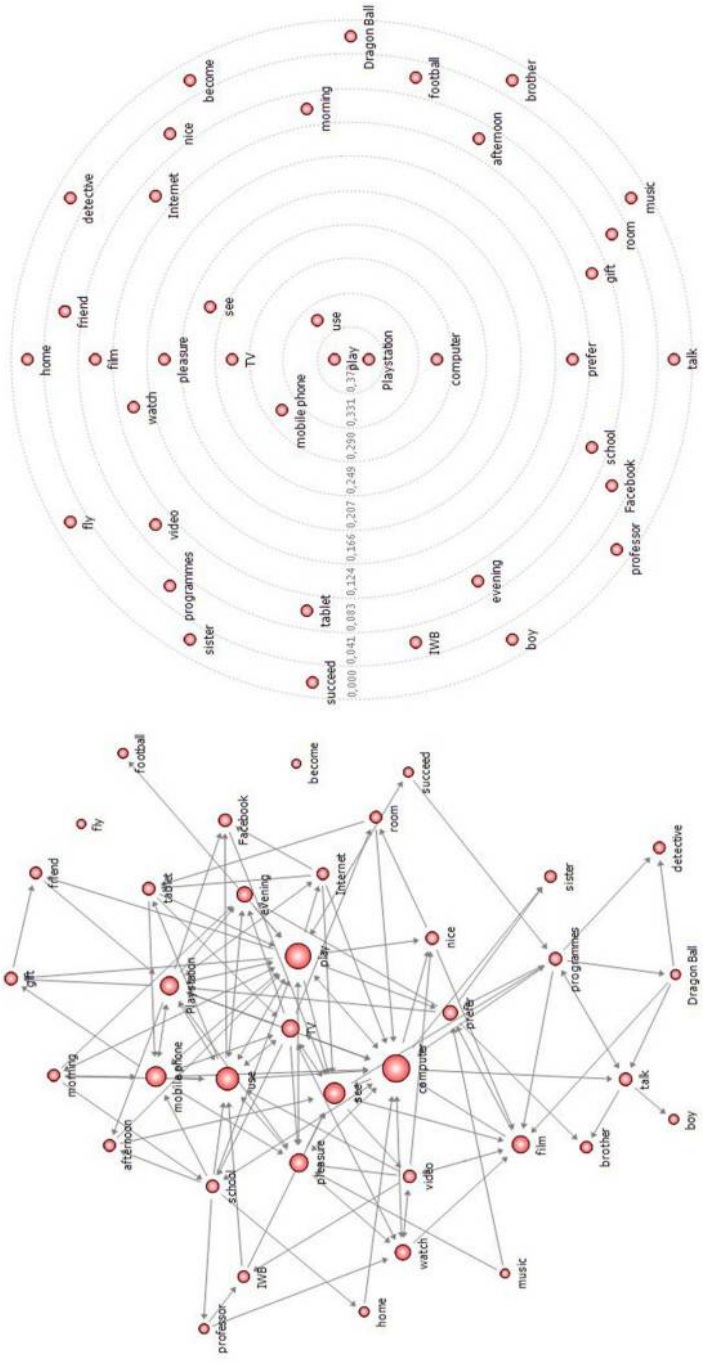


**Figure 9.**
Neighbourhood graph (left) and eigenvector centrality graph (right) of the keywords derived by the compositions of the boys of class IB

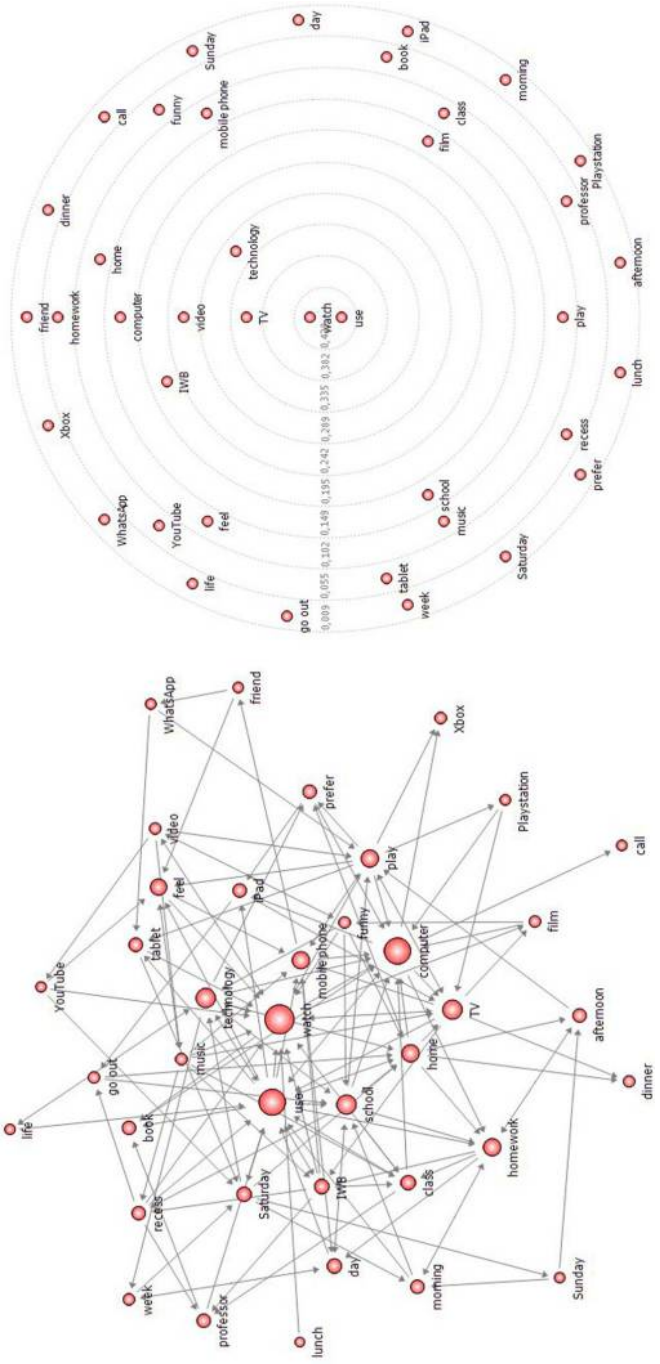


**Figure 10.** Neighbourhood graph (left) and eigenvector centrality graph (right) of the keywords derived by the compositions of the boys of class IC

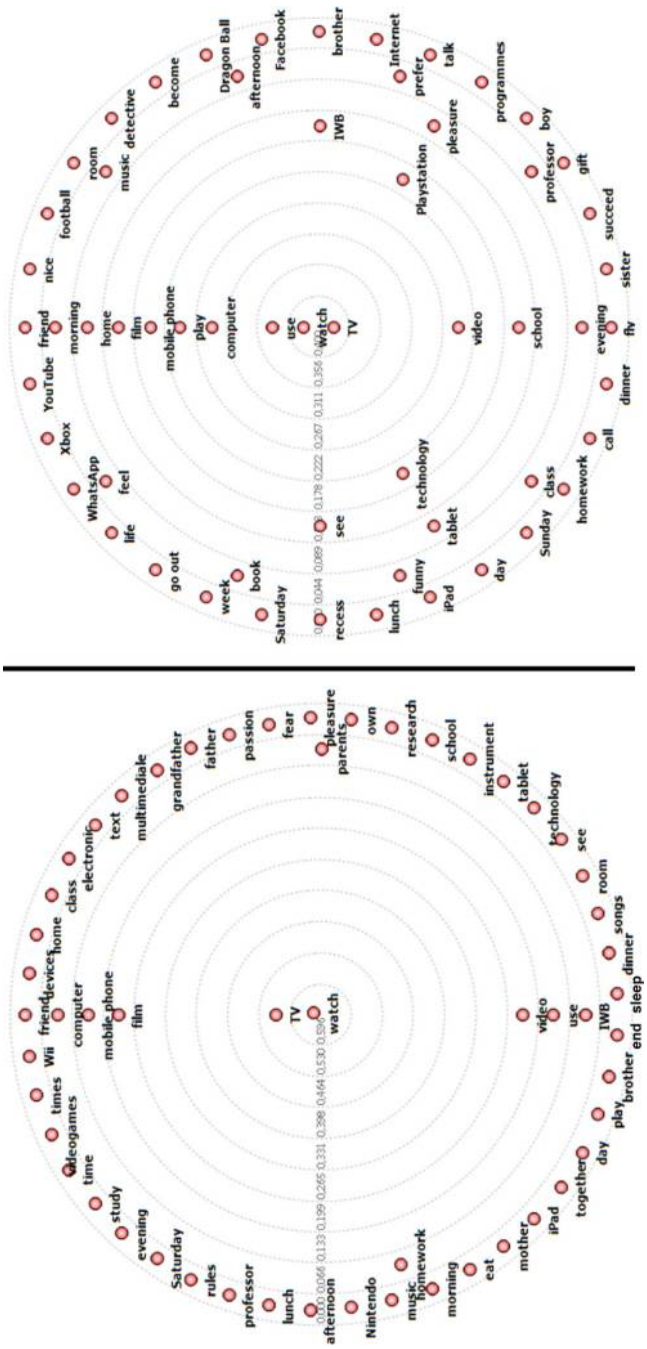


**Figure 11.**
Eigenvector centrality graphs of females (left) and males (right)

The analysis carried out in this explorative study could be very helpful to deepen the role played by technological artefacts in human life. NTA shows indeed an interesting way to analyse contents coming from human compositions but also conversations, interactions and communications (Gaggioli *et al.*, 2013), to depict social representations characterizing specific arguments, in this case the relevance of technological artefacts for children. There are two interesting aspects, which relate to the use of NTA to analyse representations characterizing groups, communities or cultures:

(1) the possibility to differentiate between elements of the central core and peripheral elements in a social representation; and

(2) the possibility to carry out a longitudinal analysis of the representation's evolution, paying particular attention to the transition of certain aspects from peripheral to central, and vice versa.

The network of relations between keywords allows to understand how lemmas are connected to each other to understand, for example, during the day, which types of actions children play with using technological artefacts. Further, the centrality analysis of keywords is strictly connected to Abric's idea of a central and peripheral system, showing the more central (and relevant) elements characterizing the children's "technological day". A longitudinal analysis of the changes of keywords positions, from peripheral to central, or vice versa, allows to have a graphical and numerical (thanks to centrality scores) description of the evolution in social representations.

## 5. Conclusions

This exploratory study has shown which types of technological artefacts are used by the children of two school classes in Rome (Italy) in their everyday lives, not only at school, but during the entire day. To achieve this scope, both tag cloud analysis and NTA have been applied, by analysing the school essays that the pupils wrote in class about their usage of technological devices during the day. NTA allowed to analyse the structure of relations between the keywords derived from children's compositions, to have a deeper understanding of the relevance that technological artefacts have in their everyday life.

The results obtained, distinguishing between the two classes and between males and females, show some differences in both the types of technological artefacts used and the intensity of usage (in terms of relevance) by the students. Due to the limited size of the considered sample, only a qualitative illustration of the main outcomes achieved has been presented. As a matter of fact, the study was intended to be a preliminary exploration, i.e. a pilot research project whose main interest resides in the test of the methodological tools used.

In this sense, NTA has revealed its strength, thanks to its synoptic diagrams, which also offer an effective visualization of the socio-technological phenomena under consideration.

Further studies, based on wider field research campaigns and on the use of NTA and other methodological tools, both qualitative and quantitative, could allow the study of dynamics of adoption and use, attitudes and cultural patterns, user profiles, consumptions and psychological and social risks.

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