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## DIPARTIMENTO DI MATEMATICA

*in convenzione con*

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TESI DI DOTTORATO IN DIDATTICA DELLA MATEMATICA

*La Stampante 3D come mediatore semiotico per l'apprendimento della competenza geometrica nella scuola dell'Infanzia*

## ABSTRACT

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# Abstract

This work is part of an experimental research project of INDIRE - National Institute of Documentation, Innovation and Educational Research, about the didactical use of the 3D printer in kindergarten.

Starting from the assumption that the evolution of geometric thought must be sought from the first spatial experiences of the child and that his development process does not depend exclusively on the age of the pupils but on the "mathematical" education provided to them (Pierre and Dina van Hiele, 1986), the introduction of CAD modeling with 3D printing in kindergarten can have an added value, compared to all the artifacts already in use in kindergarten (plasticine, clay, etc), that of enabling the child to identify and recognize the invariants of geometric shapes, strengthening the entry skills in primary school, thus preventing those states of geometric deprivation to which children are mistakenly subjected in the first years of life.

The objective of this research work is therefore to verify whether the 3D printer can be considered an artifact of semiotic mediation to contribute to the development of geometric competence since the Kindergarten.

The focus was therefore on spatial skills, a group of processes that allow the individual to interact correctly with the surrounding world. In fact, in the literature it is now clear that spatial skills are the basis for a good learning of geometry. Among these, spatial visualization was examined, that is the ability to understand, mentally encode and manipulate 3D shapes (Carroll, 1993; Hegarty & Waller, 2004).

Therefore, a wide-ranging experimental research was designed which, starting from the level of visual-spatial skills possessed by 5-year-olds, allowed to deepen the classification, representation and dissection of solid figures in relation to the use of a 3D printer using both qualitative and quantitative research methods.

Specifically, the research project envisaged the identification of standardized tests suitably adapted to the purpose and the definition of an educational path co-designed with the teachers of the kindergarten, which starting from an integrating background would include a series of didactic activities specific for the acquisition of geometric concepts and the use of CAD software and which would lead to the creation of a narrative character with the 3D printer.

The trial, which took place in two preschools, involved about 80 children aged about 5.

The analysis of the results of tests administered to pre-school children, before and after an educational intervention that also includes the use of a 3D printer, showed that the level of competence acquired by them for the classification and recognition of the graphic representation of a solid figure as well as of its flat section, and therefore in synthesis of the "spatial visualization", is superior in number of children and quality of possession.

Furthermore, the use of this instrumentation within the didactic action favors on the one hand, that of teachers, the planning of innovative activities, on the other, that of children, a positive attitude towards learning: direct involvement of children in the creation of concrete objects, makes them active protagonists and builders of their own learning.