Babeş-Bolyai University, Cluj-Napoca
Faculty of Psychology and Education Sciences
Education, Reflection, Development Doctoral School

Learning-teaching process supported by interactive and multimedia resources

Development of interactivity, accessibility and usability as elements for increasing the skills of the level of learning and specific skills in secondary school students

SUMMARY

DOCTORAL COORDINATOR
Prof. univ. dr. ION ALBULESCU

Doctoral student
Giorgio Poletti

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INTRODUCTION

"*Carrying out critical and objective analyzes of reality is always difficult, but when it comes to the world of children everything is complicated by the type of nostalgia and comparison with age represented in our personal experience.*

It is easy to fall into a moralistic reading of this growing reality in our society.

I also believe that the local world is lacking due to the widespread diffusion of the mass media and the consequent communication company has made this universe uniformly varied and in need of enhancement rather than continuous analysis.

We must improve the strength of young people, we must improve our strengths.

However, I think that regardless of the motivation, the open spaces, I know that kids can express themselves; we show that this is a world. Recreational or cultural, today's reality affirms its vitality in its truest expression.

I believe that a careful look at the world of children can only lead to a re-evaluation of what it is today.

People with expressive canons and their needs who seek, rather than develop, to channel understandable canons in an adult world, with a completely one-sided interpretation of adaptation.

It is therefore a question of lack of space.

Renovation for a protagonist less and less sought after by adults and more experienced by children.

In this way, you will be able to have a certainty without such a reality. " (Bulletin of the Dicesi of Ferrara, September 1983, p. 3)

Rereading the small article that I wrote in 1983 (in the Bulletin of the Diocese of Ferrara in September 1983, p. 3) in relation to pastoral and catechetical actions, I think that, subject to the modification and updating of some terms, it is appropriate to reflect constantly on the relationship between technological reality and educational reality. It is also advisable to reflect on the guarantee of being able to use every social change for an effective and constant didactic action, for an update of that of the teaching-learning processes, we know the aspects of improvement that in considering the risks they entail.

Talking about updating does not mean following fashion or adapting to what is common sentiment, but maintaining a constant attitude of research and innovation for the educational effectiveness of the younger generations, who are the object but also subject to social innovations.

It is necessary to consider the progressive increase in the use of multimedia and interactive platforms, including the world of social media, mobile devices, which affects the new generations.

This continuous and widespread use has generated a habit and a culture of access to many different paths of use of information strongly characterized as information with trans-media and cross-media characteristics.

The use of technologies and these multimedia and interactive platforms shows how it is possible to integrate different media and use them not only as a tool for accessing information but as an added value of a highly contextualized learning experience such as teaching-learning processes , access to content in a semantically defined way.

Overall, the importance of the theme of the introduction of technologies in teaching-learning processes goes beyond a simple "modernization" of the school, but it is in its nature to be "contemporary" of its students.

No tool can be adopted without evaluating the pros or cons, but certainly, the study of technologies to support training processes is fundamental because technologies are a present and necessary skill to interact with reality.

Technologies are present and active in formal, informal and non-formal environments and question the way school is.

The importance of the theme of the introduction and evaluation of technologies supporting and integrating the teaching-learning processes is underlined for the Italian school by the PNSD (National Digital School Plan - National plan of digital schools) which is an orientation document issued by the Ministry of Education, University and Research.

PNSD promotes and effectively supports a global strategy that has as its objective the innovation of the Italian school.

This innovation aims to govern a new positioning in the Italian education system that addresses the challenge of the digital age.

The National Plan for the Digital School is the guideline and the operative document for a law (Law 107/2015) which since 2015 has tried to regulate and face the challenges that the digital age has launched to the public administration and to the whole society civil.

Law 107 also aims to innovate the school system to seize the opportunities offered by digital technology, both in terms of material production and in terms of building and managing learning communities.

The plan, considered appropriate to consider the structure of the thesis, indicates a way to get out and evolve from the concept of digitization on which these topics have often been reduced in a simplistic way.

No technology inserted in educational contexts can ignore, but rather must draw efficacy and meaning from the epistemological and cultural dimension.

It is recognized and recognized that every educational process is indispensable for the constant and significant interaction between the teacher and each individual learner; technology cannot ignore or worse make fundamental human relationships seem useless.

The **OECD** (**O**rganization for **E**conomic **C**ooperation and **D**evelopment) recalled and continues in its reports to underline this "interpersonal" aspect in the teaching-learning processes.

We are called to build a vision of education in the digital age, through a process that allows students to face, interpret and support a learning logic for life (for life) and in every context in which we live: formal , informal and non-formal (for a lifetime).

This perspective is confirmed in the European Commission's High Level Conference (December 2014) and featured in various publications for the OECD's Center for Educational Research and Innovation, the World Economic Forum's New Vision for Education Report, and research "Education for the 21st century" by the Ambrosetti studio.

This framework and various training interventions for teachers of schools of all levels, as well as the training of future teachers and the theoretical and practical study of educational robotics, led to the choice of this thesis.

It was considered important to understand and test how technologies, both online and physical, can be an effective tool in teaching-learning processes.

Schools are equipping themselves with technologies and often make purely instrumental use of them. The importance of these themes in which the thesis is developed is the translation or updating of a motto that I found myself sharing many years ago: "we must switch from IT Class to IT in the classroom ".

The motto is to indicate that it was not a computer lab (physical class) the key to understanding the evolution of the PC as a learning tool, but the ability to give the possibility to use a PC but in the classroom, which is integrated into the learning-processes teaching.

Now instead of the "simple" calculation, we have more technologies, more tools and their portability facilitates, if not stimulates, the use of the school's "newspaper".

Above all, we can read a paradigm shift in which learning gets the focus of the project, because it allows the student to be placed at the center, review and formalize the teaching processes.

The challenge of education in the digital age can no longer be only a function of the amount of technologies available; rather, it must combine the growing availability of technologies and enable skills, rapid technological obsolescence and new educational needs.

Understanding this relationship means helping the school to acquire digital solutions that facilitate preparatory environments for active and laboratory learning, as well as for constructivist or project learning.

Education in the digital age must not focus on technology, but on the new models of educational interaction that use it.

These principles and reflections led to the need to make choices on how to approach and conduct research.

The first choice was the order of the school was guided by two considerations.

The first consideration is induced by the OECD data relating to first year high school students who classify students' digital skills, Italy is 25th in Europe for the number of Internet users (59%) and 23rd for digital skills of base (47%).

This gap is also visible in the case of specialist ICT skills (Italy 17th) and in the number of graduates in scientific or technological disciplines (STEM - Science, Technology, Engineering and Mathematics).

The same OECD report also states that every 15-year-old Italian uses the computer in the classroom 19 minutes a day, against an average OECD of 25 minutes and peaks in Greece (42 minutes) and Australia (52).

For this reason, it was decided to carry out research starting from the immediately preceding school cycle, with a view to training that must precede and prevent, as far as possible, the problems related to the student-tools-teacher "triangle".

The second consideration that led the choice to lower secondary school is that the key words of the competences of the different disciplines are understanding, classification, use and description; skills effectively developed by the use of technologies and their correct application.

By technology, a wide research field will always be included, in which various technical, scientific and humanistic disciplines are involved, which studies the application and use of everything that can be functional to the definition and solution of problems.

We then also reflected on the training process and its development, so it was decided to structure the research starting from an exploratory research done by giving teachers a

questionnaire to understand if and how they perceived the change in cognitive styles with the advent of technologies.

Surveys on a sample that reflects the composition of secondary school teachers for the subjects taught and teacher training.

This survey identified the ability to analyze and synthesize in the new cognitive styles that technology has induced.

The result is equalized for teaching areas, teacher training and teachers' familiarity with technologies.

Starting from these preliminary results, contacts were made with a secondary school, an intervention was agreed with the decent ones, focusing on two learning areas, and obviously trying to ensure that, although obtaining reliable data, it was not influenced excessively the ongoing educational process.

For the students the activities carried out were curricular, presented and addressed with the commitment of students and teachers comparable to all the other activities carried out during the school year.

The research made use of a neutral tool such as survey questionnaires on behaviors and opinions, anonymous in nature and completed online (Google forms) at school; some forms of observation have been used for teachers to better understand the experimental results and to hypothesize future research perspectives.

The research sought to minimize the didactic impact as an "external" and "exceptional" event and using topics that better than others could highlight the students' ability to analyze and synthesize, with the help of information and multimedia technologies.

One problem to keep in mind is the definition of the control group and possible contamination with the experimental group

Since the school has different positions, it has facilitated the overcoming of this problem and the presence of a homogeneous teaching group allows to better evaluate the impact of technologies in the learning-teaching process.

The theoretical reflections and the choices made within the research have defined the structure and development of the thesis.

The theoretical part develops the relationship between technology and teaching, points of view from an epistemological and cultural point of view and from the key to understanding and adding value to technologies: interactivity.

The first part of the thesis begins by examining what is the development of technologies and what are the development trends that can be highlighted for educational technologies.

The analysis of these trends considers the tools and the social and cultural elements of the technologies and their technological and methodological history.

The analysis of these trends considers the tools and the social and cultural elements of the technologies and their technological and methodological history.

The historical analysis of educational technologies therefore leaves room for the concept of transversal skills and independence from devices; an independence necessary from the logical point of view, in order not to constrain the logic to the devices and increasingly highlighted by the speed with which the devices evolve and change, both hardware and software.

The last part of this first block analyzes the trends of teaching technologies and the impulse received, as well as the relationship with all that can be defined as online technologies.

The history of technologies, like the history of each new tool, brings with it the eternal dualism between possibility and risk, especially for the most vulnerable or vulnerable subjects; since in this context we must deal with children, attention must always be high.

This block of the thesis therefore proposes an analysis and an introduction to the problem, its relationship with the technological background of today's young people and an analysis of the problem to propose a solution that, with attention to the problems, knows how to exploit undoubted advantages of technology both from an educational and socio-cultural point of view.

As mentioned in a study and research involving schools and technologies, a perspective involving epistemology, ontology and ethics cannot be ignored.

Chapter III systematizes these aspects, correlating them with educational technologies and taking into consideration the influences and benefits that educational technologies themselves inherit from their intertwining with constructivism and metacognition.

In this chapter, we see how the concept of artifact as a tool for learning and abstraction has deep and well-nourished roots in thought and research in the educational sciences.

It should be noted that the construction or use of artifacts whose logical structure is known helps to develop skills, which allow us to use what we know in any context that requires it.

Metacognition and "theoretical" observation of technology introduces the concept of ontology, as a fundamental tool for the representation of concepts through technologies.

To describe this ontological approach to the representation of concepts through technological tools, a broad overview of how concepts are represented was provided in Chapter IV; the concept of interactivity, benefit of digital educational technologies is relevant.

This description ends with a definition of the concept of Learning Object and its evaluation in terms of accessibility, usability and satisfaction, which are obviously applicable to the educational context.

The second part of the thesis, which originates from the theoretical part, concluded with the description of the ontological aspect and of the representation declined on the Learning Objects, describes the development of the research.

In particular, the context and the premises of the research are described starting from the analysis of the models that catalog educational technologists, such as the REMR model (replacement, enhancement, modification, redefinition), for use and innovation.

In this part, the three questions / reflections that guide the research are also introduced:

- How much has technology changed or influenced cognitive styles?
- How much the use of technologies does integrated in teaching-learning processes change their development and how much are they an advantage / a disadvantage?
- How and to what extent does the use and construction of cognitive artifacts improve learning skills and skills development?

The reality of the Italian school is also such that the sharing of experiences is not in the culture of the teaching body and for this reason; it is even complex to hypothesize the degree of novelty or innovation of a research project.

With these premises, I believe that the novelty that can be identified in this research project is to make those indicators that measure the degree of usability, accessibility and satisfaction of those who use technologies for training or learning usable for educational technologies.

The research that I believe may have traced a path with which to train teachers in the use of technologies to stimulate and increase analytical and synthesis skills with respect to the subjects that students encounter in their study path, what skills and what knowledge are becoming predominant and essential to govern learning-teaching processes in the information age.

I also believe that the research work is able to identify tools and technologies that had been reserved for "experts" to design paths in which students learn to recover information how to make them become skills and how to transmit the knowledge acquired.

It can be said that from the point of view of knowing how to do research it can explain the fact that in the world of technology it is important to know the structure of knowledge and

it’s sharing; a knowledge that is nothing other than the ability to manage the data we acquire, understanding the relationships that unite them.

I believe that research can guarantee that even for the educational sciences we can say what Albert-László Barabási says in the introduction of his Linked book, The science of networks (2004, p. 4), in which education certainly configures a complex network:

"The good news is that, for some time now, scientists have learned to trace the pattern of our interconnections. Their maps shed new light on the warp of our universe, offering challenges and surprises unimaginable until a few years ago.

Detailed Internet maps revealed the system's vulnerability to hackers; financial reporting maps and owners of several companies have traced the profile of power and money in Silicon Valley; maps of interactions between species in ecosystems have opened glimpses of human destructive impact on the environment; Maps of genes working together in a cell have allowed new discoveries about the mechanisms of cancer.

However, the real surprise came when these maps were placed side by side. We have seen that, just like humans who share almost indistinguishable skeletons, the different maps follow a common footprint. A series of incredible recent discoveries has confronted us with the fact that some far-reaching and incredibly simple natural laws regulate the structure and evolution of all the complex networks that surround us. "

The research conducted seeks to define the possibility and effectiveness of the use of technologies as a teaching tool.

In particular, the impact it intends to have is to overturn a logic that sees technology as a teaching subject, thinking of it as information technology or electronics.

The research aims to provoke a debate for an application of the concept of technology as an ability to describe an art.

We want to frame technology by returning to its meaning, what is attributed to it by the Greek term deriving from the Greek "tékhne-logìa", literally "systematic treatise on an art".

An approach that has its roots in Nicomachean ethics in which Aristotle distinguishes two forms of action, practice and téchnē: while the former has its purpose, the latter is always at the service of the other, as a means. In this sense, the "technique", a term often used synonymously, was no different from art or science, nor from any procedure or operation capable of achieving any effect, and its field spanned all human activities.

The intended contribution is to indicate through which technology, in a broad sense, is integrated in the learning-teaching processes.

It is intended to clarify that technology is not just an aid for a "better" or "less fatigue" rate for a process.

Technology changes the approach to processes and people's approach to the reality around them, to understand it and interact with it.

The practical impact is to include technologies in teaching and not to have a classroom for technologies.

TRENDS OF DEVELOPMENT OF TOOLS AND EDUCATIONAL TECHNOLOGIES

To analyze teaching and learning processes it is essential to refer to how thought works in the processes of building knowledge.

In particular, since we are interested in teaching processes supported and integrated by technologists, it is fundamental to start, in particular from how the construction of knowledge correlates with artifacts.

It is this perspective of approach that makes the existential sense of Knowledge fundamental.

The sense of Knowledge is divided into three fundamental elements:

- **Epistemology**
- **Ontology**
- **Ethics**

The concept of epistemology, science, and the epistemological frame of reference becomes fundamental, to the extent that, especially in the teaching-learning processes, knowing "how things are done" is of little use if you do not know "what things are "(Gramigna, 2015).

An epistemology that influences the assessment of both students but also determines the tools used in the teaching-learning process.

This new millennium, for didactic research, is an open construction site; a field of development and research which in recent years has presented a great variety of ideas and a ferment of innovation.

In all this set of ideas and processes it is possible to identify some fixed points that take into account the didactic research and the training of teachers, actors of the teaching-learning process; teachers who are not only called to define educational processes but also to contribute decisively to the definition and creation of cognitive artifacts, an integral part of learning.

The theoretical support is connected, albeit derived from the point of view of microteaching[1], with Bruner's theory of education, as developed since the early 1960s.

It can be said that, in this context, surveys of teachers' practices and artifacts can be made to make them understand the meaning and the objective during classroom work and individual study (Damiano, 2005).

It is a matter of taking up the concept of "*stimulated appeal*" of experience, in the perspective of an analysis of teaching practices that use artifacts.

Teaching practices that focus on reflections not "*above*" but "*within*" teaching and educational processes.

A teaching that makes explicit the tacit thought "of the teacher and is an expression of "**epistemology of practice**"as well defined by Donald Schön, who also states that "*according to the model of technical rationality, professional activity consists in instrumental solution of problems made rigorous from the application of theories and techniques based on science*".

This perspective defines as a direction of research and focuses attention on the mediator processes established.

Mediating processes can be, for example, cultural objects or physical spaces; in this context, we will deal with cognitive aids and artifacts that arise between the actions of teachers and students, thus acting as a reference framework for a didactic action that consists in the modulation and effective use of these elements.

For these reasons, the specificity of the research direction to which it is referring has peculiarities that distinguish it.

In particular, the development of research favors the product, the artifact, to enhance the different methods and different teaching-learning processes.

This perspective allows enhancing the different forms of teaching in direct consequence of the effectiveness they demonstrate in producing learning, that is, the "*teacher effectiveness*", to enhance the student's learning processes, while highlighting the design and maieutic skills of the teacher.

[1] Kim Romney and Dwight Allen (Stanford University 1963) coined the term **microteaching**. **Microteaching** was born as a training practice for teachers and as a tool for pedagogical research. The microteaching aims to provide teachers with elements for the analysis of their teaching practices, to have "t*he opportunity to acquire the techniques and skills necessary for the best possible performance of the profession*" (Allen and Ryan, 1974, p. 29) and furthermore "significantly enlarges the feedback dimension" (ibid. p.26).

This didactic research perspective, reflecting on the model, obtained from the previous research methods, focuses its attention on the sense of the didactic action, bringing to light the characteristic asymmetry of the educational relationship.

This line of development also starts from the enhancement of disciplinary teaching and comes to justify a full and distinct autonomy to teaching as a process of knowledge mediation.

This perspective derives from having evaluated the proposed model, from previous research, the result of a simple analysis of the characteristics of teaching, and derived simplistically from learning theories, from a psychological and sociological point of view.

In this context, it is fundamental to underline once again the concept of knowledge referred to.

Analyzing the teaching-learning process, the concept of knowledge is neither a function of the "**subject**" nor of the "**object**", but the constructivist interaction of both (Damiano, 2006).

We are therefore witnessing an important change in the epistemological foundation of the sense of knowledge along the path already widely traced in psychology by Piaget and Vygotsckij.

With these premises, it is easy to define what are the characteristics and roles that are integrated into the role of the teacher.

In particular, this definition of roles and characteristics are justified because if a knowledge "*is built through a complex and non-linear interaction, a mediation that takes place between numerous and composite elements - bodily, emotional, affective, operational, cognitive, symbolic [...] capable of shaping autopoietic structures, derived, but relatively autonomous and self-subsisting*"(Damiano, 2005).

These reflections have the consequence that the teacher cannot avoid questioning himself about knowledge, its forms, its operations, its acquisition processes and the artifacts that convey it.

On the other hand, those who teach are called to consider their real impact in teaching; the teacher must feel a real role of researcher and experimenter in the educational process.

The teaching role of the teacher is summarized in the three points that describe the passage made by the "*teacher effectiveness*" of the 1980s: from "*Knowing is there, it should only be applied; the tools are there, just use them, knowledge ceases to be "research" when "intervention" is made to "The didactic action is productive interpretation, the tools are built when teaching, theoretical knowledge is the language of action of teaching* "(Damiano, 2005).

In an area of research on cognitive artifacts and the definition of parameters to evaluate cognitive artifacts, the definition of an ontology, the constitution of reality, must also be taken into consideration.

Ontologies, as we understand them, are structures of shared knowledge, formalized by the scientific community through languages of semantic description.

The ontological structure reflects the main nuclei of a conceptual area shared by an academic community, facilitates the recovery of authoritative information and relevant learning materials and at the same time aims to integrate the formal dimension of a domain of knowledge, defined by a set of concepts and relationships, with the conceptual and relational dimension that develops within the daily work and study practices of different learning and practice communities (Nadin and Rizzo, 2014).

In this perspective, ontology has the potential to become a multi-referential environment to support the comparison and dialogue between the scientific world and the world of teaching.

Within a research[2], it has been found that interaction with the ontological environment becomes an opportunity to re-conceptualize one's experiential experience and to identify the optimal solutions for intervening in educational contexts.

This research and the ontological context is relevant for the definition of evaluation parameters for cognitive artifacts, the theoretical framework mainly refers to the cycle of "*experiential learning*" formalized by Le Boterf (2000).

The starting point defined by this research is the experience lived by the subject, involved in a project or in a problematic situation or simply engaged in the execution of an activity.

In this way, the lived events are transformed into stories to tell, through a process of systematization of the events, of the variables involved, of their logical and temporal succession, and of the meaning, they assume for the subjects. This narration is followed by the phase of conceptualization of the experience, in which the subject constructs interpretative schemes and action models and the de-contextualized product artifacts, that is, the load-bearing and invariable structures that support and orient, potentially, acting in situations. It is a phase of "suspension" in which the subject implements a "strategy of distancing" (Fabbri, 1995) from the situation to build a conceptual representation that allows first to understand it and then to act in it.

[2] **PRIN** (**P**iano di **R**icerca di **I**nteresse **N**azionale - Research Plan of National Interest) 2006-08 "*Ontologies, learning objects and communities of practices: new educational paradigms for e-learning*", national responsible prof. Luciano Galliani.

We must prevent and, define parameters that highlight it, that technocratic education does not help our young people to build the tools for reading complexity, the orientations in the global world, the keys to reading their existential story (Gramigna, 2015).

TECHNOLOGY AS RESOURCES AND RISK FACTOR IN EDUCATIONAL PROCESSES

As Piaget stated, in his treatise "genetic epistemology", "knowledge is a process of continuous construction".

Approaching the analysis and definition of parameters for the analysis of artifacts and the teaching-learning processes that integrate them must bear in mind that our knowledge of reality is an individual and social construction.

With this assumption, an appropriate constructivist practice is essential for effective teaching, a teaching that integrates artifacts as support but as an integral part of the process of building knowledge.

This first reflection is not only a theoretical question but has several practical implications:

- give value to the disciplines considered as historical construct; a construct that testifies to the evolution of man's relationship with the world, and not as objective descriptions of reality;
- deep roots and legitimization of diversity between cultures, and the possibility of evolving one's own points of view;
- dignity and legitimacy of the models of explanation of the students that it is not possible to interpret simplistically as an error and of which it is necessary to take into account to set any didactic action;
- importance of the constant negotiation of meanings and the uselessness of a notionism;
- development of a metacognitive and reflective attitude that bases the idea of constant learning throughout life.

The constructivist approach offers a theoretical framework from which to obtain some important indications on the meaning of learning, on what to teach and how to do it, what tools and artifacts to use and, as an important consequence, what should be avoided.

If knowledge is an active and personal construction of meaning through assimilation and accommodation mechanisms, consistent with individual history, a teacher can offer the student stimulation and direction.

In this sense, the constructive and creative potential that Piaget, Von Glasersfeld and the **Operating School** recognize to the learning subject should be recovered in research.

In Italy Alberto Munari and Donata Fabbri have used the basic thesis of genetic epistemology, aiming to combine this point of view with the paradigm of complexity (Cosentino, 2002) and with a hermeneutic and negotiating approach, in which the subject must deal with the polysemy of utterances to decide, on the basis of the situation and the personal system of knowledge, which meaning is pertinent, also having to share this path of construction with other subjects.

It is commonly said that "*if I listen or read I forget, if I see I understand, if I do I learn*".

In this sense, learning from doing could then be understood as learning that requires the learner to take action, try, put forward hypotheses, criticize and discuss, as opposed to learning where it is essentially about receiving, retaining and storing.

You can also be active by reflecting on what you have heard, comparing two concepts, wondering for example if information is reliable

The work on awareness of one's own work and the mental processes involved calls teachers and students into play; for the former it is a question of organizing occasions for reflection in the proposed activities, for the latter it is a matter of carrying out a metacognitive reflection on the work done.

FROM CONSTRUCTIVISM TO METACOGNITION FOR SIGNIFICANT LEARNING

The society in which we are living is well defined by the term "liquidity" which brings with it continuous and complex transformations which, among others, generate a change in the *cognitive* and *communicative methods* of the individual.

In this new social perspective, the constructivist view of knowledge, in particular that of socio-cultural constructivism, provides an answer so that the individual can become the protagonist responsible for his personal and social growth, through a lasting commitment throughout his life.

From a European point of view, it is the competence of learning to learn, which can be solicited in "*learning centered*" training courses, attentive to all dimensions of the learner's personality: cognitive, metacognitive, practical-operational, affective-motivational and relational -social).

The competence is nurtured in learning environments that enhance the student's natural knowledge and emphasize his active and reflective role in the processes of construction, co-

construction and sharing of knowledge and meaning. They are "authentic" contexts, in which communicative and social interaction takes place with other subjects but also with technologies.

Technologies, from the most traditional to digital and telematics, up to modern social technologies, are "*intellectual partners*" that help to think.

The class becomes a *knowledge-building community*, in which all members are engaged in authentic tasks, which encourage interdependence, effective learning, between formal, informal and non-formal knowledge.

The concept of **meaningful learning** arises within the constructivist paradigm of knowledge and develops into multiple theoretical currents, including socio-cultural constructivism.

Knowledge is a process of construction of meaning by the subject, which re-elaborates in a personal and in part arbitrary way already acquired knowledge, sensations and emotions.

This process, however, does not remain limited to the private sphere: in the awareness that the other also constructs his or her knowledge in a subjective way, is oriented towards the acceptance and understanding of multiple perspectives (Gardner, 1994) through forms of communicative interaction.

The training process abandons the teaching logic (teaching centered) in favor of learning (learning centered).

The teacher is no longer considered an "*information disseminator*", (Varisco, 2002) undisputed custodian of universal, abstract and decontextualized knowledge. It is rather a facilitator, a tutor, a coach and counselor, who guides the student to recognize with awareness and reflexively redefine the plot of his skills.

The development of knowledge is a "*social enterprise*"[3] resulting from interpersonal communication, comparison and exchange within the community to which it belongs, sharing and negotiating meanings expressed by a community of interpreters.

Hence, the significant learning model now widely shared in the educational field, which sees David Jonassen[4] among the most distinguished supporters.

Jonassen owes, with a contribution in the book *Meaningful Learning with technology*, of 2008, a meaningful definition of learning based on some attributes: **active**, **constructive**, **intentional**, **authentic** and **cooperative**.

[3] The term "***social enterprise***" is used by R. Lesh, H. M. Doerr, in Beyond the constructivism, LEA, Mahwah, NJ, 2003

[4] **David Jonassen** is a professor at the University of Missouri in the School of Information Science and Learning Technologies. Jonassen is an exponent of the Constructivism theory, according to which knowledge is reached through personal experience through a construction process.

Here then, in the "information and communication society", which then found its peak in the "knowledge society", the way of processing information and sharing knowledge is radically changing.

Therefore, in order to actively and consciously contribute to the construction of knowledge, the individual must be able to develop meta-skills, which allow him, in a European perspective, to move with reflective awareness in less and less regulated contexts.

However, the individual never acts alone. In order to respond effectively to the increasingly complex and fluid needs of the society in which it lives, it is necessary to know how to interact and co-act with social subjects: "the competent response must be a network response and not just an individual response"[5].

Learning significantly to build and manage individual and collective skills thus becomes an educational priority in the complex, flexible and dynamic knowledge society.

Priority also recognized by the European Union which, in recommending key competences for lifelong learning, considers learning to learn to be transversal to all competences.

Learning to learn is active and intentional learning, because it implies the constant commitment to organize one's cultural background, identifying, choosing and using strategies, methods, tools and sources of information and training also according to the operating contexts, the times available, the personal study and work method, their needs and objectives.

The recognition of non-formal and informal learning emerges here, able to contribute, alongside formal ones, to building and managing individual and collective competence.

It is therefore a matter of creating, even at school, social, meaningful, dynamic, authentic learning contexts, in which it is “possible to transform the knowledge to be disciplined into a process of construction and interaction between stable knowledge and liquid skills. […] At the same time, sharing with others the cognitive processes in a collective path of knowledge building, urges multiple perspectives of reality and, therefore, an attitude to pluralism as a fundamental basis for integration and inclusion "(Spinelli, 2009).

Learning to learn is also cooperative learning, because it is the competence thanks to which it is possible to develop not only an act and react, but also a conscious and responsible co-act, which positively feeds the motivation to learn and facilitates the construction and development of collective skills.

[5] See Le Boterf Guy, *Building individual and collective skills. Act and succeed competently. The answers to 100 questions*, Italian edition translated by M. Vitolo et alii, A. Guia Editore, Naples, 2008

In the socio-cultural constructivist theoretical framework, significant learning environments in which to be able to build, co-build and share a knowledge model that takes into account the characteristics of the knowledge society, can be supported by digital technologies, cognitive artifacts and network technologies, including emerging social ones.

ICT (**I**nformation and **C**ommunication Technology) can become artifacts, tools, significant learning tools, if they provide students with opportunities to learn with technologies and not from technologies (Jonassen, 2008).

Technologies, suitably defined by Jonassen as "*collaboration tools*", can promote collaboration, cooperation and the distribution of knowledge in knowledge-building communities; make possible and support the dialogic processes, therefore the conversation, the discussion, the productive confrontation, the negotiation of meanings, the building of consensus, implying by all the commitment to critically reflect in a "*progressive*" perspective, of improvement of knowledge.

The network, web 2.0, cognitive artifacts designed as "intellectual partners", can provide the teacher with a valuable contribution for the preparation of learning centered environments capable of developing "the competence" of learning to learn, without neglecting the typicality of the forms, styles and learning contexts of today's children and young people.

In the complexity of today's society, in fact, the daily life of students is very different from that of adults. If the everyday life of the latter is made up of digital and telematic pre-technologies or in any case of technologies conceived with a view to "digital migrants", that of today's children and young people is imbued with technologies. Video games, computers, the Internet, mobile phones, tablets and any other kind of similar device are "*experienced*" by multitasking "*digital natives*", as physical extensions of their bodies, as normal and natural presence in their places of life, built-in constant elements simultaneously, spontaneously and with extreme naturalness in personal and social practices.

Digital and network technologies, emerging social technologies, therefore, must be thought of as tools capable of breaking down technological and economic barriers, of breaking down the digital divide that is the cause of the knowledge divide, for the effective globalization of knowledge, for a conscious access to information.

REPRESENTATION SYSTEMS OF KNOWLEDGE: AN EXPERIENCE OF REPRESENTATION OF AN ONTOLOGY

The development of technologies and their diffusion, and the emergence of constructivist-social pedagogical models have determined the development of interactive and multimedia educational resources.

This wide spectrum of resources and learning objects are a precious patrimony for students and teachers; in particular, teachers can use these resources for a personalization of teaching-learning processes, both in the classroom and for individual study.

In general, we will refer to the concept of **L**earning **O**bject (**LO**), understood as Wiley[6] defines them, as any type of digital resource that can be used and reused to support learning.

In order to catalog and define the syntax and semantics of the descriptive schemes of the LOs, numerous proposals have been made, of which however a complete and updated bibliography is lacking; however, taxonomic classification models of didactic objects have also been proposed in the literature (Convertini et al., 2006; Redeker, 2003).

Among them, one of the best known has been defined because of the identification of the different characteristics of the LOs, such as the number of combined elements and the type of objects contained (Wiley 2000).

In the evaluation of digital cognitive artifacts and LOs, therefore, we will also find what is generally called "educational software".

By didactic software, as well summarized by Garavaglia[7], we mean an application program that contains didactic contents organized according to a design oriented to the achievement of specific learning objectives in the different study disciplines.

However, as Garavaglia always specifies, more properly an educational software is a specific program for teaching the various study disciplines.

In consideration of this specificity for the evaluation of the quality of an educational software, it is necessary to consider not only the technical aspects, but also above all those aspects related to:

- **communication methods**
- **proposed contents**

[6] **David A. Wiley** is Chief Academic Officer of Lumen Learning, Education Fellow at Creative Commons. Wiley's work on open content, open educational resources, and informal online learning communities.

[7] **Andrea Garavaglia** is associate professor in the grouping of pedagogy, at the Department of Human Sciences for Training “R. Massa "of the University of Milan-Bicocca and teaches Training Technologies and Media Training Methods and Techniques. He is the technical-scientific coordinator of the LISP - Computer Laboratory of Pedagogical Experimentation and deals with the topic of learning and new media with a particular focus on environments for learning, teaching methods, the design and evaluation of training systems.

- **possibility of activating significant learning processes** according to active and personalized methods.

There are several modalities and tools for a LO assessment, but applicable, in general, to interactive and multimedia cognitive artifacts.

In particular, we will refer to the models:

- **LOEM** (**L**earning **O**bject **E**valuation **M**etric)
- **LORI** (**L**earning **O**bject **R**eview **I**nstrument)

The LOEM model was developed by Kay and Knaack in 2008 on the basis of many of the instances considered positive by the previous models.

The definition of the criteria underlies the intention expressed by the authors to privilege the quality of the constructivist activities where the user is able to control the process sufficiently and an adequate level of interactivity is ensured.

According to the authors, a quality LO should ensure the opportunity to participate in open and rich activities and not to close the user in prescribed and closed learning paths (Brown, Voltz, 2005).

The quality categories used for design concern the layout, customization, and the quality of the graphics and the emphasis of the key concepts.

Usability is measured because of ease of use, clarity of the on-screen instructions and navigation.

Nesbit and Belfer proposed the LORI (Learning Object Review Instrument) system in 2004.

The LORI tool has been tested on a small population of adults (Krauss & Ally, 2005; Vargo et al., 2003), but unfortunately it has not been possible to validate the tool for all the specific criteria considered.

The tool has undergone several revisions, the latest being version 1.5. For each item, the evaluation is expressed through a Likert scale of five modes, from 1 = Low to 5 = High and the choice NA = not applicable is also contemplated.

In both models and in general in the analysis of interactive and multimedia tools, accessibility and usability are elements to be analyzed.

Compared to the evaluation of cognitive artifacts, the development of guidelines on the ergonomics of the interfaces is also interesting.

It is therefore important to also have test tools, especially of usability in which user satisfaction is understood.

Per i test di usabilità, in particolare per le interfacce si fa riferimento alle 10 euristiche di Nielsen[8].

For usability tests, in particular for interfaces, refer to Nielsen's 10 heuristics.

In this panorama, it is evident that the activity of the teaching designers, and of the teachers, is very complex and can derive significant benefits from the availability of rich information sources in which the necessary information is available so that the most adequate teaching resources can be selected with respect to the characteristics of the training context in which it operates.

In this regard, although with undeniable differences, the most widespread educational design models in the literature appear to share the definition of four main phases:

- design
- realization
- dispensing
- monitoring / validation

Information on the pedagogical model, strategies and teaching techniques are not represented in the descriptive models but must be entered for a correct evaluation of the cognitive artefacts

In conclusion, it is noted that, despite the emergence of web technologies of constructivist-social learning models, the models described above do not yet appear adequate to represent the social.

Collaborative and participatory dimension in the processes of building knowledge, having remained substantially anchored to a conception of behavioural content and didactic resources which provides for a more or less rigid transmission of content from the teacher to the student, for this reason the definition of parameters must not only measure but also stimulate this design dimension.

[8] **Jacob Nielsen** is a writer, speaker and consultant. He holds a doctorate in user interface and computer design from the Danish Polytechnic. Nielsen worked in Bellcore, IBM, and as a senior researcher at Sun Microsystems.

TECHNOLOGY AS A FACTOR TO IMPROVE LEARNING; DEVELOPMENT OF LEARNING SKILLS THROUGH THE USE OF INSTRUMENTS FOR THE STRUCTURING OF KNOWLEDGE AND THE DETECTION OF DATA

Structured and implemented research has as its central theme the use of technology to support learning-teaching processes.

In particular, the central theme is how technological development strongly characterizes every section of people's lives.

Very often, we notice the changes that highlight the problems that generated or enhanced the news. If technology enters the learning-teaching processes, it is certainly necessary to evaluate the problems and the potential to add value.

In summary, the central theme is therefore how to integrate a technology that is already permeating the lives of people, especially young people.

Both the theoretical part and the practical part of this thesis work refer to a cone of technology as a treatise on an art, to see what the logics are implemented and induced by new technologies.

All this because no new technology has supplanted the previous ones but has integrated them and often incorporated them from a logical, even if functional, point of view.

For the world of education in formal, informal or non-formal environments, we want to reflect on how we can establish a virtuous circle that begins with the training of teachers for the design and implementation of effective and virtuous processes from a cognitive point of view.

The aim of the research is therefore to start from what are the "impressions" of how technology has influenced the learning processes of teaching, to highlight what the potential of technology is in teaching.

The potentials we try to highlight start from the consideration of perceived limits and risks, both real and hypothesized.

Technologies are too often seen from the point of view of a fashion or trend to which we must adhere, but it is not possible to imagine that there is a pure attractive effect of technologies.

The reflection that guided the research is that technology must be considered from a functional "familiar" point of view for students, so that by overcoming a kind of instrumental obstacle we can exploit the increase in cognitive potential for effective learning.

The purpose of the research is therefore not binding for a specific technology that too often is identified with a hardware or software tool, to underline the possible improvement of the teaching learning processes.

The research tries to indicate a path for teacher training in the analysis and use of technologies and their use in training processes.

In particular, the goal is to emphasize the concepts of interaction, multimedia and logical connections as indicators of the educational effectiveness of a technology.

The ultimate practical goal is to ensure that tools and technologies enter the school as educational tools in an organic way to allow them to become more effective in their training.

In practice, an attempt is made to ensure that the great stratification of the information that students have to face is transformed into a learning model for the analysis of contents for continuous training and that includes all the years and environments in which a person will find themselves live.

The research, which starts from the hypothesis and social evidence of the use and influence of technology in everyday life, is divided into 2 points that act as a cornerstone for reflections and the definition of practical interventions:

- technology has changed cognitive styles and highlighted the limits and potential of the person-technology-knowledge relationship; this first part is developed through an exploratory research of teachers 'feelings in relation to the modification of their students' cognitive styles
- technology is an integral part of children's lives and they use technology as a privileged way of accessing training, this second part is developed with the introduction of specific technologies in the educational path.

This new millennium, for didactic research, is an open construction site; a field of development and research which in recent years has presented a great variety of ideas and a ferment of innovation.

In all this set of ideas and processes it is possible to identify some fixed points that take into account the didactic research and the training of teachers.

Actors of the teaching-learning process; teachers who are not only called to define educational processes, but also to make a decisive contribution to the definition and creation of cognitive devices, resources or techniques an integral part of learning.

The theoretical support is connected, although derived from the point of view of microteaching, with Bruner's theory of education, as developed since the early 1960s.

Kim Romney and Dwight Allen (Stanford University 1963) coined the term microteaching.

Microteaching was born as a training practice for teachers and as a pedagogical research tool.

Microteaching aims to provide teachers with elements for the analysis of their teaching practices, to have "the opportunity to acquire the techniques and skills necessary for the best possible performance of the profession" (Allen and Ryan, 1974, p.29) and "greatly expands the feedback dimension" (ibidem, p. 26).

It can be said that, in this context, it is possible to carry out surveys on teachers' practices and artefacts in order to make them understand their meaning and objective during class work and individual study (Damiano, 2005).

It is a matter of taking up the concept of "stimulated recall" of experience, in the perspective of an analysis of teaching practices, which use resources or technical devices.

Teaching practices centered on reflections that are not "above" but "within" the teaching and instruction processes.

Teaching that makes explicit the tacit thought of the teacher and is an expression of "epistemology of practice" as well defined by Donald Schön (1983), who also states, that develops the concept that according to the model of technical rationality the professional activity consists in instrumental solution of problems made rigorous by the application of scientifically based theories and techniques.

This perspective defines education research as a direction and focuses attention on established broker processes.

Technology-mediated processes can be, for example, cultural devices or physical spaces; in this context, we will deal with the aids and artifacts that arise between the actions of teachers and those of secondary school students, thus acting as a reference framework for a didactic action that consists in the modulation and effective use of these elements.

Research in education can be defined, clearly and precisely, as a systematic and rigorous investigation; a survey that aims to deepen, increase or test the complex of knowledge, theories, documents, laws related to a specific discipline.

The definition of the term research becomes the key with which data is analyzed, of the methodologies with which information derives from data, that is, the relationships existing between data are determined.

More and more the epistemological debate that is developing tends to highlight a dimension, a conception of research that shows, among others, specific traits and inspiring

motifs the instinctive tendency towards problems, a free exploration with traits of "serendipity" and with a focus on the complexity of the approaches.

By serendipity, we mean the ability to correctly detect and interpret a phenomenon that occurs completely randomly during scientific research oriented towards other fields of investigation.

The logic of this research emphasizes the profound relationship between mental processes and the construction of knowledge of the subjects and of the processes that take place around the subjects; processes and phenomena that can be natural or social.

This first reflection highlights the impossibility of a project and the consequent implementation and realization of a research project that starts from predefined results because the research feeds on the desire to test hypotheses, which can be wrong, in the continuous virtuous circle.

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The epistemological debate that is developing increasingly tends to highlight a dimension, a conception of research that shows, among others, specific traits and motivations inspiring the instinctive tendency towards problems, a free exploration with traits of "serendipity" and with a focus on the complexity of the approaches.

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In fact, the research feeds on the desire to test hypotheses, which could be wrong, in the virtuous continuous circle of model research and realities increasingly suited to the analysis of the individual's social, natural and internal processes.

A research therefore that works on the belief that the error is a scientific reworking of an aphorism by Rabindranath Tagore "If you close the door to all errors, the truth will also remain out of it".

When we talk about educational research and in the field of pedagogy, we can apply a categorization that involves the positioning of research methods in two macro areas, namely qualitative methods and quantitative methods even if in literature we can use the two types of investigation using an approach integrated (Saukko, 2005).

Such a broad reflection and debate involving many disciplines, such as the pedagogical sciences, which pass through engineering and psychology not only arouse interest but the need to question whether and how these technologies "interact" and "condition" the learning teaching processes.

It cannot be ignored that, although not systematically, formal, non-informal and informal learning cannot be thought of without "technological" influences.

The focus of the interest of this work is certainly formal, but aware that today more than ever the non-formal and the informal are part of the life of each and especially of the young people for whom many cognitive behaviors and styles are borrowed that technologies "suggest".

From this overall image, object of many analyzes, observed from different points of view, a description of the BYO perspective is obtained.

This evolution of technology and trends in its use and methodological reflections bring educational technologies to a BYOD or BYOT design approach (take your devices or bring your technology), but with an interesting BYOB perspective (bring your behavior), as analyzed by several authors who have addressed the use of technologies and learning in a digital world (Boldascio, 2015; Craig, 2018).

Research and experimentation in the development phase consider the fact that, although innovation derives from the interactivity of the tools, on the other hand now has the advantage of interaction and connectivity, a potential that must however be transparent compared to the device used by the pupil.

BYOD or BYOT means, "bring your device" and is a philosophy born in the company as a policy that aimed to allow employees to access company information using their PCs, smartphones and tablets.

This policy has not only an economic and security impact, but also in the design phase, in which the definition of tools is required to implement applications that can be used with the same potential in different user environments, both for the operating system and for the device.

BYOD born in a corporate environment with the main purpose of reducing costs has the undoubted advantage of allowing people to continue using a technological object that they know and use competently.

BYOD logic in school and education in general allows you to share material and maintain a continuum between class work, at home and in any other place where you can access data and information.

Of course, both from a technological and methodological point of view, a BYOD approach can have advantages and disadvantages, but careful planning and structuring certainly allows us to make the most of the advantages that BYOD brings.

In particular, it can be noted that today mobile devices and successful services have two characteristics in common: they are intuitive and quick to use and if you do not understand how to complete a task in a few seconds, you search, download, try a other application; all of this, in addition to taking advantage of the skills of secondary school students, improves the user experience in the classroom

The fundamental questions that act as a plot and a watermark for research and that derive from the reflections made so far can be summarized in 3 questions / reflections:

1. How much technology has changed or influenced the cognitive styles of young people in general and secondary school students in particular? If you use hardware and software technologies to structure the topics learned and technologies that can experimentally detect data, does the level of learning increase?
2. How much the use of technologies integrated in learning-teaching processes changes their development and what are its advantages / disadvantages. Do the technologies introduced among the teaching aids change and to what extent the level of learning by changing the way information is processed?
3. How and how much the use of cognitive artifacts improves learning skills and allows secondary school students to acquire new skills. By incorporating physical tools and cognitive artifacts into teaching tools, have transversal skills increased, making it possible to see technology as a skill applicable to any learning environment?

With reference to the research questions, it is good to specify what is meant by some terms that characterize these questions.

Especially when we talk about the relationship between technologies and cognitive styles, we refer to the problems related to the analysis of cognitive fields and cognitive modifiability.

Habits, in fact, are "cognitive paths" (Cussins A., 2002, pp. 651-658), experimental models of behavior with which we relate to the world, they are learning patterns that presuppose visual points.

These paths outline the limits and potential of the cognitive field.

In particular, the question is whether problem solving can be defined as a didactic approach aimed at developing, on a psychological, behavioral and operational level, the ability to solve problems.

Finally, the acquisition of new skills refers, in addition to the skills of analysis and synthesis, to those skills of structuring artifacts that can help in the problem solving processes, reusable skills in different areas and not only educational.

This raises a further question: **Can technology be integrated both as a teaching aid and as a tool to improve learning?**

To identify and better define what it means to ask these three research questions, which also represent a reflection in the field of educational research with respect to the field of study and investigation of this thesis, we define the purpose and objectives of each question.

The first question concerns technologies and cognitive styles, focusing on secondary school students:

- the purpose of understanding which, if any, is the influence of technologies, which pervade daily life and pass through every phase of life, on cognitive styles; if and how they modify them;
- the objective is to identify the keys to interpretation and the tools that allow to correct the distortions and to exploit the potential to allow children to reach effective cognitive styles.
- the consequent question, in particular, to what extent the use of technologies integrated in learning-teaching processes brings advantages and disadvantages has:
- the purpose of understanding if and how the use of technologies introduces changes in the planning processes of teaching activities and changes the times and roles that students and teachers play in formal learning environments;
- the objective of defining methodologies and processes for the design and development of the learning path in formal training environments.

The last question concerns the use of artifacts by students and their construction in a perspective of learning content through the ability to understand the data connections that generate knowledge.

This artifact question has:

- the purpose of understanding the contribution of artifacts (both software and hardware) to improve learning, as an application of constructivist thinking;

- the goal of defining the types of artifacts that lead to an improvement in learning skills and the acquisition of skills; especially problem solving skills, as we are analyzing in the context of educational robotics and it is interesting to see in the field of machine learning.

In this context, it can be said that we are talking about applied research because it aims to identify practical solutions and in the specific context of formal learning and how cognitive technologies and devices are an aid for teaching-learning processes.

The primary objective is certainly not to progress in theoretical knowledge but to make "theoretical" knowledge related to relations for the development of tools that can be integrated in the technical field of the relative technology "fruitful".

This research, from a theoretical point of view, is also based on Dewey's (1938) reflection on the problem between pure science and applied science, a reflection that can be summarized:

1. knowledge and ideas are the result of a method intelligently followed by men who interacted with the environment;
2. science in a technical sense is a formal elaboration of daily operations. Its meaning can only be understood by keeping in mind its relationship with attitudes and procedures that can be used by all people born with the ability to act intelligently;
3. common sense is relative and consists of both scientific and non-scientific attitudes.

The purpose of analyzing and identifying possible practical solutions for the use of cognitive artifacts, from Apps to educational robotics, is certainly a vast research horizon that has a "reasonable" number of objectives in the work to be developed.

In summary, three are the objectives of the research:

1. test of a hypothesis: the use of interactive technologies and cognitive artifacts as didactic tools allows increasing the level of learning; moreover, the use of technologies as a side effect allows generating collaborative processes (relational dynamics) in relation to the use of the technologies themselves.
2. nomothetic objective: to define parameters that evaluate the didactic effectiveness of cognate artifacts, also as an extension of the concept of learning objects and inclusive of educational robotics methods and to define the rules according to which these parameters can be used to classify by use and cognitive artifact effects.
3. Methodological objective: starting from the cataloging of technologies such as that created by the pedagogical wheel, we intend to identify which types of technologies can be

integrated into the teaching process, both from the point of view of learning and from the point of view of teaching methods.

The research that has developed starts from the general assumption that technology is rooted and interconnected with people's normal actions.

It starts from the general hypothesis that in everyday reality technology is a fundamental and characterizing part.

A technology, as reported by the 15th census of the Italian population carried out by Istat (National Statistical Institute) is strongly rooted in the life of the Italian population.

Each family is equipped with devices and connections to the network, both "fixed" and portable instruments, and this determines social and relational behaviors.

Technology has a strong influence on social, relational and economic dynamics, making its influence felt strongly on cognitive styles and approaches to the world around us.

These reflections that underline how the importance of technology and its evident influence on socio-economic-relational processes and cognitive styles can be summarized as follows:

- Students through a conscious and targeted use of technology can highlight how we can increase learning skills. How, from a structural point of view, to imagine technologies as an integral part of the students' growth path. The introduction of device-mediated technologies (software) and developed through application hardware (for example electronic) in the learning-teaching processes lead to an improvement in the level of learning. The level of learning has increased through an improvement in technology-driven development of analytical and synthesis skills. This involves a research program that structurally incorporates technologies for the study, learning and communication of educational content.

General hypothesis: the use of technologies that develop interactivity and present characteristics of accessibility and usability in integrated learning-teaching processes increases the level of learning, developing analytical and synthesis skills.

Interactivity as an induced attitude stimulates students' proactivity and participation in knowledge-building processes. Accessibility and usability as a perception induced by technologies will activate, respectively, the inclusion of the student, both from a relational and didactic point of view, and a perception of learning as positive. A positive perception that is not strictly functional but as a method of relating to the world around us.

By level and learning ability, we mean mastery of knowledge in the appropriate disciplines, languages and tools, operational skills and information search, analysis and synthesis skills.

The measure therefore also considers the extent to which students can analyze and synthesize the topics they face, the knowledge they are called to make their own.

The hypotheses lead to define the intervention program that works to integrate technologies in learning processes. Teach in a formal environment where interactivity, accessibility and usability lead to defining more specific research hypotheses.

In particular, the general hypothesis can be rejected:

1. with interactivity, the main advantage of digital tools, the level of proactivity and the active participation of students in teaching processes will be activated; this first reflection leads to the hypothesis that the use of technologies and tools to structure, communicate and collect information, increases the level of learning and develops an effective system of relationships for an active participation in the construction of knowledge;
2. with accessibility it will intervene on the inclusion of each student, also from the point of view of the study tools; we hypothesize that the introduction of technologies that must be accessible reduces the difficulty in the use of teaching aids and favors the development processes of individual skills;
3. with usability, will implement the learning endowment with positive experience which leads to a continuous experience of endemic curiosity; on the basis of these reflections it is hypothesized that the use of measurable technologies in terms of satisfaction induces learning styles of the same technologies seen as transversal and non-functional tools connected to single-action processes..

From this general hypothesis there are two that specifically concern the formal training areas, to which we will pay attention, but also informal and non-formal, which often represent the main environments in which children live:

- technology is a valid aid for learning and perception of the world around us as a set of relationships; the systematic introduction of technologies in learning-teaching processes allows foreseeing organic learning. A learning that the knowledge of the logical structures of the knowledge learned makes it permanent in the students' baggage; therefore, changing the paradigms of the learning models.
- technology must aim to be increasingly transparent towards the user, making it an accessible and usable way for knowledge; the introduction of technology in learning-

teaching processes allows us to observe a conscious use of technologies and their active integration in the continuous training processes that students will have to face.

For this reason, the research aims to ensure that through technologies, understood in a broad sense and not only "electronic", allow students to make their own skills in analyzing and determining the logical networks that are the framework for all actions practical and abstract.

We intend to highlight how multimedia and digital technologies have a real advantage, interactivity that allows you to improve the skills that allow active learning.

The assumption of the research is that the use of technologies, both in the form of cognitive artifacts, ready or to be built, and in the form of digital applications are an added value both in the learning process and in the process of "socialization" and development of skills for collaborative work.

These reflections and the research hypotheses made refer to secondary school students (between 11 and 14 years of age) and the related learning-teaching processes.

From this point of view, the general hypothesis is that technologies, thanks to their ability to generate interaction and their pervasiveness in children's lives, are a privileged way for an increasingly effective learning-teaching process.

It is not possible to ignore the social and technological environment in which children find themselves immersed in the planning of a learning path.

Two main secondary hypotheses are associated with this main hypothesis:

1. tools and devices are transparent for secondary school students; the ability that secondary school students have acquired to use technological devices and content production methodologies with the use of technologies; the technological tool is not an obstacle and must not be "learned" in the use of its basic functions; the use of technologies for the production of content, texts or audio-video is part of the "experience" of children starting, for example, from the daily use of social networks;
2. the current use of the devices has produced a more technological than functional development of the use of the technologies themselves; children know how to use the tools but do not perceive, consciously or unconsciously, their functionality, their potential, to transform this operational capacity into competence.

In concrete terms, two reflections can be made:

- students who normally use technologies will make targeted use of them, understanding its purpose and the structure of what they use;

- technological skills are transformed into cognitive skills, knowing how to understand the use of a tool means understanding its logic and structure in order to facilitate an approach such as knowledge and reality.

These reflections identify the following secondary hypotheses:

1. interactivity with integrated teaching technologies promotes and increases student participation in training and knowledge acquisition
2. usability of educational technologies promotes and improves the inclusive dimension of teaching processes by generating exchange of information and skills for students
3. accessibility of teaching tools implements student satisfaction, giving an impulse to the "pleasure" of knowledge as an intrinsic improvement of the person; moreover, in the absence of obvious and immediate practical or operational implications.

This reflection explains why technology focuses on the terms of accessibility and usability.

Usability indicates the effectiveness, efficiency and satisfaction with which users achieve certain objectives in certain environments (ISO - International Standard Organization - 9241, Ergonomic requirements for office work with visual display, Part 11).

Efficiency means that users can achieve the goal, for the efficiency that users are able to operate in optimal times and for the satisfaction that users are satisfied with what they do, without stress.

Accessibility means the ability to ensure that services, such as web access, are available to people as widely as possible regardless of whether or not there are disabilities of any nature that are not a handicap problem, but are not obliged to have tools of specific capacity; that is, the idea is to make sure that the causes of the problems are not analyzed but the possible problems and their solutions.

This focus is on making artifacts and machines usable for the people for whom they were designed and for everyone who should benefit from them.

The awareness of these processes and the integration of technologies would also allow integrating the lesson into a learning flow that technologies are "spreading" in formal, informal and non-formal learning environments.

The lesson would therefore become not only an opportunity for learning with the help of technologies, but also for learning technologies and education for their correct and effective use.

The feeling is that, while there is a strong and constant attention to all the problems related to technological addictions, the "daily" use of technologies could have its finalization and enhancement in the inclusion in a training path, especially in the formal learning context.

It is hypothesized that a use aimed at learning, in addition to giving a benefit to the teaching-learning processes, presents the side effect of the re-contextualization of the "technological" skills that children assume.

A virtuous process can be generated that can be summarized in the effectiveness of a process that emerged in research and experimentation as the correct use of tools in educational contexts: an **AUM** process (**A**pproach, **U**se and **M**etabolisation).

A path that has a first phase approach, in which you are familiar with the tool to know the functions.

After we have a second phase, when you use the instrument to achieve the required objectives, and a third, an evolution of the previous phases, metabolism, in which the tool becomes a "competence" of the student and used to access content and activities for learning or verification.

As has been defined, the general hypothesis is that technologies, thanks to their ability to generate interaction and their pervasiveness in children's lives, are a privileged way for an increasingly effective learning-teaching process.

From the main hypothesis it is expected that there may be two side effects detectable in students' practices:

1. tools and devices are transparent for secondary school students
2. the current use of the devices has produced a more technological than functional development of the use of the technologies themselves

To define which variables are measured, considering the hypotheses formulated, refer to the classic definition whereby:

1. independent variables: the factors that the experimenter manipulates
2. dependent variables: the variables measured in the experiment.

The use of these variables derives from observations and preliminary research on the modification of learning styles is significantly correlated to the hypotheses.

It is hypothesized that the use of devices and technologies that permeate the daily lives of children is an excellent vehicle for improving their level of learning.

In particular, the use of these devices and production technologies and the use of content must also be used to metabolize and transform these skills into skills.

From the research point of view and with these reflections, the level of learning is a factor that the researcher manipulates, as it tends to increase it by using devices and technologies that should be the keystone, as a wealth of experience and experience of the children but they are used to finalizing learning.

A learning that tends to make people understand the pattern of knowledge.

A pattern and a skill that has been lost, because through the web, information can be found at any time. In the same way, the mnemonic capacity changes and changes when we know we have supports that can complement or replace it.

The independent variables that the intervention program, using software and hardware technologies (educational robotics) can be listed make:

1. level of content learning, using a rating scale, in relation to the objectives of the learning teaching process;
2. level of metabolization of the processes of use of technologies such as "competence" by evaluating during the observation phase and the questionnaires, transforming them into a scale of values.

In relation to independent variables, the intervention plan for:

- content learning level: the collection of assessments, the level of understanding of the contents before the use of the technologies and therefore after the use of the technologies. Knowledge assessment and verification systems are the tests that normally each teacher administers periodically to his students; test that you know among students as "interrogations" and "classwork"
- level of metabolization of the processes of use of the technologies: the use of evaluation questionnaires that evaluate the students' perception of the tools and technologies and the functional and cognitive processes they induce.

The measured dependent variables will cover three areas:

1. The level of interactivity of the technologies used, to be understood as the measure of the potential ability of a medium to allow the user to exercise an influence on the content and form of mediated communication (Laurel, 1993); an interactivity that can be seen divided into types:

- Selection of contents

- Editing content
- Social sharing
- Identity claim

2. Accessibility, intended as a characteristic of a device, a service, a resource or an environment to be easily accessible by any type of user; in this context, we could speak more precisely of usability. Usability in the ISO (International Organization for Standardization) definition, such as the effectiveness, efficiency and satisfaction with which certain users achieve certain objectives in specific contexts. In practice, it defines the degree of ease and satisfaction with which the interaction between man and instrument takes place.

3. Usability, understood as defined by the ISO (International Organization for Standardization), that is effectiveness, efficiency and satisfaction with which certain users achieve certain objectives in specific contexts. In practice, it defines the degree of ease and satisfaction with which the interaction between man and instrument takes place. The term does not refer to an intrinsic characteristic of the tool, but to the process of interaction between classes of users, product and purpose.

#	**Dependent variables**	**Research methods**	**Researcher tool**	**Researcher tool's characteristics**
1	**Interactivity: technologies: Frequency** (how often you can interact) **Range of variability** (how many choices are available) **Relief** (how choices affect problems)	Experimental	Test to detect the level of interactivity	Taken from literature (Laurel, 1993)

2	**Accessibility of technologies**	Experimental	Test	W3C standard test, WCAG project
3	**Usability of technologies**	Experimental	Empirical and inspection tests	Taken from literature (Cantoni, et al. 2003; Krug,2000)

The research will sample 6 middle school classes and 3 classes as a control sample.

The sample consists of 182 students and 54 students in the control group, all students are from secondary schools.

Instead, the analysis phase of teachers' perception is based on a sample of 182 area and training teachers.

The scientific area and the humanities area were divided by both training and teaching.

We also intend to evaluate the fact that the control group secondary school students are not separated from the technology they also use to study and in schools, although using a simple IWB, almost all secondary school students have experienced technologies in their processes. of teaching learning.

The structure of the groups that have been the subject of analysis, research and control group reflect what the numerical relationships are with respect to the sex of the subjects, their training (in the case of teachers) and the training course on secondary school students.

The teachers of the preventive analysis are 182, 36 males and 165 females and 3 who do not respond.

The research focused on secondary school students because I considered, also based on OECD surveys that it was appropriate to start from this stage of education to identify a process that starts from teacher training to the use of technologies in teaching and then start with the first cycle training.

The continuous and integrated use of technologies is not a response to a didactic fashion but to a complex analysis of society that offers tools and areas that cannot be ignored in formal training environments.

We chose a school that had technological resources and environments in which to experiment; in fact, this has also introduced the complex discourse of the relationship between training environments (classes) or rather environments as an important element of the learning-teaching process.

The chosen school, a secondary school (secondary school) had, in addition to the technical-environmental characteristics, a uniformity of the teaching body and divided into two separate complexes.

Having a homogeneous teaching body allowed us to suppose a homogeneous didactic approach to the two groups, experimental and control, and to be the school divided into two different places has guaranteed less influence and interconnection between the students of the two groups, the experimental and the one of control.

In a complex, the one with the best teaching equipment and in which there are 4 sections for 12 classes, 50% of the classes and the control group were chosen; in fact, in the complex in which the three classes were chosen, the sections were 2 for a total of 12 classes.

From an analysis made with the teachers both from the point of view of performance and from the point of view of group dynamics, the classes presented the same characteristics.

Both in percentage and in terms of quality, the distribution of returns was homogeneous, to respect a Gaussian distribution.

The experimentation takes place directly in schools and covers a period of 3 months in the 2018 school year, since school needs, curricular activities and direction do not currently allow a different time and method.

It was decided to work with the middle school classes located in the city complexes.

Classes, as well as schools, present children who come from different social situations, even if an area of difficulty is not relevant and do not present situations of learning difficulty; there were no learning difficulties declared.

Schools have characteristics that can be found in almost all Italian schools that have been standardized by different national projects.

Note the presence of computer labs and interactive whiteboards LIM (**L**avagna **M**ultimediale **I**nterattiva, *multimedia interactive blackboards*) present in the classroom.

As for the characteristics and educational objectives, as well as the final exam, they are homogeneous throughout the national territory.

Middle school is included in the compulsory training cycle for all Italian children.

There are basically two methods used in research

Observation through questionnaires provided to teachers for the observation of cognitive styles and in the post-experimental phase to teachers of experimental and control groups for an evaluation of the modification or otherwise of cognitive styles, learning and socialization.

Experimentation phase in the application of interactive and multimedia technologies to teaching, definition of the scope of intervention, attempt to "manipulate" learning, metabolization of technologies to make them competent and measurement of learning outcomes and communication of acquired knowledge.

Before analyzing the characteristics of the research methodologies, it must be said that the research made use of tests and questionnaires and a statistical analysis of the data.

The tests and questionnaires were used to detect:

- students' attitudes and behaviors in their interaction with technologies;
- problems with the use and understanding of the solution methods used by students;
- verification of the level of understanding and learning of the topics introduced.

The collection and analysis of statistical data was used in terms of:

- frequency: the absolute frequency was used to understand the dominant characteristics in the fields of analysis
- percentages: understand the incidence of certain attitudes and learning outcomes of the didactic intervention
- Cronbach's Alfa: to measure its reliability or to verify the reproducibility of the intervention over time, under the same conditions, of the results obtained.

By introducing the intervention program, we remind you that the dependent variables referred to are those identified above:

1. level of content learning, using a rating scale, in relation to the objectives of the learning teaching process;
2. level of metabolization of the use of technologies, of how technologies become transparent for students, to understand how technological "competence" becomes the ability to use one's skills in a transversal way; the level of "metabolization" is assessed during the observation phase through questionnaires and transforming the observations into a scale of values.

The intervention, which will be discussed below, provides that teachers from the two areas concerned make a 20-hour speech (divided into 3/4 per week, for a period of 5/6 weeks).

This educational intervention includes a part of the classroom explanation, of 4/6 hours and then the laboratory work in which the students under the guidance of the teachers do exercises and use technologies to summarize what has been learned and prepare for:

- communication of learned contents
- content verification (classwork)

The main content of the intervention from the point of view of the content focused on a scientific theme of pH and a historical-scientific topic, the main socio-cultural-scientific events of the 1900s.

From a technological point of view, an electronic kit represents the content with acidity detection sensors and software that allow a semantically and logically defined structuring of the relationship between the contents.

The research intervention program starts from the study and participation in teacher training experiences and experimentation in educational robotics.

The reflection and the path of preparation and delivery of the training path for students led to speculate the need to imagine a path that does not pursue technological innovations but that evolves the teachers' ability to analyze and use the tools for which they become familiar.

This reflection gave rise to the institution and administration, to a large sample of middle school teachers, of a questionnaire to understand if and how the influences of the use of technologies on cognitive styles and learning practices were perceived.

It turned out that the same technologies could improve those skills that seemed to have diminished.

In particular, the analysis and synthesis capacity that seems to be delegated to technology but that the same technology could increase if we thought of using technologies as a tool to understand reality and communicate knowledge.

Starting from this investigation and hypothesis, the intervention program in schools has drawn its intervention logic from educational robotics experiments that in Italy has been and is developed by Robocup Jr Italia, a network of schools recognized by the Ministry of Education, University and Research (MIUR), founded in 2008 and involving over 200 schools of all levels.

The challenge of educational robotics is to develop, through technologies, effective cognitive styles that derive their strength from problem solving and error-learning methods.

The research intervention aimed precisely to see that in addition to enhancing learning skills, interactions between students and between them and teachers have also improved.

RESEARCH'S FINDING

The results obtained lead to an extremely positive reading and a positive impact of technologies in learning processes.

The data determine that hypotheses on the use of technologies produce more effective knowledge.

Effectiveness is the result of the logical reconstruction and a correlation between notions, data and discoveries obtained from reality, literature and teachers and to measure the reliability of the data Cronbach Alpha was calculated in consideration of the fact that it is a statistical indicator used to measure its reliability in psychometric tests.

For the evaluation an EXCEL spreadsheet was used and by inserting the 6 elements of the 182 students of the experimental group Alpha = 0.83 of Cronbach (see Annex A.7), an excellent result was obtained considering that values of high reliability among those ranging from 0.70 to onwards.

Cronbach's Alpha = 0.59 obtained from the control group shows the greater "randomness" of the results and consequently a low correlation between the teaching method and learning, more closely linked to the factors due to the student.

The empirical research as it is configured and the results it proposed even within the limit of the sample and of a well-defined reality in which it took place, presents an interesting relationship with the use of technologies and the effectiveness of teaching-learning processes .

Empirical research must certainly be extended so that technology, with its epistemological, cognitive and relational implications, can become one of the cornerstones on which to develop training training environments.

Of course, the research also highlighted the feeling of a strong inclusive factor that technologies can bring.

We could say with a phrase attributed to physicist Edward Teller during a conference that today's science is tomorrow's technology, so we should have knowledge of past science again to allow children to build effective technology for the future.

A final reflection on the collected data leads to report these data with the hypotheses formulated, hypotheses that can be said to be confirmed.

We can start from the main hypothesis: thanks to their ability to generate interaction and their pervasiveness in children's lives, technologies are a privileged way for an increasingly effective learning-teaching process.

This hypothesis is certainly confirmed, since the results of the final tests show that it has a high and significant percentage of students who have improved their performance (in terms of the average of the evaluations. To confirm the main hypothesis the results of the control group present data which underline how the performance of the students of the control group maintain a trend in line with the past.

Furthermore, it is significant to note that applying the Cronbach alpha, the calculated value shows that we can speak of reliability and reproducibility over time of the intervention as regards the experimental group.

For the control group, Cronbach's alpha notes the unreliability and reproducibility of the intervention, clearly linking the results to strong influences both on the individual's ability and on the environment from which he comes, without detecting a significant intervention by the teaching the process.

Similarly, in relation to the experimental group, the secondary hypotheses can be considered verified, considering the data that highlight the ability to use the tools and the ability to face and solve technical and logical problems, both individually and in groups.

In the same way, the results of the final verification tests, seeing excellent results both in terms of evaluation and communication of contents (see Annex A.5.) Confirm that technological skills are transformed into cognitive skills, making both the synthesis ability that the ability to grow analytical skills.

CONCLUSION

The research work was born from the need to reflect on the improvement of learning-teaching processes. The reflection was born from the attempt to understand if technology, whose negative influences have always been more highlighted, could be re-evaluated within formal training environments, in relation to the fact that in non-formal and informal environments it had a great impact also in relation to the spread of social systems.

In formal environments, the hypothesis that the use of technologies could increase the level of learning derives from having discovered, through exploratory research on middle school teachers, that technology had changed cognitive styles, but that these changes could be well-integrated teaching-teaching processes that improve the level of learning.

By setting the work, it seemed important to understand what could be some indicators that made technology significant to increase the level of learning, inserting it in the learning processes of teaching.

It was therefore decided to use as indicators that well described an effective use of the technologies, of which measuring instruments were present and which should have been linked to the development of the level of learning.

The increase in the level of learning measured, through the results obtained in the verification tests and related to the previous results (both experimental group and control group), was found to be strictly connected to the use of technologies in the learning-teaching processes.

The interactivity indicator, measured by the high level of exchange of information and actions between student and tools, has encouraged and increases the participation of students and as indicated in the questionnaires, and the training and acquisition of knowledge, as noted by the reluctant verification tests.

The synthesis and analysis skills are the result of the accessibility of educational technologies, which, by promoting and improving the inclusive dimension of the teaching processes generate information exchange processes, which are optimized with the induced analysis and synthesis skills.

He underlines how the tests of the topics, developed also through knowledge communication tools (infographics), have shown how the accessibility of teaching tools implements student satisfaction, giving an impulse to the "pleasure" of knowledge as an intrinsic improvement of the person.

All measurements made through questionnaires and observations related the technologies to the attitudes aroused and generated in the class group, which has become a learning community.

At the end of this arduous and limited study and research trip, it is interesting to look back to write a reflection on the structure of the research work and try to define a conclusion.

But, since we often find ourselves difficult to reach conclusions and if it is a matter of reflecting on pedagogical processes, cognitive styles and the relationship with the reality that surrounds us in a way, we could refer to Massimo di Matz, written in the book of semi-paradoxes Scientific "Murphy's Law" by writer Arthur Bloch: "*The conclusion is the point where you are tired of thinking*".

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