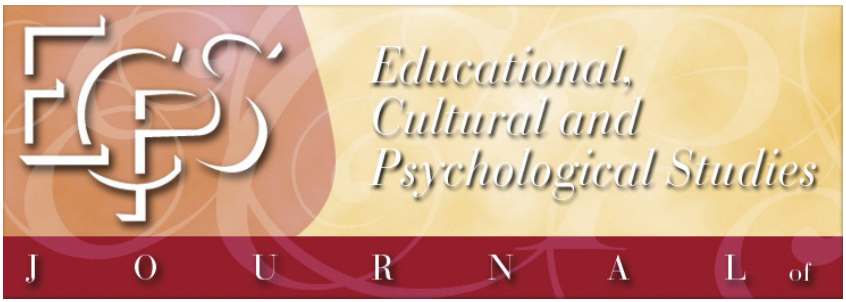

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Note di Ricerca
Research Notes

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Multivariate Analysis Methods to Distinguish Adolescents' Attitudes on Digital Consumption and Skills, Opinions on Technologies, and Adults' Views *

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METODI DI ANALISI MULTIVARIATA PER IDENTIFICARE GLI ATTEGGIAMENTI DEGLI ADOLESCENTI SU CONSUMO DIGITALE, COMPETENZE E TECNOLOGIE, OPINIONI DEGLI ADULTI

* According to CRediT System, L. Rossi, E. Orsenigo, C. Pellizzari, and M. Valentini: conceptualization, resources, writing - original draft, project administration. A. De Santis, and T. Minerva: methodology, formal analysis, data curation, writing - original draft, writing - review & editing, visualization.

Abstract

Do the type and amount of owned digital devices, time spent using them, and household habits in daily life allow us to distinguish groups of students that differ in personal features, perception of their digital skills, opinions on technologies, and communicating choices made by their parents or the adults that have a relevant role in their lives? The study here presented analyzed the results of a questionnaire administered to students of a high school in Reggio Emilia (Italy) as part of a mixed-methods research and, using multivariate analysis techniques (Multidimensional Scaling and Cluster Analysis), provides a clustering of around 300 students that replied to the survey. Four clusters emerged, differing in the number of owned devices and the time spent using them. This classification suggests four students' behaviors towards technologies: device-oriented, strengths-oriented, meaning-oriented, and use-oriented.

Keywords: Digital consumption; Domestication; Generational gap; Multivariate analysis; Students' behaviors.

1. Introduction

Already in 2009, Edward Castronova emphasized the new modes of human interaction and the frequent shift from reality to virtual worlds created by machines, defining it as an unprecedented migration and «the largest migration in human history» in quantitative terms.

Various social groups, such as families, students, and teachers, experience coexistence mediated by technology, exposing the need to establish new norms for the collective management of time and space. Emerging digital technologies function as personal semiotic tools, influencing learning methods and communication across generations (Panciroli & Rivoltella, 2020, 2023; Rivoltella, 2020; Barone, 2021).

Digital tools assume a role that cannot be disregarded in managing social relationships that also pass through the Internet.

In an ISTAT (Italian National Institute of Statistics) survey conducted in 2023 involving nearly 40 thousand 11- to 19-year-olds residing in Italy, 8.4 percent of the sample declared to be constantly online or on the phone with friends (chats, calls, videocalls etc.), and 40.3 percent said they are online or on the phone with friends several times a day. The study notes that «virtual» contacts are not alternatives to «real» contacts since those who are more connected online also have more frequent relationships in «real life», but they represent one of several ways in which youngsters

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build relationships. Older boys are more connected as well as girls. Male respondents have more relationships in «real» context than females, while respondents coming from abroad have lower percentages of online and «real» contacts (ISTAT, 2024).

Research on students' digital consumption usually focuses on the association between digital media usage and well-being, including neurocognitive development, anxiety, and depression in youngsters (Browne *et al.*, 2021).

Few studies focused on the role of family dynamics in the use of digital devices, especially those that are easily portable. It has been demonstrated that effective parental monitoring of their children's digital practices can indeed limit the invasive impact of Information and Communication Technologies and prevent the development of internet and device addictions (Lee *et al.*, 2018; Lancini, 2019).

Other research has highlighted that young people's digital skills improve when parents provide adequate support in introducing them to technologies (Chen & Shi, 2019). A key moment in the development of device usage occurs with the acquisition of the first personal smartphone (Vaterlaus & Tarabochia, 2021).

It is essential for parents to be active in defining common rules for the use of shared spaces with technological devices and in demonstrating to their children how to effectively and ethically use portable devices such as smartphones, smartwatches, and tablets. It is also crucial to consider the findings of studies conducted by the Pew Research Institute (Pew, 2018; 2019; 2020), which show that more than half of the young respondents (51%) perceive their parents as being «sometimes» distracted by their phones during conversations, and 14% state that this happens «often». Conversely, 68% of parents acknowledge being distracted «sometimes» by their phones in the presence of their children, and 17% admit that this occurs «often». These studies have also revealed a negative link between parental «phubbing» and adolescents' psychological well-being (Pancani *et al.*, 2020; Geng *et al.*, 2021).

From these considerations, the research question that guides our current contribution has emerged: do the type and amount of owned devices, time spent using them, and household habits allow us to distinguish groups of students that differ in personal features, digital skills, and opinions on technologies?

From a structural perspective, the paper is configured as follows: in section 2, we describe the phases of the research and the analysis methods after defining the sample involved and the variables chosen. Section 3 presents the results of the analysis, particularly the clusters with their features. In section 4, we briefly discuss the findings and conclusions.

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2. Materials and method

This paper is part of a broad study investigating teenagers' perceptions and opinions on technologies and social tools in which they are fully immersed, starting from the availability of devices at home and parents'/adults' perceptions of these tools, also based on domestication theories (Silverstone, 2006; Aroldi, 2010; Manzato, 2011; Boriati, 2021). We studied adolescents' points of view, habits, and social practices as part of a (Italian or multicultural) family or, however, in their relationship with parents or other adults which play an essential role in their lives. Our goal is to understand the familiar involvement in developing digital skills, using technologies for communication, and the role of technologies in the home and family.

The research used mixed methods in an explicative strategy according to a sequential architecture where, after a quantitative analysis of a phenomenon, a qualitative tool is applied to go in-depth on the results previously obtained (Trinchero & Robasto, 2019). The first (quantitative) phase of our study involved administering a questionnaire to students in a high school in Reggio Emilia (Italy). After an initial analysis of the results, we conducted two focus groups (Rossi *et al.*, 2024; 2025) to in-depth study the questionnaire's results and investigate issues to which it could not provide an answer (qualitative phase). Part of the survey results have already been published, focusing on family context (Rossi *et al.*, 2023a) and students' skills and opinions in the generation gap (Rossi *et al.*, 2023b).

Whereas our previous studies on data collected through the survey have been aimed at describing general trends in digital device ownership and intergenerational views on their use, this paper focuses on capturing the diversity detected among adolescents in their relationship with digital tools.

The study presented here and realized through the application of multivariate analysis techniques on the data collected in the survey uses a high number of variables to define groups of students, starting by the number of personal/family, mobile/desk devices, hours spent in their use (alone, with friends and for school). In the analysis, we also verified if the groups created on these variables differ by perceptions of own level of digital skills, use modes in family and for school, opinions on technology and social spaces of students and referring adults.

2.1. *Data*

A 90-item survey with open- and closed-ended questions was administered in a high school in Reggio Emilia (Italy); 362 students, or 23% of the total

school population, responded. The high percentage of respondents qualitatively supports the hypothesis that the sample is representative of the whole school population.

In the sample, missing values were replaced with mean and median according to the type of variables. We excluded observations with more than 5 NA.

Thus, the statistical units (students) included in the analysis were 291.

2.2. *Variables*

The survey investigated the place and meaning of technologies at home, the kind and number of technologies (mobile/desktop, private/shared), the time and habits of using technologies in daily life and during lockdown due to Covid-19 (hours, rules, habits), and the differences between students and adults in skills, opinions, and ways of communication.

We chose 21 variables for analysis listed into groups and briefly described in *Table 1*. In addition to variables related to personal data, the dataset includes quantitative and qualitative variables related to the possession of digital devices in the family, hours spent using them, the level of digital skills, and opinions of students and adults from the students' point of view.

2.3. *Analysis methods*

After studying the sample using descriptive statistics and correlational analysis, we used multivariate analysis techniques to synthesize variables losing the minimum number of information. We selected the *Cluster Analysis* (CA) technique to create groups among statistical units based on our research goal. The presence of numerous ordinal variables in our sample led us to previously use a dimensionality reduction technique, *Multidimensional Scaling* (MDS), in the non-metric approach to reduce the number of variables to be clustered and switch from qualitative to quantitative variables.

CA and MDS are techniques of interdependence that work on distances among observations (Hair *et al.*, 2010).

Multidimensional Scaling is a group of methods for data reduction in computational statistics that go from n variables to k dimensions through a process of trial and error. These techniques are based on an optimization problem: trial-and-error processes aim to ensure that the observed distances are similar to those calculated by the algorithms.

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Table 1. – List of variables (the starred groups were used in MDS and CA).

Group	Variable	Description	Range/ Options
Personal data	Age	Age	Min: 13 Max: 20
	Gender	Gender	Male Female No reply
	Mean	Mean score in the previous scholastic year	Min: 0 (failed) Max: 10
	N_family	Number of family members	Min: 2 Max: More than 5
	I_family	Origins of parents (Italian/Foreign)	Yes (Italian parents) No (at least one foreign parent)
Digital skills	S_comp	Level of digital skills declared by the student: variable composed as the sum of 7 answers in a 4-point Likert scale referring to 5 areas in DigComp (Vuorikari *et al.*, 2022) plus use of software for text elaboration and presentation	Min: 7 (basic level) Max: 28 (highly specialized level)
	A_comp	Level of digital skills of parents/ referring adults according to student' opinion: variable composed as the sum of 7 answers in a 4-point Likert scale referring to 5 areas in DigComp (Vuorikari *et al.*, 2022) plus use of software for text elaboration and presentation	Min: 7 (basic level) Max: 28 (highly specialized level)
Digital devices*	N_mobile	Number of mobile devices in the family	Min: 0 Max: More than 5
	N_desk	Number of desk devices at home	Min: 0 Max: More than 5
	N_personal	Number of device considered «private» by the student	Min: 0 Max: More than 5

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Hours of digital device use*	Hours_alone	Daily hours when the student uses the devices alone	Min: 0 Max: More than 5
	Hours_family	Daily hours when the student uses the devices with other family members	Min: 0 Max: More than 5
	Hours_friends	Daily hours when the student is connected to his/her friends through digital devices	Min: 0 Max: More than 5
	Hours_school	Daily hours when the student uses the devices for study	Min: 0 Max: 4
Habits at home*	Home_habits	Frequency of activities done at home that have to do with digital (social and network news, netiquette, watching videos, rules): variable composed as the sum of 4 responses on a 4-level Likert scale	Min: 4 Max: 16
Opinions and modes of communication by students and referring adults	S_words_1	Three terms that student associates with digital technologies	–
	S_words_2	Three terms that student associates with internet and social networks	–
	S_language	Languages/modes that student uses to communicate through digital tools	–
	A_words_1	Three terms that parents/ adults associate with digital technologies according to student	–
	A_words_2	Three terms that parents/adults associate with internet and social networks according to student	–
	A_language	Languages/modes that parents/ adults use to communicate through digital tools according to student	–

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The difference between the two distances (observed and calculated) has to be as small as possible or, at best, zero. The criterion for measuring the goodness of the approximation is the *stress* function. Stress values are good when close to 0.05; values around 0.20 indicate a poor fit. The stress values can be plotted in a scree plot with the number of dimensions to choose the most appropriate number of dimensions to describe the dataset.

The Shepard diagram plots theoretical distances (ordinates) and observed distances (abscissae) from the shortest to the longest distance. If the stress factor is 0, the points will be on a straight line passing through the origin (Bartholomew, 2008; De Santis, 2022).

We used variables from the groups «Possession of digital devices», «Hours of use of digital devices», and «Habits at home» in MDS.

The dimensions taken from the MDS procedure were used as data for the Cluster Analysis.

CA is for grouping statical units in clusters in which distances are small inside the groups and high among the clusters. In particular, we used *K-means* clustering, an algorithm for partitioning a dataset into a set of *k* groups pre-specified by the researcher (Kassambara, 2017).

For the analysis we used R/R Studio, particularly the packages: *psych*, *MASS*, *vegan*, *tibble*, *ggplot2*, *ggpubr*, *haven*, *dplyr*, *splitstackshape*, and *factoextra*.

3. Results

3.1. *Descriptive analysis*

The analysis's sample shows an 85% prevalence of female students, representing one of the study's limitations.

Approximately 70% of the respondents were between 16 and 18 years of age, and 80% of students said their mean grades in the previous school year were between 7 and 8. 40% of the students interviewed had a family of four members, and 28% had three. 10% of the families had one or two parents of non-Italian origin.

From the students' point of view, the referring adults generally have a lower level of digital competence than they do. *Figure 1* shows the different distribution of competence levels among the two groups. While the average and median values for students are 19, for adults, these values drop to 16 on a scale between 7 and 28, where 7 is the basic level and 28 is the highly specialized level.

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28% of the students appeared to have lower levels of digital skills than their parents, and only 5% declared the same levels in the composed variable.

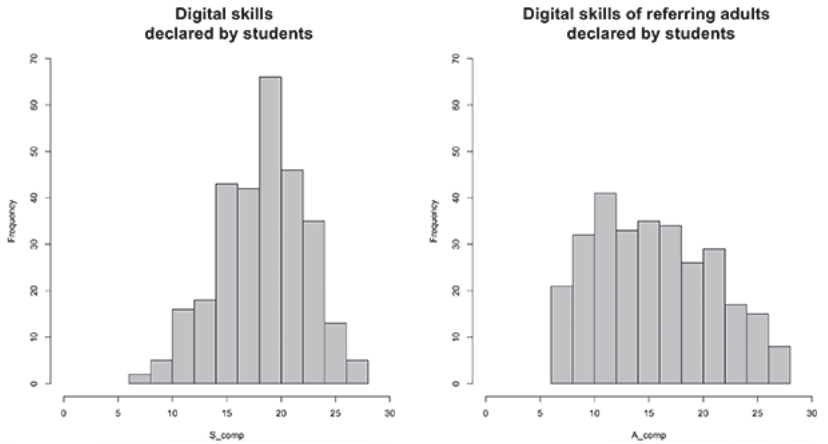

Figure 1. – Digital skills of students (left) and referring adults (right) declared by students.

Figure 2 shows the distributions of the variables used in both MDS and CA.

The number of mobile devices in the home (A) equals or exceeds 5 in 81% of cases. The possession of desk devices (B) is still high, but there is more variety in distribution. Most respondents (73%) consider between 1 and 2 devices to be «private» (C).

53% of students spend between 3 and 5 hours per day alone using devices, and 36% spend more than 5 hours (D).

21% of respondents do not spend even one hour using media with family (E), and the largest number of students (62%) are between 1 and 2.

The time spent online with friends (F) or for school homework (G) is more diversified than previous ones.

Turning our attention to the family habits adopted (H), such as watching videos together, commenting on news from the net, and discussing good online behavior, we find a diverse range of practices. The median is around 10 on a score of between 4 and 16, indicating a diversified level of engagement.

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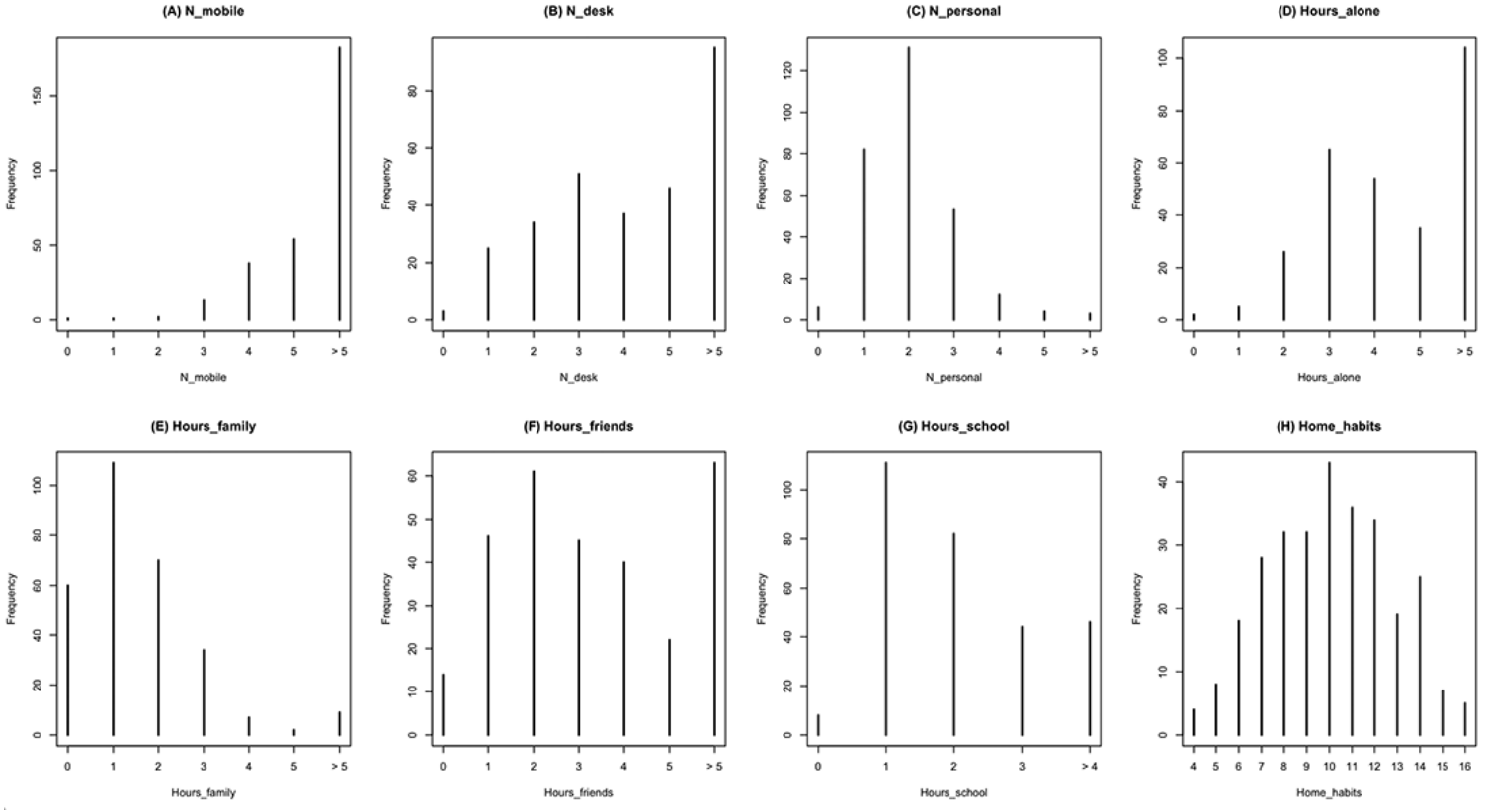

Figure 2. – Distribution of variables used in MDS and CA and related to possession of devices, time and habits in their use alone and in family.

Table 2. – Correlation among variables (correlations within group variables in light green).

	Age	Mean	N_ family	S_ comp	A_ comp	N_ mobile	N_ desk	N_ personal	Hours_ alone	Hours_ family	Hours_ friends	Hours_ school	Home_ habits
Age	1,00												
Mean	-0,08	1,00											
N_family	0,01	-0,03	1,00										
S_comp	0,10	0,09	0,05	1,00									
A_comp	**-0,17**	0,03	0,09	**0,18**	1,00								
N_mobile	0,09	0,01	**0,23**	0,03	0,09	1,00							
N_desk	0,08	0,02	**0,17**	-0,06	0,09	**0,27**	1,00						
N_personal	0,07	-0,04	-0,07	**0,13**	-0,00	**0,24**	**0,22**	1,00					
Hours_alone	0,10	**-0,15**	-0,01	0,08	**-0,12**	**0,19**	0,14	0,11	1,00				
Hours_family	0,08	0,01	0,03	**0,16**	0,06	0,09	0,03	-0,10	**0,18**	1,00			
Hours_friends	**0,23**	**-0,14**	0,02	0,08	**-0,13**	**0,12**	0,12	0,09	**0,65**	**0,21**	1,00		
Hours_school	**0,15**	0,03	-0,07	0,12	0,02	0,11	0,08	0,07	**0,28**	**0,20**	**0,32**	1,00	
Home_habits	-0,09	0,05	**0,17**	**0,16**	**0,30**	0,08	-0,02	-0,05	-0,11	**0,13**	-0,05	0,09	1,00

3.2. *Correlation*

Table 2 shows the correlations among the variables that generally are low.

Within groups of variables in light green, we observe a not very high value of correlation (0.18) between S_comp and A_comp, which represents a light relation among the skills that students attributed to themselves and their referring adults. The correlations among variables related to the number of devices owned are between 0.22 and 0.27, showing a weak but positive correspondence among the ownership of different types of devices. The correlations in the group of hours spent using devices are higher. There is a strong correlation between Hours_alone and Hours_friends (0.65). If students use the devices for many hours alone, they generally are more likely to spend more hours with family, friends, and for school.

Other interesting elements:

- Age correlates weakly with A_comp, Hours_friends, and Hours_school: for some students, as age increases, confidence in adults' digital skills decreases, and time using devices with friends and for school increases.
- The school score (Mean) is independent of the number of devices owned and digital skills. It is negatively correlated with very low values for time spent alone (-0.15) and with friends (-0.14) using devices.
- The number of family members, in addition to affecting the number of devices in the home, has a slight correlation with Home_habits (0.17).
- The correlation value between A_comp and Home_habits is 0.30. Spending more hours with adults using digital tools may lead students to perceive adults as more capable, or it could be that parents' capability encourages more family discussions and using devices together.

3.3. *Multivariate analysis*

We calculated the Euclidean distance among points and applied the non-metric Multidimensional Scaling to the 8 variables shown in *Figure 2* belonging to groups «Digital devices», «Hours of digital device use», and «Habits at home».

Figure 3 shows the plot generated among dimensions and the stress value to identify the best number of dimensions to keep in the analysis. We do not see a point in the plot where a change in trend is evident. We should opt for a 4-dimensional solution by balancing the need to reduce the number of dimensions with the need to retain the greatest amount of information and evaluating the stress value of 0.08 (optimum value at 0.05).

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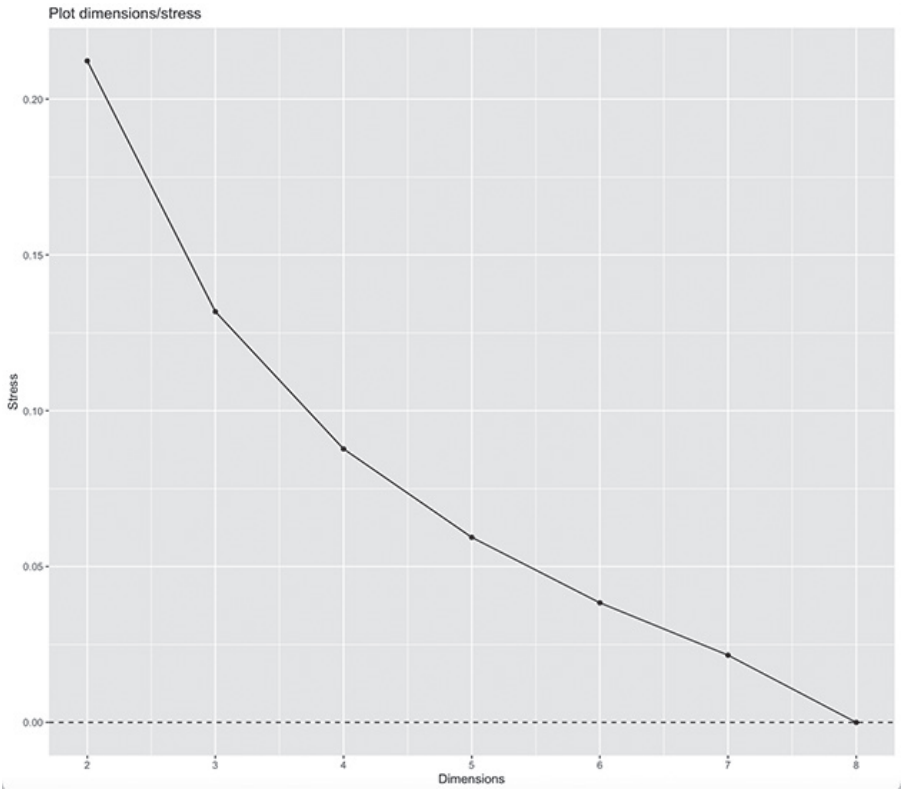

Figure 3. – Plot dimensions/stress.

However, since we prefer to plot the 2-dimensional solution, we chose this last one with stress equal to 0.21. The poor fit, as evidenced by the stress value, also appears in R^2 of linear fit in Shepard's plot (*Fig. 4*).

The plot in *Figure 5* determines the optimal number of clusters to generate. We identified an elbow in the plot at four, which is the number of clusters we used for running K-means. The four clusters are distributed in four quadrants as seen in *Figure 6*.

Cluster 1 is the least numerous, with 52 students. The number of teenagers in the others varies between 72 and 85.

Figure 7 shows the boxplots of the distribution in the clusters of the 8 variables used for the MDS and, later, the Cluster Analysis.

The variable Home_habits has a similar distribution in all clusters, while those related to device possession and time spent using them show different trends. Therefore, the student clusters differ by the situations gen-

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erated at the intersection of device ownership and time spent using them. Clusters 2 and 3 are characterized by the presence of a high number of mobile and desk devices in the home. Clusters 1 and 4 show far less desk device ownership. In addition, Cluster 4 shows slightly less mobile device ownership for 25 percent of students. Time spent using devices is broadly higher in Clusters 1 and 2 and lower in Clusters 3 and 4.

Figures 8 and *9* confirm the previous statements and provide the observations in the plane coded by the clusters (shape) and the trends of the variables N_desk and Hours_alone (colors). Moving from top to bottom the number of desk devices owned by families increases, and moving from left to right the number of hours students spend alone with digital devices increases.

Thus, simplifying, the 4 clusters present following features:

- Cluster 1: a smaller number of desk devices, high consumption in device hours.
- Cluster 2: many devices and much time spent on their use.
- Cluster 3: many devices and low usage in time.
- Cluster 4: a smaller number of (mobile, desk, and personal) devices and low utilization in terms of time.

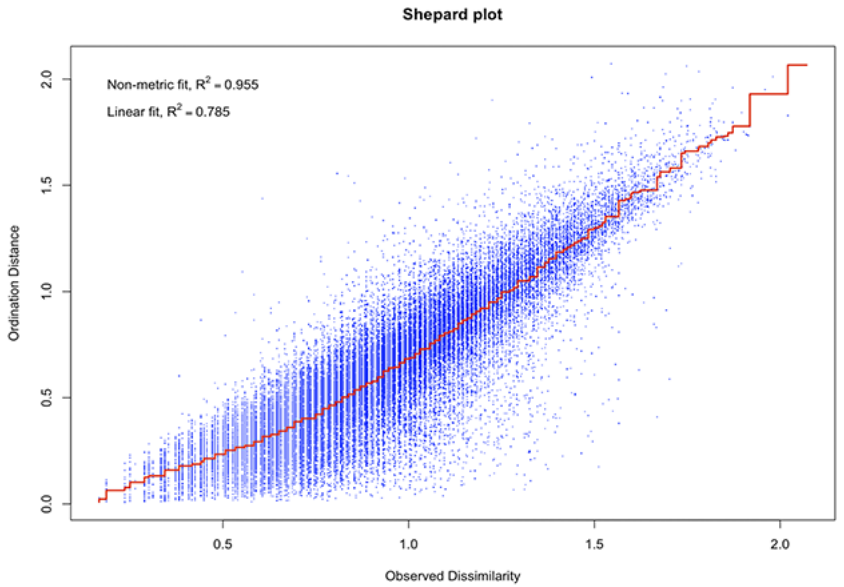

Figure 4. – Shepard Plot for the 2-dimensional solution.

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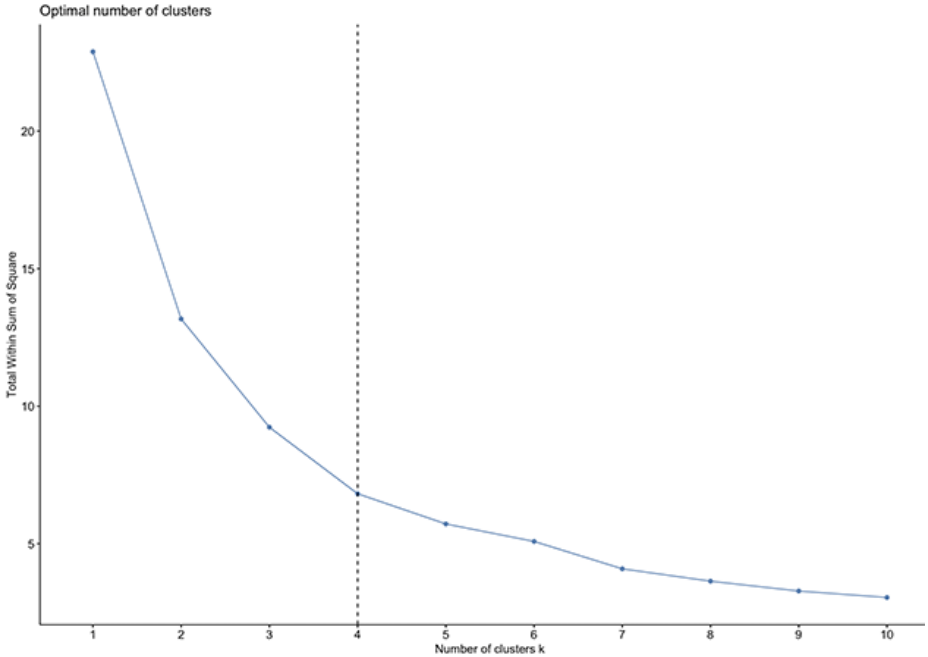


Figure 5. – Plot to identify the optimal number of clusters.

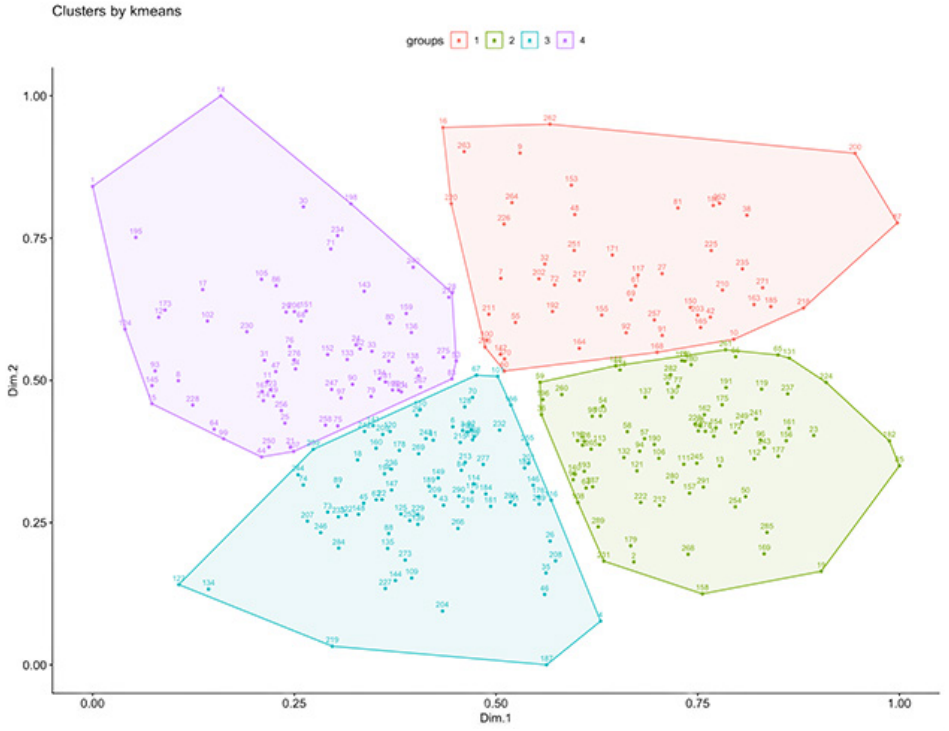


Figure 6 . – Four clusters identified after MDS and Kmeans.

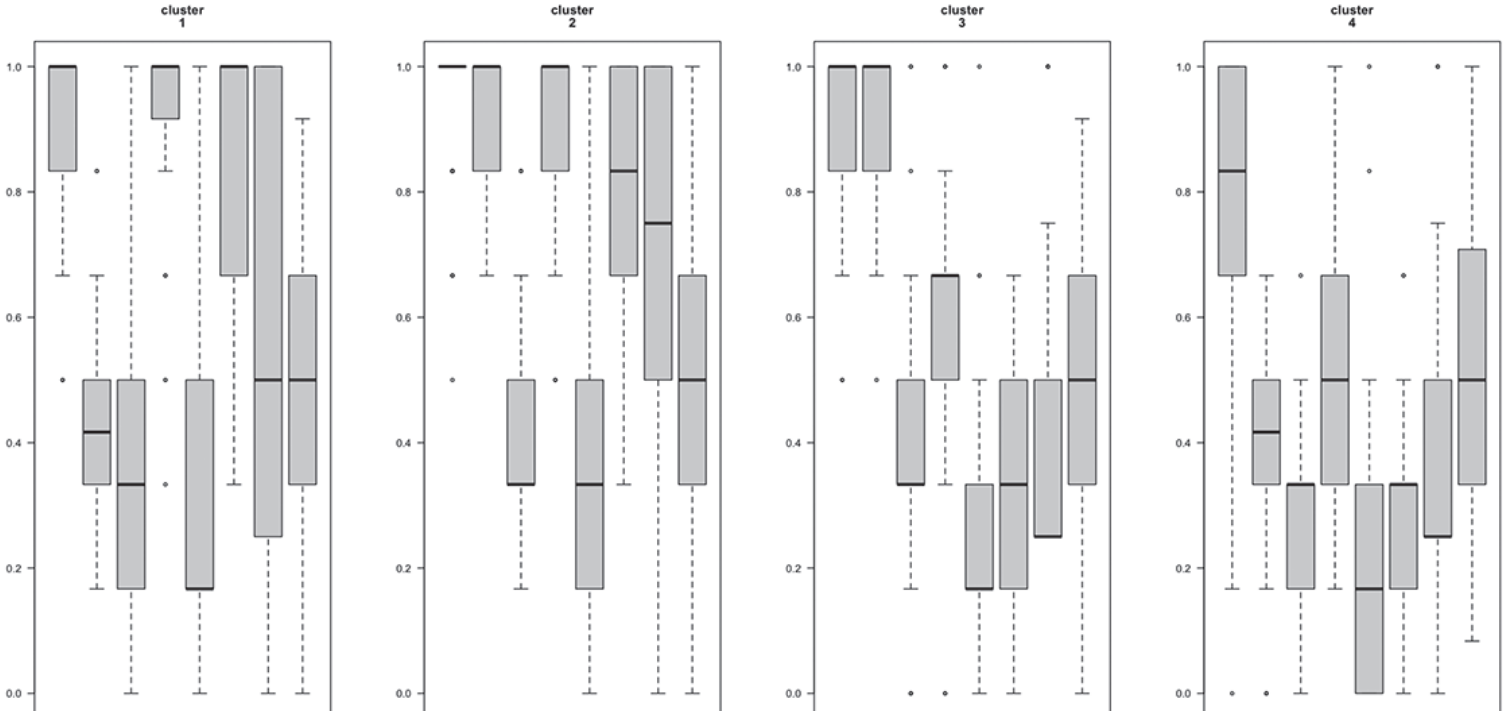
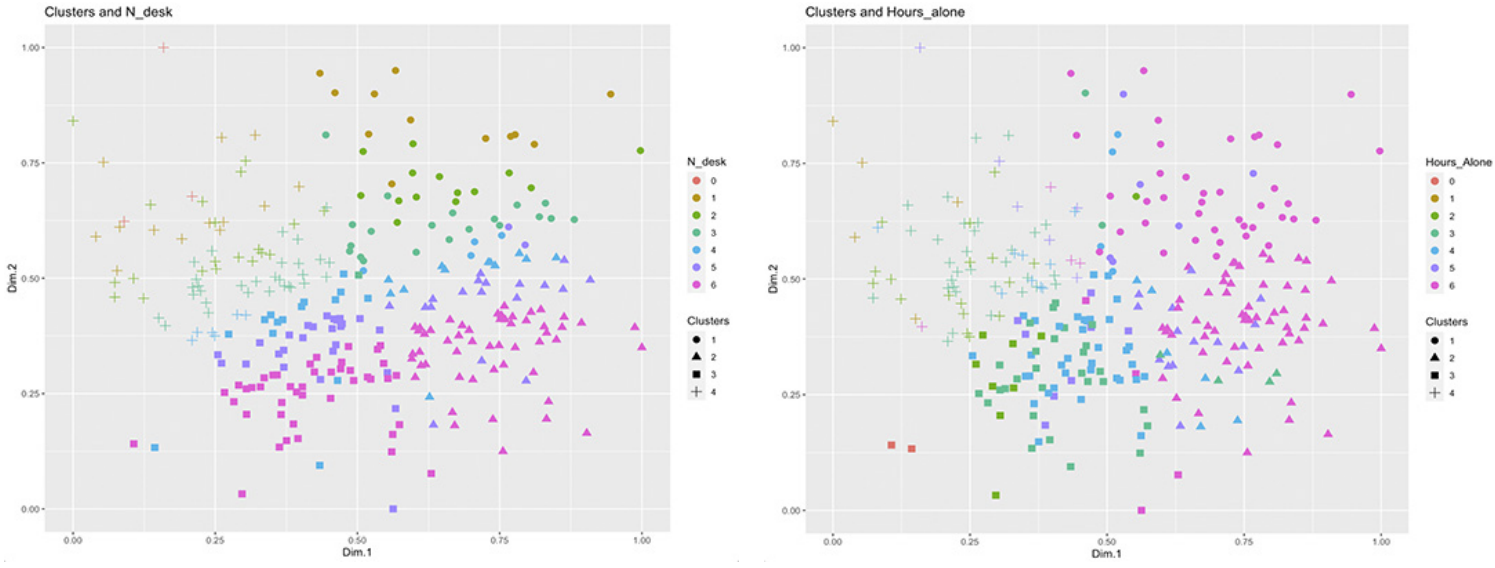


Figure 7. – Clusters by number of owned desk devices.



Figures 8-9. – Clusters by number of owned desk devices (left) and hours spent alone using devices (right).
[Please note that 6 in Hours_alone corresponds to «More than 5»; 6 in N_desks corresponds to «More than 5»]

Table 3. – Percentages and tendency values for variables in the groups «Personal data» and «Digital skills».

	N.	Personal data					Digital skills	
		Male	*Less than 15 years old*	*Less than 4 family members*	*Multicultural families*	*Scores 8-10*	*S_comp**	*A_comp**
Cluster 1	52	9.6%	25.0%	80.8%	19.2%	46.2%	20 (9-28)	14 (7-27)
Cluster 2	82	6.1%	14.6%	70.7%	4.9%	46.3%	19 (9-27)	15 (7-28)
Cluster 3	85	16.5%	23.5%	68.2%	9.4%	56.5%	18 (7-27)	17 (7-28)
Cluster 4	72	16.7%	36.1%	80.6%	11.1%	63.9%	19 (8-27)	16 (8-26)

Note: * Median and range of quantitative variables related to Digital skills.

Our analysis follows by examining the distribution of the variables of the other groups according to the cluster division.

Table 3 contains percentages and tendency values to describe the distribution of variables in the groups «Personal data» and «Digital skills» in the clusters.

Cluster 1 has the highest percentage of multicultural families compared to the other clusters.

Cluster 2 has a higher percentage of older students than the others, with few multicultural families and a higher number of members. The latter element is also recorded in Cluster 3.

Although the research sample is predominantly female, the largest number of males is in Clusters 3 and 4 (around 17% for both). In this last cluster, higher percentage of younger students and those with higher grades are also present.

Moving to digital skills, the median level students attribute to themselves in all clusters is higher than that of the reference adults. In Cluster 1, in contrast to the highest score of students' median (20), there is the lowest score of adults (14) and, consequently, a greater gap between the two generations trends.

The gap between medians is, on the contrary, less pronounced (almost nil) in Cluster 3.

We complete the analysis with the last group of variables: «Opinions and modes of communication by students and referring adults». *Figures 10* and *11* collect the words students indicated on digital tools for themselves and referring adults. *Figure 12* and *13* concern the topic of Internet and social tools. In the histograms, the terms were grouped into four areas: *devices* (including computer, tablet, smartphone, TV, video, photos etc.), *online tools* (social media, website, post etc.), *strengths* (innovation, progress, communication, friendships, news, information, research, knowledge etc.), *weaknesses* (dangerous, privacy, difficulties, cyberbullying etc.).

The general tendency in the first two figures on digital technologies is that students chose words on tools, online resources, and positive aspects for themselves. They added words related to dangers in virtual spaces when selecting words for referring adults, reflecting their awareness of potential risks.

When comparing clusters, students in Cluster 1 focus on digital and online tools, and in Cluster 2, they focus on digital tools and their strengths. The same happens in Cluster 3, where the list of positive words is higher than each of the other clusters. In Cluster 4, positive elements have a high percentage, and a small percentage of negative elements, such as dependence and privacy, appear.

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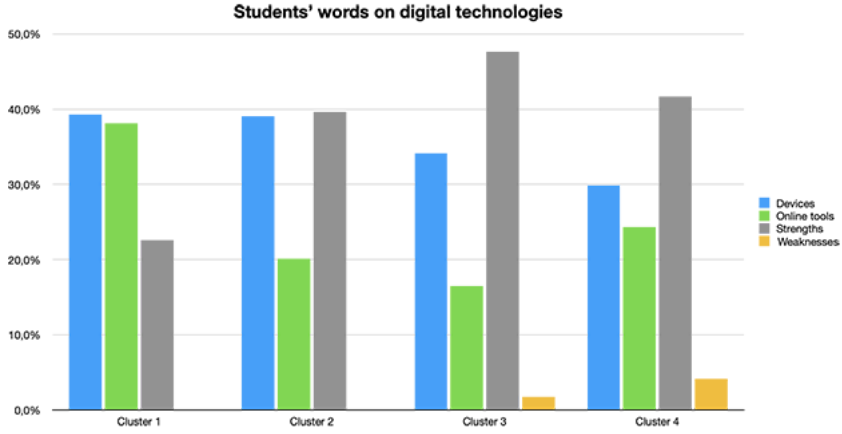

Figure 10. – Students' words on digital technologies by cluster.

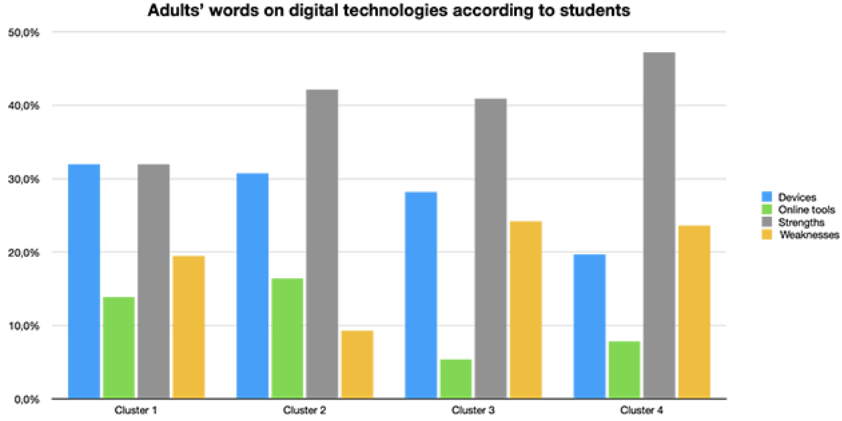

Figure 11. – Adults' word on digital technologies according to students by cluster.

Looking at the terms chosen by students to represent adults' ideas about digital technologies, we notice a shift from devices to their opportunities or dangers. Generally few words are related to online tools. In Cluster 1, we found words related to devices and strengths, with 20% of words related to weaknesses. In Cluster 2, strengths increase compared to weaknesses and dangers. In Clusters 3 and 4, many words are related to opportunities and many more to weaknesses. The percentage of strengths always remains higher than that of weaknesses.

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Speaking of internet and social networks, the distribution is almost similar in all clusters, with percentages around 40% of terms on online tools and strengths in each group. When compared to *Figure 10*, we begin to see percentages of around 10% on terms relating to weaknesses, which had appeared weakly in Clusters 3 and 4 in the previous histogram.

Moving to adults' perceptions, if we exclude the terms referring to the tools, the percentages of negative words that students attribute to adults' points of view even outweigh the positive ones except for Cluster 2, in which the differences are irrelevant. Cluster 3 is the one in which fewer words are attributed to the type of tools and more to the weaknesses.

Internet and social networks are of more concern than the tools.

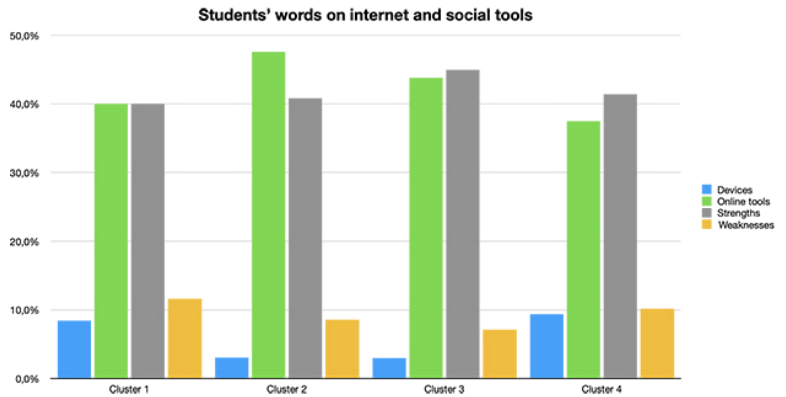

Figure 12. – Students' words on internet and social tools by cluster.

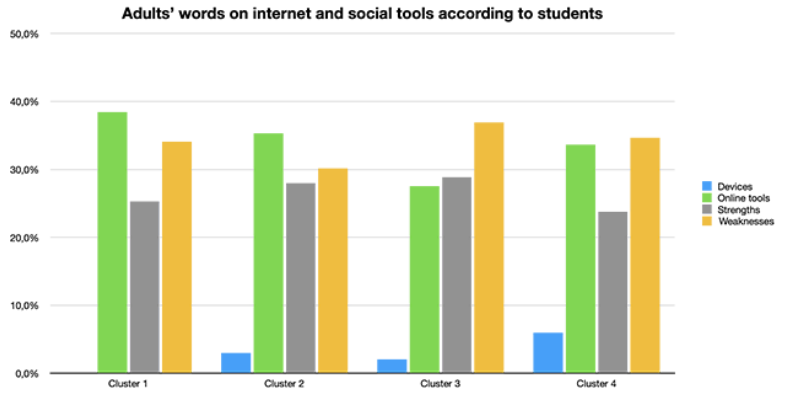

Figure 13. – Adults' words on internet and social tools according to students by cluster.

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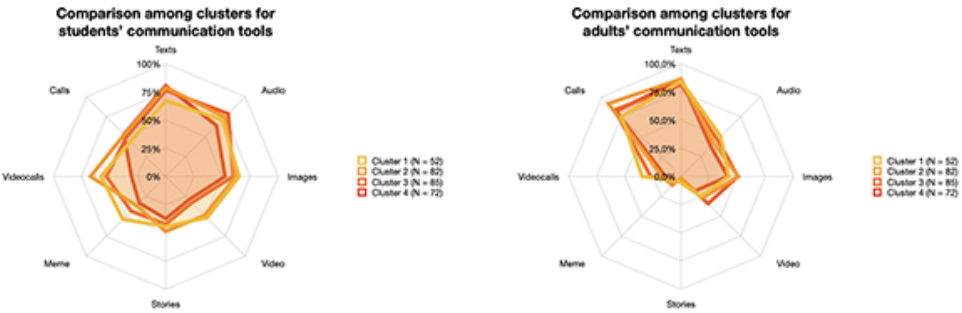

Figure 14. – Comparison among clusters on communication tools for students (left) and for adults according to students (right).

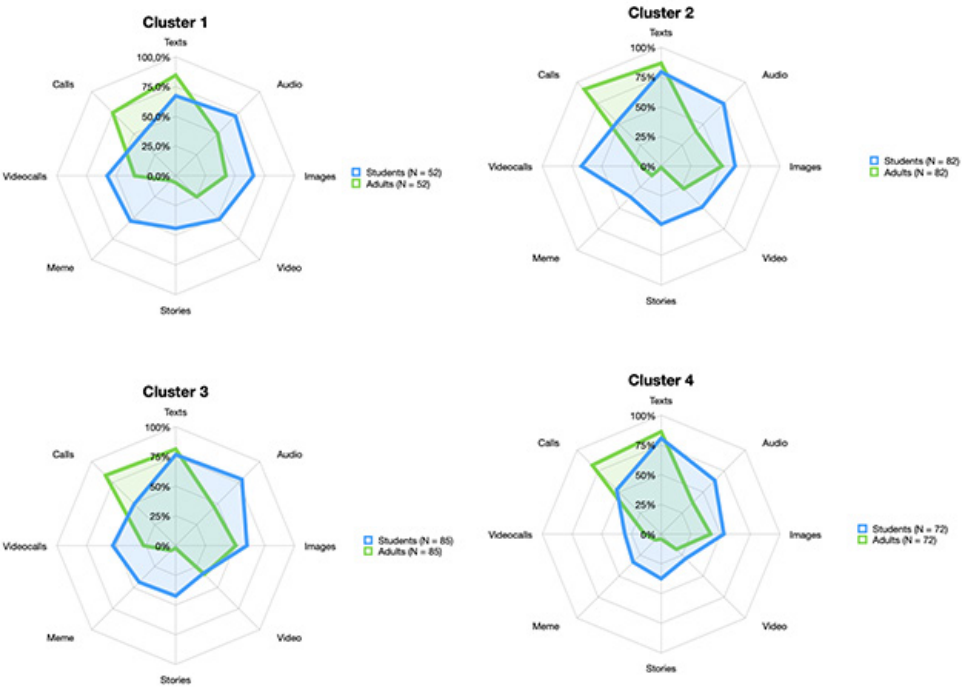

Figure 15. – Languages/modes of communication of students and referring adults according to students' opinions by clusters.

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We also analyzed the communication choices students make and which they attribute to adults. Adults tend to use texts and phone calls more than students, while students use various tools, with higher percentages of audio, text, and images.

Figure 14 shows the overlap among clusters based on students' opinions on their choices and those made by adults. *Figure 15* shows the comparison among students' and adults' communication tools for each cluster.

Subtle differences are evident in most cases.

Students in Cluster 1 use more audio, texts, and images. Compared to the other clusters, they use a little bit of everything, fewer texts and calls, and more memes, images, and videos, presenting a more multimedia approach. According to them, adults use texts, calls, and audio. Compared to other clusters, adults in Cluster 1 are said to use a little bit of everything and fewer images and calls.

Cluster 2 is composed of students who use text, audio, videocalls, and images. They use a lot of everything except memes. Their percentage of using videocalls and calls is higher than that of other clusters. Adults in Cluster 2 are referred to using calls, texts, and images. They have a higher percentage than the others in using images and calls, lower for videocalls. This latter element contrasts with the results for students.

Students in Cluster 3 moderately use every kind of tool. The preferred tools are audio, texts, and images. Compared to the other clusters, they use videos less. Adults in Cluster 3, according to students, use many tools; in particular, the higher percentage is represented by calls, text, and images. Compared to the other, their percentages are strong on video and videocalls.

Students in Cluster 4 have a lower percentage than other clusters in everything, with exceptions for texts and calls. Also for the adults, they declared a moderate use of communication tools with a preference for texts and calls.

Figure 15 shows that Clusters 1 and 2 show greater differences in the choices of communication tools for students and adults, and Cluster 3 shows more moderate differences.

Cluster 4 has the greatest overlap in the tools used, but mainly because the students master a lesser variety of them.

4. Discussions and conclusion

Our study aims to investigate students' use of digital tools, their role in everyday life, and their views on adults' lives.

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The goal of the analysis is to detect the differences among students rather than the regularities we have analyzed in previous publications on this research.

From the proposed survey, using the techniques of multivariate analysis (Cluster Analysis and Multidimensional Scaling), we identified four clusters of students.

Cluster 1 is the less numerous and includes students with fewer digital tools who spend many hours using them. In the cluster, there is a presence of students from multicultural families, and also less numerous families. The students talk about the tools when asked about the meanings of digital, online, and social media. From their point of view, adults' opinions on this theme regard devices and mainly their weaknesses. There is a wide gap in the perception of digital skills and communication choices between students and adults according to students' views.

Students in Cluster 2 have many digital tools and use them for many hours daily. Students in larger families and with lower scores at school belong to this cluster. Students use device-related and strengths-related terms as keywords on technologies as well as a balance of strengths and weaknesses of technologies from the point of view of adults. In their opinions, there is an intergenerational distance in both skills and communication tools.

Cluster 3 contains students who have a lot of tools and use them for less hours. There is a higher percentage of males and students from large families and with higher scores than in the other clusters. Students indicate keywords about technologies related to devices and their positive aspects. When choosing words for adults, mainly when talking about online, weaknesses appear next to strengths. There is some distance between them and parents/adults regarding communication tools but not in the perception of digital skills, for which the scores are similar.

In Cluster 4, there are students who have fewer desks than the others and use them little. Percentages of male and younger students fall into the cluster. Again, students point to device types and strengths when talking about technologies but terms related to weaknesses appear unlike the others already in the first question. From the adult perspective, many strengths are listed for digital and weaknesses related to online and social media. According to them, they are closer in the way adults communicate, and there is more reduced difference in the perception of digital skills.

Considering the profiles in general, the four clusters respectively suggest four attitudes that, broadly speaking, students may hold toward technologies:

- *Device-oriented.* The focus is on tools of all types that are used frequently without fully reflecting on and considering their positive and negative

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aspects and the competencies necessary for correctly approaching them. The pervasive use of devices contributes to feeling/living a stronger intergenerational distance from parents/adults who could have fewer skills to use.

- *Strengths-oriented*. This attitude is characterized by a relevant use of devices to their full potential, guided by a positive reflection on their strengths. This predominantly optimistic approach can bring difficulties to the risks that must be taken into account with adult guidance.
- *Meaning-oriented*. Devices are used sparingly, aware of their functions, meaning, and skills needed to use them, which go beyond the purely functional issues. As a cause or consequence, this approach can shorten the distance in communication from adults.
- *Use-oriented*. In this attitude, a not at all excessive use of digital tools is done, the function of the tool matters more. Intergenerational distances on this issue are limited by the fact that there is no, if not functional, interest in the use of these tools.

These four attitudes require different educational interventions on students to develop an awareness of the use of digital tools, an awareness of the risks and potentials that also concerns the referring adults to increase skills, and to develop the function of guidance towards the younger ones.

References

Aroldi, P. (2010). Addomesticare i media nella vita quotidiana. Dal consumo alle pratiche. In F. Pasquali, B. Scifo, & N. Vittadini (a cura di), *Crossmedia cultures. Giovani e pratiche di consumo digitali* (pp. 3-20). Milano: Vita e Pensiero.

Barone, P. (2021). Evoluzione di un concetto. Adolescenza post-moderna. *Journal of Phenomenology and Education*, *25*(61), 3-9. [20/02/2024]. https://doi.org/10.6092/issn.1825-8670/12948

Bartholomew, D.J., Steele, F., Moustaki, I., & Galbraith, J.I. (2008). *Analysis of multivariate social science data* (2nd ed.). Boca Raton, FL: CRC Press, Taylor & Francis Group.

Boriati, D. (2021). Lo smartphone alla prova della Domestication Theory. *Mediascapes Journal*, *18*, 114-127.

Browne, D.T., May, S.S., Colucci, L., Hurst-Della Pietra, P., Christakis, D., Asamoah, T., Hale, L., Delrahim-Howlett, K., Emond, J.A., Fiks, A.G., Madigan, S., Perlman, G., Rumpf, H.-J., Thompson, D., Uzzo, S., Stapleton, J., Neville, R., Prime, H., & The MIST Working Group (2021). From screen

Online ISSN 2037-7924 - Print ISSN 2037-7932 - ISBN 978-88-5513-208-4

time to the digital level of analysis: A scoping review of measures for digital media use in children and adolescents. *BMJ Open*, *11*(5), e046367.

Castronova, E. (2009). *Exodus to the virtual world: How online fun is changing reality*. New York: St. Martin's Griffin.

Chen, L., & Shi, J. (2019). Reducing harm from media: A meta-analysis of parental mediation. *Journalism & Mass Communication Quarterly*, *96*(1), 173-193. [21/02/2024].
https://doi.org/10.1177/1077699018754908

De Santis, A. (2022). *Analisi multivariata e learning analytics. Metodi e applicazioni*. Milano: Pearson.

Geng, J., Lei, L., Ouyang, M., Nie, J., & Wang, P. (2021). The influence of perceived parental phubbing on adolescents' problematic smartphone use: A two-wave multiple mediation model. *Addict Behav*, *121*, 106995.
https://doi.org/10.1016/j.addbeh.2021.106995

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., & Tatham, R.L. (2014). *Multivariate data analysis* (7th ed.). Edinburgh Gate - Harlow (Essex, UK): Pearson.

ISTAT (2024). *Indagine bambini e ragazzi | Anno 2023. Nuove generazioni sempre più digitali e multiculturali*.
https://www.istat.it/wp-content/uploads/2024/05/Bambini-e-ragazzi-2023.pdf

Kassambara, A. (2017). *Practical guide to principal component methods in R. STHDA*. Statistical Tools for High-throughput Data Analysis.

Lancini, M. (a cura di). (2019). *Il ritiro sociale negli adolescenti. La solitudine di una generazione iperconnessa*. Milano: Raffaello Cortina Editore.

Lee, J., Sung, M.J., Song, S.H., Lee, Y.M., Lee, J.J., Cho, S.M., & Shin, Y.M. (2018). Psychological factors associated with smartphone addiction in South Korean adolescents. *Journal of Early Adolescence*, *38*(3), 288-302. [26/02/2024].
https://doi.org/10.1177/0272431616670751

Manzato, A. (2011). Tecnologie quotidiane. Intorno al paradigma della domestication. *Ocula. Occhio semiotico sui media*, *12*.
https://www.ocula.it/files/OCULA-FluxSaggi-MANZATO-Tecnologie-quotidiane-domestication.pdf

Pancani, L., Gerosa, T., Gui, M., & Riva, P. (2020). «Mom, dad, look at me»: The development of the Parental Phubbing Scale. *Journal of Social and Personal Relationships*, *38*(2), 435-458. [27/02/2024].
https://doi.org/10.1177/0265407520964866

Panciroli, C., & Rivoltella, P.C. (2023). *Pedagogia algoritmica. Per una riflessione educativa sull'Intelligenza Artificiale*. Brescia: Editrice Morcelliana - Scholé.

Pew Research Institute (2018). *How teens and parents navigate screen time and device distractions*. [11/03/2024]. https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2018/08/PI_2018.08.22_teens-screentime_FINAL.pdf

Pew Research Institute (2019). *How parents feel about – and manage – their teens' online behavior and screen time*. [11/03/2024]. https://www.pewresearch.org/fact-tank/2019/03/22/howparents-feel-about-and-manage-their-teens-online-behavior-and-screen-time/

Pew Research Institute (2020). *Parenting children in the age of screens*. [12/03/2024]. https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2020/07/PI_2020.07.28_kidsand- screens_FINAL.pdf

Rivoltella, P.C. (2020). *Nuovi alfabeti. Educazione e culture nella società post-mediale*. Brescia: Editrice Morcelliana - Scholé.

Rossi, L., De Santis, A., Orsenigo, E., Valentini, M., & Minerva, T. (2023a). Generational relations, technology and digital communication: A comparison between multicultural and native families. *Rivista Italiana di Educazione Familiare*, *23*(2), 59-71.

Rossi, L., Orsenigo, E., Pellizzari, C., De Santis, A., & Minerva, T. (2025). La percezione dei giovani del divide generazionale. Analisi qualitativa di focus group. *Orientamenti Pedagogici*, *72*(2), 57-71.

Rossi, L., Orsenigo, E., Valentini, M., De Santis, A., & Minerva, T. (2023b). Contesto familiare/culturale nel divide generazionale introdotto dalle tecnologie digitali. *The Lab's Quarterly*, *25*, 1-20.

Rossi, L., Valentini, M., Orsenigo, E., Pellizzari, C., De Santis, A., & Minerva, T. (2024). I giovani e la percezione delle competenze digitali. Uno studio qualitativo tramite focus group. *RicercAzione*, *16*(1), 73-91.

Silverstone, R. (2006). Domesticating domestication: Reflections on the life of a concept. In T. Berker *et al.* (Eds.), *Domestication of media and technology* (pp. 229-248). Maidenhead (Berkshire, UK): Open University Press.

Trinchero, R., & Robasto, D. (2019). *I mixed methods nella ricerca educativa*. Milano: Mondadori Education.

Vaterlaus, J.M., & Tarabochia, D. (2021). Adolescent smartphone acquisition: An exploratory qualitative case study with late adolescents and their parents. *Marriage & Family Review*, *57*(2), 143-164. [09/03/2024]. https://doi.org/10.1080/01494929.2020.1791302

Vuorikari, R., Kluzer, S., & Punie, Y. (2022). *DigComp 2.2: The digital competence framework for citizens. With new examples of knowledge, skills and attitudes*. Luxembourg: Publications Office of the European Union.

Riassunto

Il tipo e la quantità di dispositivi digitali posseduti, il tempo trascorso ad utilizzarli e le abitudini quotidiane e familiari permettono di distinguere gruppi di studenti in base a caratteristiche personali, percezione delle proprie competenze digitali, opinioni sulle tecnologie e scelte comunicative dei genitori o adulti di riferimento? Lo studio qui presentato analizza i risultati di un questionario somministrato a circa 300 studenti di una scuola superiore di Reggio Emilia (Italia) nell'ambito di una ricerca che ha utilizzato metodi misti di indagine. Applicando tecniche di analisi multivariata (Multidimensional Scaling e Cluster Analysis), sono stati individuati quattro cluster, che si differenziano per il numero di dispositivi posseduti e per il tempo dedicato al loro utilizzo. Questa classificazione suggerisce quattro comportamenti degli studenti nei confronti delle tecnologie: device-oriented, strengths-oriented, meaning-oriented, e use-oriented.

Parole chiave: Analisi multivariata; Comportamenti degli studenti; Consumo digitale; Divario generazionale; Domestication.

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