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Innovative Teaching and Digital Literacy in Preschool. App Content Analysis and Experimental Case Studies in a Sociological Perspective

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Abstract: The objective of this article is to illustrate, from the theoretical and methodological perspective, the construction of an experimental process of a “digital education app” in several preschools in the municipality of Rome. The general objective the project fits into is related to a sociological analysis, based on the relationship between theory and empirical research, of the effects of introducing digital media into preschool didactics. Preschools are a privileged site for observing and analyzing the formation and development of children’s capabilities (Nussbaum, 2000), since the plasticity of the child’s thought begins to be configured as early as preschool and evolves progressively taking into account the perceptive, sociocultural and behavioural conditions emerging from different educational agencies (Piaget, Inhelder, 1950). The article refers to the research project of the Mediamonitor Minori Observatory of the Sapienza University of Rome entitled “Media Usage in Pre-school. Analysis and Evaluation of the Influence of Digital Media on the Socialization of Children between 0-6”. The article retraces in particular the stages of the research strategy designed to structure a formative, experimental protocol to be experimented in some case studies in Rome and illustrates the main results.

Keywords: App Digital Education, content analysis, didactic experimentation, innovative teaching, sociological perspective

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Introduction

This article is related to the recent contemporary debate on the emotional, cognitive, social and behavioural effects derived from the growing use of digital devices in preschool age in different socialization contexts (like the family and the school) (Ofcom, 2014; Livingstone, 2015). According to statements made by experts, above all paediatricians, premature use of digital media brings a variety of negative consequences on the child, some of which are physiological and behavioural, such as for example inadequate nutrition or physiological deformations, thus increasing the risk of physical illness (such as obesity, loss of sight, sleep deprivation, diabetes, cardiovascular pathologies, and so on) (Nunez-Smith et al., 2008); as well as cognitive ones causing learning disorders, like loss of attention or concentration, difficulties in memorizing information or in verbal expression as well as aggression, anxiety and depression, victimization, social isolation, and reduced prosocial behaviour (Parkes, et al. 2011; Neumann, 2015). These alarms, not completely new in the scientific debate but widely taken into consideration by public opinion, need to be treated more often in research and studies. There is often no empirical evidence of a direct, cause-and-effect relationship between behavioural and physical effects, and exposure to the media (McPake et al., 2012), while other research confirms that the use of these devices might foster the development of relationship skills, promoting face-to-face relating with other family members (Verenikina & Kervin, 2011), as well as the development of communication skills, especially for exploring the world and expressing oneself (Hisrich & Blanchard, 2009; Levy, 2009; Marsh, 2005; Plowman & McPake, 2013).

Despite the extent of the phenomenon worldwide, research on media use by toddlers is still uncommon for economic, ethical, and scientific reasons. It is a complex issue to propose quantitatively relevant interventions on children so young, who cannot be interviewed directly. Most research in this area is in fact qualitative and based on observing the family setting. Educational mediation, then becomes essential in research, although the problem remains of the perceptive filter of the parents (or teachers), in addition to the difficulty of involving them in experimental paths due both to prejudices related to technology, and to poor skills in using the media and risk of exposure to still little-known effects. The very lack of an established research protocol in this area further complicates intervention, due precisely to the dearth of ethically and methodically tested procedures capable of protecting children and the families involved, while still ensuring rigorous research (Holloway et al., 2013).

The concluding report of the research work *Children's Use of Online Technologies in Europe, A review of the European evidence base*, conducted by the *EU Kids Online* in 2014, stated, in fact, that only 7% of empirical research

focused on the relationship between media and children relates to children under six years of age. Within this small percentage, however, surveys mostly confirm there is a progressive increase in the use of digital media, and especially of tablets and smartphone devices. This use does not seem to be exclusive and central in the media consumption of preschool children, as there are still other cultural activities that children love, such as listening to fairy tales or watching TV (Kaiser Family Foundation, 2011; 2013) but also playing with friends, outside the home and with other material and not necessarily technological objects (Livingstone et al., 2014; Matsunoto et al., 2016). In another European Union research effort (“Young children (0-8) and digital technology: a qualitative exploratory study”), the ethnographic method was used to explore the relationship between the use of digital technology and some relationship dynamics within the family. The results showed that children easily develop skills in accessing tablets and smartphones, often by way of behavioural imitation of what their parents do (Neumann, 2015). According to some scholars (Lauricella, Wartella & Rideout, 2015), then, family mediation is fundamental for determining the type of relationship the child has with the medium, and therefore for making positive use of the technologies. Toddlers have no perception of the risks associated with navigation, and even in parents, these risks appear focused not on the content used but on the child’s quantity of exposure and on the danger of isolation from other not necessarily digital activities.

More in-depth analysis of this phenomenon would, in fact, calculate its impact and more deeply identify those social and cultural variables which can condition a potential misbalance of the consumption of digital media towards the previously mentioned risks or towards opportunities for learning development.

It is, however, appropriate to ask what changes can come from using these devices in primary socialization processes and what effects derive from the specific relationship between the consumption style or the content used, and the development of competencies within the formal socialization context.

Material and method

Media Usage in Preschool: a sociological analysis of the digital didactics in preschools

The new cultural and communication habit involving the use of digital devices in preschool age has caught the attention of and raised concerns among educators, parents, politicians and researchers from different disci-

plines, prompting a series of queries of a psychological-cognitive, socio-educational, relational and communication-related nature, to which adequate answers and precise indications need to be provided.

Some of these issues refer to protecting the rights of children using these devices informally, as well as to verifying the quality of the content offered and services delivered. These ethical and political questions, in any case, appear supported no longer by a mere orientation towards protection, but also by an attitude in digital education towards developing empowerment – for instance by strengthening instruments and services – that can guarantee a progressive acquisition of awareness in digital consumption, and towards activities of educational accompaniment that help improve responsibility and active participation. Many international research efforts in this area provide recommendations for political guidance on activating processes of education in self-regulation in using media, which is to say balancing this use with other activities during the day, fostering co-use socialization, and promoting the sharing of online activities and discussions between parents and children (Matsunoto et al., 2016)

The research-intervention project *Media usage in pre-school*, on which this article focuses, has proposed a digital education experiment in preschools aimed at harmoniously integrating digital media and the touchscreen into the traditional didactic-play setting. Media education has foreseen the use of the digital media, not only in an isolated and exclusive way, but also in subordination to the achievement of larger formative objectives, to the stimulation of transversal competencies related to cognitive development in preschool age, and to the combination of activities done using a tablet with other more traditional play activities. This takes place in accordance with a process of cognitive and “soft” emotional stimulation, which is heterogeneous and rich, programmed step by step by educators and researchers together.

This experimentation would aim to be configured as an early educational response to the balancing of risks and opportunities related to the use of digital media; its objective is to diminish risks and strengthen opportunities

Children at preschool age develop an initial awareness, mostly sensorial (sensory-motor) or constructed through the handling and perception of, and contact with, physical objects. From there, they acquire information of space and motor orientation, and they then develop an intuitive (or preoperative) instinctive or emotional awareness capable of stimulating the imagination and iconic representation based also on the processes of recognition and decoding of the external social reality (Bruner, 1986). This development, in any case, cannot ignore the surrounding social context and the activities of mediation by some key figures, like parents and teachers, who accompany the child during the cognitive exploration of the surrounding reality and who should facilitate the “progression of learning” (Vygotskij, 1934).

The nature of mediation thus risks conditioning cognitive development, in terms of mental representations of the surrounding reality, emotional and behavioural attitude towards external stimulations, and modes of expression and communication – and therefore, of language development.

Cognitive empowerment or disempowerment through stimulation with digital media therefore cannot ignore a sociological and mostly qualitative analysis of the educational micro-context, within which digital stimulation should be promoted through activities of cultural mediation and within the company of educators for those educational activities that include the use of digital devices in class.

Specific objectives at the basis of this pilot project are therefore connected to two factors:

1. The influence of digital media on psychological and cognitive development and on the improvement of the soft skills of preschool children;
2. The analysis of social capital, referring to parents' educational and media styles as well as to the relational dynamics between educators and children in the classroom setting. This article, in particular, focuses on the phase of the research dealing with the review and analysis of the contents of educational apps for children. The objective of this phase is to select apps that can be used within an educational experimental protocol, which will be implemented empirically in four case studies.

Research methodology: from analysis of apps for early childhood to projecting a formative experimental protocol

Research strategy designed for scientifically researching the implementation of the idea of the “digital school” in preschool educational routes is configured as innovative and cutting-edge for two key reasons: 1. The target of the research, children under six years of age, seems to be still little explored in the sociological framework, mostly due to privacy-related reasons; 2. Methods and research-intervention strategies on this topic are still in the experimental phase (Campbell, 1969).

In order to respond to the previously illustrated questions and evaluate the mechanisms of didactic experimentation, the methodological framework of research proposed is articulated in the following phases:

1. Mapping of the expected competencies for preschool children based on the Ministry of Education's “Ministerial indications for the preschool curriculum and the first cycle of education, 2012”;
2. Review and analysis of content for about 400 apps (Apple system) for constructing a didactic experimental protocol;

3. Meetings for co-designing an educational experimental protocol with teachers from the schools participating in the research, in collaboration with media educators, experts on the evaluation of competencies and on digital communication, sociologists, psychologists and educators;
4. Survey on the socio-cultural capital of families of children participating in the didactic experimentation;
5. Implementation of four experimental case studies (Yin, 2005) and comparative analysis of results.

Adhering to these phases has yielded a precise and rigorous definition of a formative protocol of the “digital education app,” shared with educators and adapted to different educational settings in Rome. The research strategy can be framed within the tradition of mixed methods and is configured, specifically, as an experimentation of a true “Mixed approach”. This approach consists of an analysis perspective, which is constructed in an emerging way during the research and by combining different approaches in order to respond to questions on various aspects of the object of analysis, which are always connected to each other. Constructing the research with this approach is inevitable when, as in this case, the program we wish to analyze and assess is “complex” – as Patricia Rogers (Rogers, 2008) would say – and presents different research questions, which engage several subjects and multiple research environments. First of all, we need to understand whether children learn in a more or less different way in school when they are exposed to stimuli, which include digital media. Second, it is important to observe how the teachers’ relationship with children changes, as does their way of teaching when it includes digital media. Lastly, we need to reflect on the capacity of schools, over the long run, to modify their consolidated didactic strategies by experimenting with a mix of traditional education, linguistic/didactic innovation, and the different socio-cultural capital underlying individual schools.

Research phases have allowed us to analyse each question and operationalize it by framing it in research approaches that are adequate to the expected objectives and results. In particular, the exploration phase has allowed a research team to adapt the concept of the “digital school” to the specific characteristics of preschools and educational needs of children under six. In the explorative-descriptive phase, it was possible to conceptualize and problematize the introduction of perspectives, methods and instruments of digital education in the preschool programming. The context of educators’ great fear of the effects of integrating digital media in preschools has oriented the researchers towards choosing responsive approaches, or those that are “sensitive” and aimed at understanding the characteristics of the intervention that is the object of analysis and evaluation, through a participatory perspective of analysis capable of having ideas emerge from the teachers, experts and researchers on how to experiment with an innovative didactic

project among children without upsetting their daily school habits. On this point, the meeting for co-designing the didactic intervention with the educators proved to be a fundamental tool for working together to construct the characteristics of a didactic intervention of the digital education app. On the other hand, the documentary analysis method has allowed researchers to better understand the regulations and formal indications on expected competencies indicated by the Ministry of Education as the central factors of work of teachers in preschools. In this way, we chose to design a formative intervention that is easy to monitor (and thus, easy to evaluate over the long term) in relation to behavioural changes, to the development of specific competencies of the child, and to the ways they relate to school and family.

Table 1 illustrates the passage to the phase of designing and developing the intervention with the digital education app, through the integrated use of methods of observation and participatory analysis. At the intervention co-design meetings, a participatory definition shared by the experts and educators of the micro-experiments with the digital education app was reached, keeping in mind that it will be used in the “protected” context of preschools, which in general follow didactic strategies that are not very structured, and are often tailored to the daily needs of children and their daily routines.

The experimental formative protocol was designed starting from a review and analysis of the content of about 400 apps (free and sold by the Apple operating system), taking into account 3 macro-dimensions of analysis: contextual, aesthetic/linguistic, and the one related to the actual content of the apps.

In order to select the applications to be used within the experimentation, we proceeded to identify together with the teachers the macro-skills to be developed in the educational path envisaged by the program for the 2015/2016 school year. The fields of experience foreseen by the National Ministerial Indications for preschool (2012) are as follows: the self and the other; the body and the movement; images, sounds, colours; speeches and words; the knowledge of the world. From the comparison during the working groups it was agreed to concentrate the attention in particular on two fields of learning: the self and the other and images, sounds, colours.

During the meeting for co-designing the intervention, teachers and researchers ran the apps on tablets, and discussed how they are related to the competencies that need to be developed and trialled in order to imagine how they might be integrated into the daily didactic programme.

After directly testing with teachers the pros and cons of the individual contents of the applications identified, the choice fell on the following products: *My first Tangram HD* by the developer Alexandre Minard, *Busy Shapes* of the developer Edoki Academy, *Identikat* of the developer Ovolab S.R.L. and *Toca Robot* from the developer Toca Boca AB.

Through the experiment, the teachers engaged in the research project were stimulated, and they will have opportunities to acquire new competencies for decoding digital contents and promoting a process of baby digital socialization based on mediation and control, by co-designing a process of school-family interaction.

Classroom experimentation involved educational workshops led by the educators, in which teaching projects already included in the programmes were carried out in a different way, which is to say with the use of apps, in experimental groups for this purpose, and in accordance with the traditional ways in the same number of control groups, precisely in order to observe how and whether the practice of “touch” modified learning and the development of intuitive and spatial-motor intelligence. Starting from the National Ministerial Indications for preschool (2012), analysis was focused on developing children’s language skills, skills in recognizing oneself and others, spatial-motor skills, and socio-relational skills. In this regard, during the workshops, the previously trained educators compiled an analysis grid to record the changes observed in the children’s behaviour respectively following the performance of the proposed didactic activities.

Table 1. Analysis map: phases of design and development.

Phases/evaluation questions	Approaches	Methods /techniques	Results
<p>Phases of design and development: what are the content and instruments for implementing the digital school for children 3-6?</p> <p>Initial questions of researchers and educators: how to integrate apps and tablets in the didactic project usually addressing children. What projects, what contents and concrete tools to offer children without upsetting the educational model of each school and without causing concerns about the potential risks of the use of digital media among the parents.</p>	<p>Models of analysis of competencies (basic and cross)</p> <p>Mapping the competencies (macro and micro) and the areas of experience on which the preschool didactic programme is focused</p> <p>Textual and content analysis</p> <p>Participatory design</p>	<p>Review of 400 Apps (free and sold by the Apple system)</p> <p>Analysis of the contents of the apps with a scheme of analysis of contents constructed based on the analysis of usability by Nielsen (2006)</p> <p>Designing a formative protocol and a didactic calendar to be implemented in the second year of preschool</p>	<p>Selection of the apps that are most appropriate for the experiment in class based on the criteria of multimediality, interactivity and educational orientation</p> <p>Analysis and debate about how appropriate the apps are for the didactic project, through discussion among experts, educators and researchers</p>

The four months of experimentation included the use of the training protocol based on tangrams; traditional techniques such as using “paper and pencil” and drawings based on storytelling or exchanges of guided dialogues between children and educators on such key issues as the family and close friends, alternated with more innovative techniques, such as the use of tangram apps, available for tablets, to creatively build a story, working chiefly on two fields of experience: the one related to recognizing the self and the other, and the one of recognizing images, sounds, and colours. Experimentation allowed the children’s emotional and interactive/behavioural effects in the educational process to be progressively observed, while comparing similarities and differences between the experimental and the control groups.

The last phase of the research pointed to two main focuses of the research analysis: cognitive capital and human capital. In order to research hypotheses related to cognitive capital – and thus, to the influence of the socio-cultural capital of families on the tendency of children to learn and develop competencies with support from the digital media – a typical survey research tool was used: a semi-structured questionnaire to be administered to the parents of children participating in the experiment. The objective of the questionnaire was to analyse the socio-cultural background and control the socio-territorial influences of the municipality of Rome on family living contexts in order to ensure the quality of the results of the experiment’s case studies.

With respect to human capital, in order to analyse the development of capacities of children under the age of six in school, we chose to mix the classical experiment with an ethnographic observation in the field. In this sense, the meetings for co-designing the intervention pointed to the fact that it is impossible to control all the variables of the school environment. In fact, it is difficult to ask the school contacts – who have their own, recognized educational tradition and a consolidated style of communication and of relating with children – to modify their educational routines for the purposes of the experiment. Hence, analysis of media ethnography and of cultural studies (Morley, 2003) inspired us to mix the observation of the school environment with an innovative formative protocol in every school, which includes careful participation by a researcher/observer and a media educator. On the other hand, the use of the participatory evaluation perspective and of evaluation brainstorming in the meetings for co-designing the intervention and the meetings with parents and educators *ex ante* and *in itinere*, allowed us to remodel the activities while taking their observations and opinions into account (Davidson, 2005).

Main results

The pilot study, Media usage in preschool, was configured as the opportunity to design and develop a model for including digital education within the

preschool didactic programming. The results of the research may be referred to the two main actions: the content analysis app and the experimentation with integrating the apps into the teaching.

In the first case, the analysis was done starting from the most popular apps in the market store, not necessarily for didactic/educational purposes. Overall, about 400 apps designed for children “under 6” were analyzed, and may be categorized¹ as follows:

Baby talk apps (171 apps, 47%), for children 2-3 years of age. These apps have a basic narrative and graphic interface structure with a low degree of interactivity and usability, but with just as little orientation towards the commercial and marketing side.

- *User friendly apps* (146 apps, 40.1%), for children 4-5 years of age. These apps focus on the user’s psycho-emotional and cognitive-behavioural characteristics. This central importance can be seen in a number of aspects: in the lack of brands and advertising, showing an attention to protecting the minor; in the strong usability of the interface combined with the food level of interactivity and multimediality; and in the constant presence of a navigation guide, at any rate letting the child understand the virtual presence of a guardian.
- *Marketing apps* (47 apps, 12.9%), for children 6-7 years of age. These apps are more oriented towards commercial objectives. In this sense, a central role is played by brand and advertising in these apps, while attention to the interface’s interactivity, multimediality, and usability is of secondary importance.
- The analysis of the apps was functional for two main reasons: 1. Identifying design and development recommendations for apps targeting children in the “under 6” category; 2. Selecting the apps to be used in the classroom during the didactic experiment.
- In the first case, the following main recommendations emerged:
- Guaranteeing the minor’s protection, both by limiting advertising and brands within the apps themselves, and by respecting the privacy of users and their families when the app is downloaded onto their device.
- Paying attention to the linguistic/expressive dimension, by proposing apps of a complexity directly proportional to the users’ age. In this sense,

¹ For the categorization of apps we use the cluster analysis where we included variables coming from different dimensions: contextual (indicators: cultural mediation, target and gender, reference category, developer and language, price and updating, compatible operating systems, off line/on line, user evaluation, brand and advertising and safety), syntactic (indicators: multimediality, level of harmonization of codes, linguistic register, interface analysis, usability, level of interactivity, levels of immersions, complexity of actions), narrative semantic (indicators: tag, topic, story, setting, competences, microcompetences).

single-medium – prevalently voice – apps for a younger target may be hoped for, as well as more multimedia apps for older children.

- Allowing internal navigation that is more flexible (that is to say with the possibility of choosing a number of paths) and repeatable: repeating activities, including digital activities, allows the minor's learning to be stimulated.
- Guaranteeing facilitation tools when navigation is particularly complex and the user shows greater difficulties.
- Requesting feedback from older users, and using “baby talk” language for the younger ones.

In the second case, the integration of apps into teaching was done in a manner complementary to the didactic objectives, the tools, and the materials already used by the educators in the classroom on a daily basis, so as to guarantee educational continuity for the child's psycho-emotional equilibrium. The experiment that was done, then, was more of social nature than in the lab. In this sense, during experimentation, the interaction dynamics between educator, observer, media educator, and the children influenced, in a more or less conscious way, the spontaneous reactions of each of the parties involved in the research.

Experimentation involved two case studies, and for each, the following aspects were analyzed and assessed:

1. The contribution of digital stimulation to increasing two fields of experience: “the self and the other,” and “images, sounds, and colours”;
2. Digital's impact on the stimulation of the individual descriptors of the two fields of experience introduced earlier.

The results, both with reference to both the control and the experimental groups, were obtained through analysis of the trend of average scores, by class, attributed to the skills for each experimentation meeting. Starting from the averages, the mean values for the pre- and post-experimentation meetings were then analyzed, with the objective of examining the variation of the competence acquired by the experimental and control groups for each descriptor in the two fields of experience.

In light of the initial results of the pilot study, it may be stated that the incidence of digital didactics within an experimental protocol appears more evident with children who show lower levels of competence at the start of the path.

Both fields of experience at the end of the experimentation path were acquired better by the children in the experimental group than the control group. Specifically, the clearest and most significant increases in skills, underlining the impact of experimental teaching with digital for increasing competence, were found in some specific descriptors, such as: “Takes part in

imitation and dramatization games” (28%), “Reproduces shapes and colours of the environment” (20.4%), “Follows shows of various kinds (13.2%), “Is autonomous in routine activities” (10%) in one case study, and “Cooperates with others” (15,4%) in another case study (tab.2).

Table 2. Difference of % variations of assessments between experimental and control groups.

CASE STUDY 1	Experimental group
Is autonomous in routine activities	10.4%
Relates with the adult	-7.5%
Cooperates with others	5.5%
Behaves appropriately	-6.0%
Applies him/herself and competes the activity	-1.3%
Willing uses the means of expression	0.0%
Tries different techniques and materials	-4.0%
Verbalizes his or her production	3.5%
Reproduces shapes and colours of the environment	20.4%
Takes part in imitation and dramatization games	28.6%
Follows shows of various kinds	13.2%
Shows an interest in music	7.4%
CASE STUDY 2	Experimental group
Is autonomous in routine activities	7.7%
Relates with the adult	7.7%
Cooperates with others	15.4%
Behaves appropriately	-8.9%
Applies him/herself and competes the activity	0.0%
Willing uses the means of expression	7.7%
Tries different techniques and materials	10.7%
Verbalizes his or her production	-7.3%
Reproduces shapes and colours of the environment	3.4%
Takes part in imitation and dramatization games	-19.3%
Follows shows of various kinds	3.4%
Shows an interest in music	0.0%

Of course, these first attempts are exploratory in nature, also from the methodological standpoint; they were in fact of use for testing instruments

and methods of investigation on individual case studies. The conception of an ad hoc protocol for assessing a complex phenomenon like *competence* requires the involvement of a number of case studies, in order to guarantee comparable results while also taking account of the influence of the family's and the school's socio-cultural setting. This experiment all the same identified some basic, methodological indications to be employed when proposing an experimentation of this kind in preschool, with so young a target. In this regard, it is appropriate:

to plan preliminary meetings between all the players in the experiment (teachers, media educators, and research teams), in order to share research objectives in such a way as to establish a relationship of mutual trust between insiders and outsiders, and to minimize any distortions.

- to involve the media educator, specifically competent in the field of digital education, as cultural mediator in the classroom, in order to guarantee a tranquil teaching climate.
- to provide guiding indications for observers on the behaviour to be maintained during the experiment and for all the experimentation tools to be adopted, in such a way as to monitor that they are duly compiled and returned.
- to rely on an observation grid as a guide for selecting the relevant aspects of the experimentation to be observed, in order to make them more comparable with other experimental situations.
- to guarantee procedural rigour in the experimentation, by making sure that all the survey tools (observation sheet, assessment grid) are completely filled in for each meeting, so as to prevent information gaps that may compromise the interpretation of the results.
- to use other observation techniques where applicable, such as for example in-depth interviews or focus groups with educators, especially in order to go deeper into the emotional, conative, and motivational aspects emerging during the experimentation.

Discussion and Conclusion

Results of the review and of the analysis of app content offers a series of points of interest for the teachers attending the co-design meetings. Results were, in fact, presented in detail to the teachers who were invited to contemplate the points of contact between the topics, projects and activities conducted daily in their schools with the characteristics, arguments and competences expressed in the analyzed apps.

Meetings were quite important for understanding how much the world of educational apps and activities with "pen and paper" used daily by the teachers are not as distant from each other as they would appear to be in the collective imagination and debate on media education.

Teachers engaged in the project were quite open to and interested in the innovative possibilities of applying didactics integrating the potentials of digital media, and imagined – with support from researchers – didactic projects not alternative to the ones already in place in schools, using projects adapted thanks to the use of tablets and educational apps.

After an evaluation brainstorming phase with teachers aimed at identifying points of distance and contact between the results of the analysis of the apps and the topics and arguments regularly worked on in the classroom, the research team structured a formative experimental protocol to be shared with teachers and to be adapted to the contexts of schools participating in the project. A tool highly used in activities already implemented in all the schools engaged, the classic tangram, was chosen, because it is capable of stimulating children's imagination and creativity using only seven pieces that can be fit together.

The hypothesis underlying the Media usage in pre-school project refers, then, to the digital capacity to stimulate the executive, iconic and symbolic representation starting from early childhood, thanks to the sensorial stimulation provided by touch; similarly, the ideographic language of the apps (De Kerckhove, 2008) might contribute toward stimulating the emotional intelligence (Goleman, 1995) and intuitive learning of Piaget, heuristically providing the child with opportunities to strengthen and develop emotionally and cognitively. Some scientists also speak of improvement of spatial imagination, visual memory and the speed of processing information through video-fun practices (Guan & Subrahmanyam, 2009); others point to a weakening in terms of linguistic function, ability of vision in static mode, and capacities for decoding, negatively impacting the competencies related to reading, language and writing (Greenfield, 1989).

Then, the research group engaged in the phase of observation/ experimentation in the field, and micro-experiments in the case studies were conducted. So ethically delicate an experimentation required the entire research team's commitment, in both form and substance, to guaranteeing total respect for the four bedrock principles of the guidelines for doing research with children, as proposed by the Children's Research Centre at Trinity College Dublin: beneficence; non-maleficence; autonomy; fidelity.

On the other hand, the micro-experiments represent a major step towards defining a specific methodology for assessing the effectiveness of digital education didactics integrated with the tools of traditional didactics.

The experimental intervention that was conceived constitutes, on the level of methodology and of empirical research, an innovative proposed investigation in the field of sociological studies on children and on "digital education," and therefore provides significant, in-depth analysis for both the sociological scientific community and for education professionals and

experts interested in improving the quality of the methods and of didactic projects with the aid of the digital media, with a view to integration and pluralism.

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