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DIGITAL TECHNOLOGIES AND LEARNING PROCESSES. THE ETERNAL GOLDEN GARLAND

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ABSTRACT

Beyond any possible rhetorical division between those who are for or against a more or less massive use of technologies, it is undeniable that technologies always have effects on cognitive, relational, and autonomy processes of individuals, in every season of life and by virtue of the quantity and quality of the use to which we are exposed.

The experience of the pandemic caused by Covid19 definitely amplified and highlighted this fact, making the advantages and disadvantages of online life, to which many were forced, immediately apparent. The data on the learning process, in particular on the exclusions that online education has generated, is evident, although very patchy. The difference was determined by the technological skills of learners and teachers, by the possibilities of access to appropriate infrastructures and devices, and by the style of conducting teaching. With regard to this last point, pre-Covid teaching methods were an important factor: digital teaching has often amplified, for better or for worse, what was already being done in the traditional way, with the evidence, however, that some changes that were less evident in frontal teaching were urgent in mediated teaching. The speed of the lesson, for example, the didactic rhythm, the anchorage to the concrete and the levels of personalization were some of the conditions that compromised the success of online training.

Technological teaching has also concerned the population of pupils in difficult, disabled, and disadvantaged situations, for whom the impact with the ICT world has been accompanied, as research has shown, by other risk factors (Ianes, 2020), again linked mainly to pre-Covid elements, and referring above all too experienced integration, practiced as a cultural model for schools or as a routine afterthought.

The United Nations Convention on the Rights of Persons with Disabilities, recognizes new technologies as an essential contextual element for the promotion of the person's functioning, becoming tools capable of compensating for deficits, facilitating independent living, or, conversely, an obstacle and depriving environment/tool. For this reason, they find a specific place within the

Environmental Factors of the ICF (WHO, 2001) and the assessment that must be made of them in view of individualized educational planning.

International research (Woodward et al .,2001) based on evidence that tries to define what works in the ICT world for children with special educational needs, taking into account a plurality of variables, amount and type of feedback, practical experience, evaluation systems, motivation, teaching strategies - comes to the conclusion that the fact that software has been validated on the research level, does not guarantee that it works in practice (ibid., p. 21). The contribute aims to go in this direction and intends to provide some general reference criteria for evaluating and choosing technological opportunities.

KEYWORDS: Inclusion, special needs, ITC, intellectual deficit, learning

Introduction: ICT and education, a discussed partnership

The expression Information and Communication Technologies (ICT) describes the set of digital technologies that permeate much of the human experience, in all its components: educational, work, and everyday life. Beyond any possible rhetorical division between those who are for or against a more or less massive use of technologies, it is undeniable that technologies always have effects on cognitive, relational, and autonomy processes of individuals, in every season of life and by virtue of the quantity and quality of the use to which we are exposed.

The experience of the pandemic caused by Covid19 definitely amplified and highlighted this fact, making the advantages and disadvantages of online life, to which many were forced, immediately apparent. The data on the learning process, in particular on the exclusions that online education has generated, are evident, although very patchy. The difference was determined by the technological skills of learners and teachers, by the possibilities of access to appropriate infrastructures and devices, and by the style of conducting teaching. With regard to this last point, pre-Covid teaching methods were an important factor: digital teaching has often amplified, for better or for worse, what was already being done in the traditional way, with the evidence, however, that some changes that were less evident in frontal teaching were urgent in mediated teaching. The speed of the lesson, for example, the didactic rhythm, the anchorage to the concrete and the levels of personalization were some of the conditions that compromised the success of online training.

Technological teaching has also concerned the population of pupils in difficult, disabled and disadvantaged situations, for whom the impact with the ICT world has been accompanied, as research has shown, by other risk factors (Ianes, 2020), again linked mainly to pre-Covid elements, and referring above all too experienced integration, practiced as a cultural model for schools or as a routine afterthought.

The United Nations Convention on the Rights of Persons with Disabilities, reaffirming the duty of the signatory states "to promote the access of persons with disabilities to new technologies and to information and communication systems, including the Internet" (2006, Article 9), emphasizes that new technologies must represent a key instrument for promoting equity in educational and social opportunities and that their indiscriminate access must be considered a right for all. They are recognized as an essential contextual element for the promotion of the person's functioning, becoming tools capable of compensating for deficits, facilitating independent living or, conversely, an obstacle and depriving environment/tool. For this reason, they find a specific place within the Environmental Factors of the ICF (WHO, 2001) and the assessment that must be made of them in view of individualized educational planning.

International research (Woodward et al .,2001) based on evidence that tries to define what works in the ICT world for children with special educational needs, taking into account a plurality of variables - amount and type of feedback, practical experience, evaluation systems, motivation, teaching strategies - comes to the conclusion that the fact that software has been validated on the research level, does not guarantee that it works in practice (ibid., p. 21). The plurality of co-occurring factors (context of use, diagnosis, cognitive intervention variables, tutor's level of competence) constitute elements that only allow an idea of effectiveness to be sketched out, but not to systematize every aspect (Olakanmi, Akcayir, Ishola, et al. 2020). Even very extensive studies (Di Blas, Poggi 2008), which attempt to reduce the results in this field to a unicum, always tend to run aground in the face of the fact that it is impossible to generalize, just as it is impossible to do in any action concerning the training process.
Research in this field, therefore, produces important results but is always very limited and specific on clustered populations.

For this reason, teacher training, far from providing takeaway solutions, should instead aim to construct regulatory criteria for choice and assessment, anchored in established theoretical perspectives, as well as new scientifically grounded perspectives of investigation (e.g. the contribution of neuroscience or studies on epigenetics).

This contribution aims to go in this direction and intends to provide some general reference criteria for evaluating and choosing technological opportunities.

From reference constructs to operations

The history of technologies applied to educational contexts has seen a constant evolution, in parallel with epistemological models of reference and models of educational design; the use of technological aids in the treatment of disability situations finds interesting anticipations in the study and experiments of one of the founders of educational technologies: B. F. Skinner. F. Skinner. In fact, as early as 1985, in an article published in The American Journal of Occupational Therapy entitled Brief or New: Use of a Computer Program (PC Coloring Book) in Cognitive Rehabilitation, he spoke of the surprising results obtained through the use of software for coloring on the screen figures of varying complexity, which he himself had developed and tested to work on increasing attention, visual selection, color

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discrimination, sequencing, eye-hand coordination and motor activity planning in patients with cognitive disabilities.

Skinner's pioneering experiments with teaching machines (1965) were rooted in his behaviorist epistemological model, prophetically formalized in The Science of Learning and the Art of Teaching (Skinner, 1954).

In the course of time, and in any case in the space of fifty years or so, there has been a shift from pure behaviorist approaches to cognitive, constructivist, constructionist and connectionist approaches, and we have witnessed the evolution of didactic products based on linear and rigid models of computerized instruction, structured according to task analysis, to flexible, open, hypermedia, fluid environments in which learning by discovery, through the hypermedia plots of information, is constructed in a constant mediation between real and virtual, between self and social dimension, between places and non-places. Technologies have been transformed from products defined for stand-alone use to platforms for sharing, from closed and defined, strongly structured environments to collaborative, open, borderless places, without certainty and without filters or mediations in which every piece of data takes on the value of truth due to the fact that it exists and is shared. From self-supporting didactic processes to processes that delegate the strategic choices of one's own learning to the learner. But to what extent does this translate into a real training process and, above all, to what extent can this work for pupils with special needs?

The research of J. Hattie (2012) presents continuous and up-to-date data based on the analysis of the evidence of the effectiveness of teaching strategies. Technologies do not shine in this respect and their effectiveness is essentially based on the methodology of application and teacher competence (Clark et al., 2006; Hattie, 2009).

If we want to define a compass for orientation, it is useful to highlight a few indications of choice. Jonassen D. et al. (2008) emphasize the collaboration tools function of technologies as opportunities for the personal and social construction of the meaning of learning by the learner through tasks of: exploration, interviewing, writing, modeling, community building, communication, designing, visualizing, evaluating.

These positions, however, should not be confused with the conviction that free will in the teaching task is the desirable choice or that the disjointed use of digital resources translates itself into education. On the contrary, in fact, the research reminds us how important the sharing of physicality and place is in learning and in rooting learning in the personal autobiographical memory. Interesting in this regard is the Moser couple's studies on GPS neurons and their function in the social localization of learning (2015), to which one must add that one must come to terms with the failure of the pedagogy of discovery (Dehaene 2019, p. 222), one of the educational myths refuted not only with regard to

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technologies but more broadly in learning processes and which nevertheless remains stubbornly popular.

Explicit teaching, supported by practices and examples, structured teaching, guided by the teacher and making the learner participate and active in the clear and rigorous path through a progression of meanings and through stimulating material is the best solution to avoid the shopping list effect, i.e. to walk through the aisles of knowledge, stopping to pick up only what you see (what is on the list) and not what might be useful.

"Children of the new generations are supposed to be champions of the digital world (...) this is not true, their knowledge of technology is often superficial (...) only the most educated know how to manage information sources with a critical spirit" (ibid., p. 225). The teacher's function is to provide the elements of interpretation and comprehension that are preparatory to the experience and anticipatory of the same, as well as the support to go "beyond the given information" (Bruner and Anglin, 1974). Even the most innovative learning experiences in immersive environments, based on Immersive Virtual Reality (I-VR) experiences (Hamilton et al., 2021), circumscribe positive effects against experiences of short duration, on specific scientific-simulative topic cores, for declarative knowledge and on cognitive and not behavioral or affective variables, in any case against a certain familiarisation with the system and with another degree of visual-spatial understanding of the user (Maresky et al. , 2019).

Here, then, the illuminating beacon of Brunerian structuralism (1976) reminds us that in the learning environment with a high density of communication "understanding the solution must precede production" and that to make learning functional the role of simulation is important but "the student must be able to recognize a solution to a particular class of problems before being able to produce the solution himself". The structure, the scaffolding of learning is provided by the teacher who acts as a strategic tutor-organizer of protected experiences in which to experience the means-end relationship, in which to understand the solutions in a class of problems before being able to produce them.

The third point of reference comes from the systematization that the literature offers (Mayer, 2017; Butcher, 2014) about studies on multimedia instruction. Building on models of understanding information processing, cognitive load management and visuoperceptual processing, as well as experimental investigations into the retention of messages associated between words and pictures, which show that people learn better from computer-based words and pictures than from computer-based words alone, we can acquire further regulating principles for the design of multimedia instructional materials or the selection of them. Mayer (cit.) proposes summaries of these with the following guiding principles:

- Principle of consistency: eliminate extraneous material.
- Reporting principle: highlight essential material.

- Principle of redundancy: do not add text to the graphics narrated on the screen.
- Principle of spatial contiguity (graphics and words must be placed close together) and temporal contiguity (presenting the narrative at the same time as the corresponding graphic).
- Principle of segmentation: breaking the lesson into self-learning parts.
- Principle of pre-training: providing pre-training keywords
- Mode principle: use spoken text instead of printed text with graphics.
- Personalization principle: use colloquial language.
- Vocal principle: use an appealing human voice.
- Embodiment: showing agents on the screen using human-like gestures.

These indications should be kept in mind when deciding which software materials or platform to propose to the student, in order to optimize the cognitive effort to which any communication and information transmission system exposes the mind.

Guidelines for special education

In special education, the ICT mode has a wide spectrum of applications due to different disability situations. They range from assistive technologies to general-purpose educational and didactic technologies to platforms or tools for enhancement and compensation.

Experimental research in the field of special education is also extensive and often oriented towards narrow targets. If the reduction to a unicum is questionable in didactics, it is even more difficult to reason about nosographic definitions in special didactics, therefore the criteriological position remains just as functional.

In situations of intellectual deficit and behavioral disorders, reference to cognitive-behavioral models is in most cases inevitable. The most functional technologies also respond to this model. From computer- assisted instruction to software or platforms that are more flexible and customizable, and above all hypermedia (therefore very rich from the perceptive point of view because they manage several communication codes simultaneously and with a hypertextual information structure), the reference criteria should take into account the performance of these pupils. Reducing the extraneous cognitive load (avoiding an excess of images, sounds, scrolling banners, non-functional use of colors), providing closed and defined paths based on timely and systematic feedback, avoiding the double attentional task, avoiding the double code of information to be processed in parallel (audio-video-text). In situations of attention deficit and hyperactivity, research (Gatti, Pagnini, Guarnieri, 2007), comparing learning paths managed through hypertext, hypermedia and multimedia supports with respect to classic learning methods, shows that the advantage for children with this profile derives only from hypertext products that, probably, respond better to the need to guide "the learning path (...) and to orient cognitive resources" (ibid., p. 78) compared to multimedia or hypermedia products that, otherwise, cause cognitive overload and distraction (ibid., p. 80). (ibid., p. 78) compared to multimedia

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or hypermedia products which, otherwise, cause a cognitive overload and a distracting effect (ibid., p. 80).

In situations of intellectual deficit, learning disorders, language disorders and in any case in profiles in which executive functions are compromised, the use of multimedia environments in which text/images are synchronized or otherwise associated with audio materials, such as music, produces interference in the memorization of words or meanings (Smeets et al. , 2014).

With respect to educational video games, research data on what works informs that we are still some way from devising the perfect educational video game, both for typically developing children and those with developmental disorders (Durkin, 2010).

International research on comparisons of academic tasks from school to college suggests that access to general-purpose programs and platforms neither improves nor worsens learning per se, but certainly, their use has led to increased technological skills, more time spent on school tasks and better attitudes towards studying (Escueta et al. , 2017)

The use of Computer Assisted Learning (CAL) programs, which have a mildly hypertextualized and more linear information structure, shows huge improvements in learning outcomes, particularly in mathematics, reading and text comprehension (Li, Ma. 2010).

Another interesting finding concerns the impact of educational video games on task motivation. When interacting with them, there is a greater willingness to take risks with regard to the uncertainty of the reward than with face-to-face activities. In educational game sessions, intrinsic motivation, therefore, seems to be able to compensate for the uncertainty of the reward (Howard-Jones, Demetriou, 2009).

Autism and ICT

"For the autistic person, the abstract, the categorical are of no interest: what counts is the concrete, the particular, the singular... unable or unwilling to grasp the general, autistic people seem to construct their image of the world entirely out of particulars. They therefore live not in a universe, but in what William James called a 'multiverse', made up of innumerable sharp and passionately intense details. It is a mental model at the opposite extreme of the generalizing, scientific one, but it is still real, just as real, in a way that is quite different" (O. Sacks, 1986, p. 297).

With regard to the support that ICT can offer to people or students on the autism spectrum, the literature shows some interesting evidence in relation to the use of video modeling, a strategy counted among those with greater effectiveness according to the evidence-based practice's approach (Horner et al., 2005; Reichow and Volkmar, 2010; Cottini et alii 2013). Horner et al., 2005; Reichow and Volkmar, 2010; Cottini et alii 2013), with respect to app solutions for the construction of social stories (e.g. Pictello); to the development of apps, tablets and communicators for Alternative Augmentative

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Communication (e.g. IoParlo, Niki Talk) and solutions for language development or for the enhancement of Theory of Mind and emotional recognition. Following the same line of thought followed up to now, it would be appropriate to start from the specific autistic thought and identify what the digital world can provide in order to pursue coherent goals.

In the inhomogeneity of the spectrum profiles, autistic persons tend to present malfunctions of the executive functions and of the central coherence system, in addition to deficits in communication and social interaction. This profile is expressed in hyper-selective attention to detail, realistic thinking (Sacks cit.), a strong rigidity that leads them to master better in closed systems, with defined rules, they have difficulties in multitasking, planning and organization as well as difficulties in understanding and expressing language, easy distractibility such as to configure an attention deficit disorder (Baron et al., 1995) and short-term memory deficits. There tends to be a preference for visually-based ways of doing mental work, more effective picture thinking, ability to keep attention focused on a very narrow field of interest, 'islands of ability', 'isolated abilities', some of which are exceptionally developed (memory, musical talent, mathematical ability), but rather limited.

The ICT world builds a favorable context in many respects because:

- is always a predictable, visual environment with no affective overtones; in general, as emerges from the Vivanet (2014) meta-analysis, this controlled training context is preferred, characterized by regular and simplified sequences, with no particular stress elements typical of natural contexts;
- provides a communicative filter to the interpersonal relationship and offers opportunities for communication and collaboration at a distance;
- can increase shared attention. Permissive studies (Holt, Yuill, 2013) show that nonverbal low-functioning autistic children placed in computer game situations with peers and adults, in which they need to interact on the same interface to manage shared tasks, demonstrate latent abilities to coordinate social interaction and awareness of the other and the options exercised by the other;
- Digital solutions present interactions based on punctual and consistent reinforcement;
- The available products allow the targeted exercise of domain-specific functions and processes (Wilson et al. 2006);
- The mediation in a single communicative vector - the screen - facilitates the processes of maintaining attention; even more so with tablets that have excellent reactivity and the elimination of the modus peripheral to the advantage of the touch screen that contributes to reinforcing cause- effect links. In addition, the hyper-realistic graphics and image quality are further strengths.

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In conclusion: not to get lost

A great deal of data is now available on technological and methodological innovation. We know a lot about the phenomenology of technological innovation, about the fact that each wave generates peaks of expectations, accompanied by recurring mythologies, followed by failures and the advent of new waves (Cuban, 1986; Oppenheimer, 2003; Ranieri, 2011). To the question of whether there is a positive relationship between technologies and learning, the answer is yes, if their adoption is based on clear teacher awareness, knowledge of the specific needs of the pupil and conscious planning.

In order to summarise what has been discussed and to find useful reference points for applying the undoubted wealth that the digital world offers to the process teach, it is useful to highlight some positive aspects that can guide the teacher's choice.

Products and platforms allow anchoring to curricula, handle many levels of customization well. Most systems allow for the monitoring of work sessions by the teacher, which makes it possible to offer appropriate opportunities for exercise and improvement even in a time other than school, acting on the individualization of the course.

The computer and all its applications are designed to handle immediate, timely, scalar feedback. Feedback consolidates correct answers, even those given with little conviction (Butler, et al. 2008). Digital materials offer the possibility of defining learning paths that allow the learner to self-assess frequently and at deferred times, which is an advantage for memorization (Glenberg, 1976).

Research (Roediger, Finn, Weinstein 2016), in fact, attests to an improvement in terms of long-term memorization of information if learning is developed through study-testing compared to the study-study mode, i.e. massive study leading up to a final test. Curricula make it easier to manage this model in a school and home study context and to maximize the fortifying effect of the tests (Izawa, 1970).

Furthermore, with the use of technology, it is easier to manage educational paths based on the practice of spaced and interspersed study, which has proved to be more effective with a plurality of users, children, university students, the elderly, amnestic patients, animals (Roediger, Finn, Weinstein, p. 41), as well as to activate the alternating effect between disciplines and study materials, improving the speed and accuracy of recall (ibid., p. 45).

Finally, the Internet, as Steve Silverman (2016) points out, is an expression of neurodiversity to be confronted with: it has managed to transform the world within a single generation because it is designed to be 'platform agnostic', it works with any operating system and its contents are accessible to all. Neurodiversity on the web is the rule, not the exception, and the hope is that this model will extend to the offline world: 'just because a computer doesn't support Windows doesn't necessarily make it broken, so not all functions of atypical human operating systems are bugs' (ibid., p. 462),

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