INCLUSIVE DIDACTICS AND DIGITAL MEDIATION: ENHANCEMENT OF COMPUTATIONAL AND CALCULATION SKILLS

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Abstract

The presence of digital in our lives and in the world of education is transforming the processes of knowledge acquisition and conceptualisation, and influencing the teaching practices as well as the use and the role of technologies as an educational mediator. These transformations require to the research constant attention and reinterpretation of the paradigms to take into account the evolution of the technologies and the different awareness of all the actors.

Therefore, research in education must necessarily complement the analysis of the existing situations with new models and strategies of inclusive didactics supported by digital mediation, by activating collaborative research programs with schools. In this paper we outline a new multidisciplinary research project on the impact of digital mediation on education and learning in primary school students, with specific reference to the strengthening of foundational skills such as calculation, problem solving and computational thinking.

Keywords: E-education, computational thinking, digital and inclusive education, executive functions, metacognition.

1 INTRODUCTION

The introduction of information and communication technologies (ICT) in the educational world is changing the teaching and learning processes, the educational interactions, the perspectives and the tasks of each of the parties involved: students, school, family. ICTs oblige us to move from the centrality of the teacher who transmits knowledge to the centrality of the student who learns. It is therefore necessary to start up innovative training courses that go beyond the inevitable digital literacy, pushing teachers and families to become aware of the fact that the entrance of the world of education in the digital age changes the times and spaces of the didactic action and obliges them to deal with innovative models and learning environments that are profoundly different from traditional ones.

These transformations require to the research constant attention and reinterpretation of the paradigms to take into account the evolution of the technologies and the different awareness of all the actors. Therefore the function of the research in education, beyond the analysis of the existing situations, should also address the design and experimentation of new models and teaching strategies (self-regulated learning, enhancement and lightening the cognitive load [12]) supported by digital mediation, activating collaborative research with the schools, and studying their educational value and their role in inclusive education [9]. This requires a synergistic and interdisciplinary work between researchers in the computer and engineering fields and those in the field of neuroscience and teaching.

This paper sets out a multidisciplinary research project, initiated by a multidisciplinary research group of the University of L'Aquila, on the impact of digital mediation on education and learning in primary school students, with specific reference to the development and consolidation of foundational skills such as calculation, problem solving and computational thinking [17].

Several evidence-based studies have highlighted how the impact of digital technologies on learning is influenced by factors such as the presence of adequate structures and supports, the temporal and spatial organization of the school, the classroom context, the technological competence of the teacher, the extension and quality of dialogue [16]. Therefore, it becomes crucial to also explore the impact of ICT on teacher professionalism and on the teacher training programmes. For this reason, the project provides that the teachers involved are included in an in-service training course, based on the analysis of innovative teaching practices and on reflection on their actions, through the support of the research
group. The aim is to reconsider and eventually modify teaching concepts and practices, as well as an accurate reconstruction of the knowledge underlying the digital tools used in the classroom and the planning and experimentation of innovative teaching strategies, based on digital mediation, that leave space for students’ actions.

The proposed investigation, starting from the screening of calculation and problem solving skills carried out using the AC-MT Test 6-11 (the most effective tool on a national level for measuring learning difficulties in calculations), aims to evaluate to what extent a didactic mediation conducted with digital tools, can favour the consolidation and development of certain abilities.

It is worth noting that the University of L'Aquila is one of the three sites, together with Torino and Genova, of the project “The school as I wish it” ("La scuola come la vorrei" in Italian), put in place by Asso Edu for the promotion of innovation in the Italian School. Within this project, an innovative environment named Digital Class was set up, where ICTs are used for training, research, teaching and communication activities. The Digital Class is therefore configured as a place in which the teachers can actively experience educational innovation.

2 RESEARCH PROJECT

2.1 Goals

In primary school the teacher is in charge of the children's formal literacy and of the stimulation of logical and mathematical thinking and numerical intelligence. He must never forget that these developments are variable from one subject to another [6], [15]. This whole process lays its foundations on a series of prerequisites - necessary for the development of writing, reading, calculation, comprehension - that begin to develop in pre-school years and are consolidated at the entrance in primary school [9]. These prerequisites are relevant for the subsequent development of specific skills, as shown by evidence-based studies [2], [4].

The proposed investigation, starting from the screening of calculation and problem solving skills, aims to evaluate to what extent a didactic mediation conducted with digital tools, can favour the consolidation and development of certain abilities. The study has a specific focus on computational thinking skills, understood as the aptitude to use strategies and algorithmic techniques to solve problems with different complexity. Therefore, we give a broad meaning to this concept that involves the student ability to activate metacognitive reflection actions on its own learning processes.

Developing computational thinking means also learning to [14]:

- correctly follow a syntax and some rules (as in grammar)
- set up problem solving procedures (as in math)
- read and write using symbolic languages (as in mathematics and music)
- writing correct, comprehensible and expressive text (as when writing an assay), or favouring the development of self-reflexivity and metacognition.

Digital mediation is obtained through an evidence-based model which is the outcome of research works conducted by experts of the working group and successful international experiences in informatics education [1], [7]. The methodological framework, based on the analysis of the prerequisites of learning, refers to exercises of self-regulation (problem solving, modeling), exercises to strengthen (activities of planning, visual discrimination, repetition and alternation) or to lighten the cognitive load (activities of procedural facilitation, synthesis and procedural revision) [11], [12], [13].

2.2 Investigation

2.2.1 Hypothesis

The hypothesis of the proposed research project is that using digital mediation (with didactic exercises of cognitive enhancement or of cognitive load lightening) to face any critical issues in computational thinking or in logical and mathematical abilities found out through the screening test, leads to an improvement in learning.
2.2.2 Sample

Three local schools expressed their willingness to contribute actively in this project. Each of them is involved with two classes. Therefore the sample is represented by 6 third-year primary school classes composed by 25 students, in average. In the third year of the primary school, pupils should have acquired the main logical and mathematical abilities. The classes are divided into a control group and an experimental group. The criterion of inclusion of the classes, in the experimentation, takes into account the presence in them of students with Special Educational Needs (SEN) for which the need for inclusive didactic is required.

2.2.3 Tool

The screening is carried out using the AC-MT Test 6-11, administered by the teachers themselves, purposefully trained. The test is meant to evaluate math abilities not only with reference to average, standard deviation and percentiles, but also classifying them in 4 performance bands (optimal, sufficient, attention request, intervention request). The AC-MT test is, in the national sphere, the simplest and more effective instrument for measuring the acquisition of calculation skills, and possible difficulties, in primary school.

2.2.4 Analysis

Learning outcomes obtained in the experimental group will be compared with those obtained in the control group (by applying a test-retest design), in which the intervention on possible critical issues in equivalent functions (i.e., cognitive enhancement training exercises or lightening of cognitive load) will be proposed without digital mediation.

2.2.5 Purpose

The aim of the research project is to verify the mentioned hypothesis and also to possibly intervene with digital mediation techniques to improve learning in disciplines other than mathematics and technology.

2.2.6 Settings and Timeline

The investigation will involve 6 classes and up to 18 teachers. Three classes will run the experiment while the others will be the control group. Each of the 3 schools participating in the project will provide 6 teachers: the teacher officially charged for digital innovation in the school (called digital animator), two teachers for each of the classes involved, and a pre-service trainee. They will be trained on the methodologies and techniques used in the project for 2 days, in October 2020. The whole project will run for one school year. The experiment on the students will last for three months, from October to January 2020. In case of need, possible teaching enhancement are planned with deadline of March 2020, while the evaluation of the results and their disclosure is planned for May 2020.

3 CONCLUSIONS AND FUTURE WORK

Motivated by the feeling that the use of digital mediation to face any critical issues in computational thinking or in logical and mathematical abilities can lead to an improvement in learning, we outlined a multidisciplinary research project aimed at evaluating to what extent a didactic mediation conducted with digital tools can favour the consolidation and development of certain abilities.

We note that this is the first step only, and that the design of digital didactic mediation environments is the key node of this educational project. Such environments should allow to customize the didactic intervention in favour of the student (thus facilitating intervention on any critical issues encountered in learning and information processing), to facilitate and motivate learning (metacognitive self-reflexivity), to facilitate the transmission of contents and teaching units, to improve the quality of life of the class group. They will implement the innovative teaching strategies designed as part of the aforementioned survey, and also act as a bridge between classroom work and home study activities thanks to communication and learning tools. Finally they will act by producing a triple feedback: on the teacher, that builds/selects and operationalizes digital teaching strategies; on the student, who acquires knowledge and, at the same time, becomes active in the learning process; on the family that is facilitated by digital mediation in sharing common goals with the school.
The realization of the project also passes through the setting up, contextualization or ex-novo creation of technological tools to offer an educational environment rich in digital (and traditional) resources, flexible, open to active research and to constant monitoring of the teaching/learning processes.

REFERENCES


