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INVITED PAPER

Digital Sculptors

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Abstract

Together with painting and music, sculpture is considered one of the Fine Arts, for its intrinsic aim of expressing beauty. It consists of the art of modelling clay, sculpting stone, wood, and other materials to create three-dimensional objects. It allows us to shape materials and research a reality that produces knowledge of the world, and of ourselves. With its rich expressivity sculpture can be considered to all effects a language, given to children's hands, and offering them a way of communicating the interior world, creatively expressing thoughts and feelings. What happens when an artistic expression strongly associated with materiality encounters the digital? We speak today of hybrid materiality, of space and time "spime" objects, of digital fabrication and indirect manipulation of artefacts. These new forms of digital sculpting enrich imaginaries and meet original artistic visions. Relations between materiality and digital are increasingly complex and interesting, so that we wanted to explore this in a school context, with a group of 23 children at the Primary School at the Loris Malaguzzi International Centre in Reggio Emilia. The intent of the project design that supported this research, was to experiment in parallel ways with different sculpting proposals (clay, 3D pen, digital manipulation, and 3D printing), asking the children for their comparative analysis.

KEYWORDS: Digitally Integrated Didactics, Digital Modelling, Creative Thinking, Technology, Art.

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1. Pebble or sculpture?

The Makapansgat Pebble is a 3 million year old jasper cobble, reddish-brown in colour, and weighing 260 grams. Human features can be made out on its surface: round eyes, a mouth hole, and grooves tracing a head-cover or haircut.

The pebble was found in 1925 in a South African dolerite cave on the banks of the Limpopo River, but was only connected with the finding of African Australopithecus bones in 1974 (Bednarik, 2011). So, is it a pebble or a sculpture? We still cannot be certain it is a sculpture today, and it has also been suggested the pebble was taken into the cave when an australopithecine recognised a stylised face in it, which would make it the oldest known example of symbolic thinking and an aesthetic sense. The fact that an australopithecine recognised a face in the pebble could indicate the first hominids were capable of symbolic

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thinking, a necessary condition for the development of art and language (Kleiner, 2011).

Figure 1 - The Makapansgat Pebble (source: Alamy Photo Stock).

One morning, children in the third year at the Primary School at the Loris Malaguzzi International Centre were consulting accredited books and websites for the study of human evolution, when they came across the Makapansgat pebble. Is it a stone or a sculpture? The words accompanying the illustration did not clarify the uncertainty and the children's research necessarily extended to consult other sources. Debate was immediately generated in class. After magnifying an image of the pebble on their tablets some children maintained the pebble was certainly a sculpture. Other children, more sceptical, responded that the picture could be a photograph re-touched using a computer programme. Another group believed the theory that the pebble was taken into the cave because it resembled a human face. Together we decided some trials and experiments were needed in order to credit the children's different points of view and opinions. One group would try and make a similar sculpture to the pebble after studying what tools were available to australopithecines, and using these themselves. A second group would use digital technology to alter an image of a pebble and try to make it look similar to a human face. A third group chose to explore and search for other examples of zoomorphic or anthropomorphic pebbles to see if these could be found.

For two months the three groups explored and worked, trying and testing, and carefully documented the various passages of their work and investigation. Group 1 found that the mineral jasper is not found in the area they live in and after discussion chose to use porphyry cobbles as an alternative. With scientific rigour they chipped other kinds of stone to make rudimentary stone chisels with which they could work and sculpt, but after several attempts and results they were not satisfied with, they decided to suspend this line of research for the moment, and pause to reflect. The second group used two different kinds of software, Gimp and Photoshop, to retouch photographs of pebbles. They started with photographs of pebbles that either they took themselves or which they found on various websites. Then, using the digital software they altered the colours of the pebbles, and began to draw hollows, crevices, and shaded areas, until they had a collection of representations of pebbles with human features, in a similar way to their reference point, the Makapansgat pebble. The children in this group were highly satisfied with their results. However, having successfully completed their task the children wrote in their documentation that their research should be rejected, because they had discovered the Makapansgat pebble is a real stone found in the British Museum in London, and that this proof invalidated their starting hypothesis of a faked two-dimensional construction. The third group explored various environments, collecting and selecting pebbles in riverbeds, in mountain areas, and in the school garden. They put together a collection of about ten pebbles and classified them into the most interesting shapes: a fish, a lizard, a moon, an eye, and a house. However they did not find any stone resembling a human being. At the end of this journey this third group stated that they were no longer sure of their starting hypothesis, that the stone had been carried into the cave because it resembled a human face.

Is it a pebble or a sculpture? At the end of the school year we decided the question was still open for us.

2. The educational context

The majority of the children who are the protagonists of this story (16 out of 23), attended the Municipal Preschool at the Malaguzzi International Centre in Reggio Emilia before proceeding into the State Primary School in the same building at the Centre, and where the Preschool and Primary School shares the ideas and practices of teaching/learning, design/planning, organisation and participation, and documentation. It is one unified school whose identity is generated starting from two experiences, a municipal preschool and a state primary school with a continuity of educational project for children aged 3-11 years. The school is aware of, sensitive to, and active towards an epistemology of knowledge. At once operative and reflective, it seeks to create favourable conditions for divergent and creative processes, and solicit questions to which children can research answers through a multiplicity of sources and the many – "hundred" – languages the school supports the children to use. It is a transformative school, in the sense that it seeks to constantly redefine its identity in relation to new social contexts, life styles, and the symbolic languages that belong to the new generations (Tedeschi & Manfredi, 2016).

In this educational and formative context, the digital becomes part of a cultural ecosystem of "the hundred languages" in dialogue with the ideas of children.

3. Listening with our hands

Leaving questions open, without arriving at a definitive answer, allows us to return to our documentation in a recursive way over time, re-reading, and re-searching problems in the light of awareness we have gained, and new connections with other fields of research. This often happens in the work we do at school, and to favour this continuous re-elaboration of thinking, the documentation archives are always available to children, who can consult them in large folders dedicated to various themes, and digital folders they share.

The children who had investigated the Makapansgat pebble reached the fifth year of primary school, where they were exploring concepts of complexity and variety in three-dimensional forms, using different strategies such as observing with concave and convex lenses, investigation and representation from real life using various materials, and drawings and graphics on paper and using digital. During this work the children remembered the proto-sculpture Makapansgat pebble they had encountered and studied two years before. However their interest was no longer on investigating the authenticity of the pebble, but the particularity of its 3D form, and ways of exploring and investigating it. Although their point of view seems new, it is closely connected with the learning and knowledge of their past experience, with the wonder generated by ideas and that was the motor for their research as a group when they first encountered the pebble. Creativity often combines curious exploration with playful experimentation and systematic inquiry (Resnick, 2017).

There were a myriad of possible ways for the children to work on investigations from life, make interpretative representations of the pebble, and explore its 3D qualities. The children are used to researching in groups and so before beginning agreements and decisions have to be made between them, about who will work together and in what way. After conversations one group chose to work with the technique of clay, which they were investigating at the time in the atelier, with the *atelierista*, a full time part of the working group of school educators with a background in the arts. Another group chose to try and interpret the pebble using digital modelling software that was installed on a 65 inch 8 touch multi-media touch display. Together with the children we agreed that we would collect our observations and compare notes, experiences and viewpoints on the different processes of working with material clay and virtual sculpting.

The initial hypothesis of the first group, working with material clay, was that they would not encounter difficulties. However after working on explorations of the three-dimensional possibilities of this material they told us this had not been the case. In conversations about their experience the children told us: “When you sculpt the clay your hands have to shape it”; “To model a material your hands have to listen to it”; “Your hands transmit sensations and communicate data about the material”; “You can only modify clay as long as it is [soft] and damp”; “At the end you have a sculpture that is unique, defined, and finished”.

Figure 2 - Experimenting with sculpting clay (© Preschools and Infant-toddler Centres – Istituzione of the Municipality of Reggio Emilia).

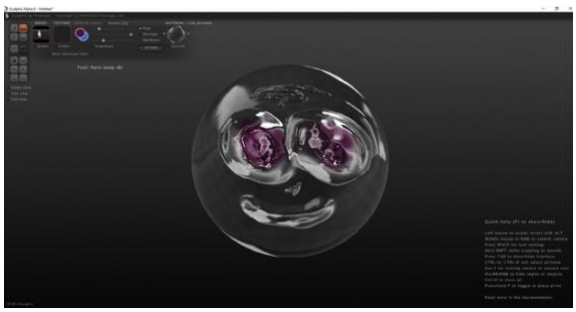

Figure 3 - Digital sculpting (© Preschools and Infant-toddler Centres – Istituzione of the Municipality of Reggio Emilia)

The second group chose to work with the digital software Sculptris. The functions of this software are accessible for those without a prior experience of digital art. In “sculpt” mode, users are offered a ball of virtual clay to shape, by touching the screen with their hands. The interface is intuitive for children to navigate and offers a rich variety of different modelling functions. Sculptris is a powerful 3D sculpture application offering a variety of virtual materials to sculpt, and at any point users can also send their work to a 3D printer, using STL (Standard Triangulation Language) universal format.

The children worked together on the screen, with several hands sculpting and shaping, also experimenting with different colours and shades, and with changing the dimensions of their sculptures. After a journey of work involving much exploration and experimentation the children were satisfied they had come to completion of their sculpted work. In conversations about the experience of digital sculpting the children told us: “In digital sculpture your hands don't meet with the clay, but they can shape it virtually”; “You can fashion virtual

material, but your hands can't listen to it"; "You can rotate a 3D image"; "You can change it until you get the shape you're looking for, even days afterwards, because this sculpture doesn't dry out like clay does"; "You can print your 3D model and make series, multiples and copies, but your sculptures can be lots of different sizes and colours too".

The second group, like the first, was working from "life" to reinterpret and represent the Makapansgat pebble, however in this group their sculpture was not considered definitive and the children continued to adapt it, making several variations, with happy faces, angry faces, ageing faces. They also represented a variety of hairstyles from Mohican to colourful braids, and also versions wearing hats.

One of the strong themes to emerge from the experience of digital sculpting was the possibility of creating series, or multiples, which may all be identical, but which can also express a vast range of variations, in size, rotation, point of view and colour etc.

One child said, "A digital sculpture is never finished, you can change it forever. You can look for the beauty that you like, and then still change your mind".

So is a digital sculpture an incomplete work? Can we speak of the sculptural technique of the incomplete, such as Michelangelo and Donatello experimented with in their work? And again, what kind of beauty is the beauty that I like? Where is it that I go to look for it? And when I find the beauty I was looking for, what then makes me change my mind about it?

Once again, from the words of one of the children in the group, many new questions were generated, opening new perspectives on our research, and crossing into two new and different areas and levels.

First there is an opening to research of an art history kind. We have been working with sculpture and exploring our capacity for thinking with our hands, but this gesture of shaping and giving meaning to material has a history we do not know, has been part of the history of humankind from our very beginning, and we would like to know more about it.

A second opening for research is of a philosophical nature. Beauty is a word we use often in relation to ourselves and what surrounds us, but not everyone has the same idea of beauty, it is an idea that changes, that speaks about us, and the world around us.

This idea is explored by the philosopher Herder when considering new criteria for understanding aesthetic knowledge, turning to an aesthetics considered as the history of relations between the human body and its world, and electing philosophical reflection on the arts as a place of verification (Herder, 1778).

Once again we find ourselves with an image of children as constructors, of knowledge, competencies, and autonomies, capable of identifying their own educational needs and of always comparing different points of view. Children who are at once rational and reflective, constructing bridges between their own experience and that of the world around them, feeling a desire, a need, and a necessity to explore and understand, traversed by the pleasure and wonder of knowing. It makes sense therefore to acknowledge children's natural philosophical predisposition, to speak of the philosopher child, understood as an inquirer, a potential scientist and thinker (Malaguzzi, 2012).

It is essential to cultivate our questions, conserving the pleasure of time engaged in conversation, without giving in to the temptation of given answers (Dallari & Moriggi, 2016). The activity of reflection, and asking philosophical questions are spontaneous. We need to philosophise together with children, and let them be free to explore, themselves. We need to inhabit questions, to persist and stay with the questions, rather than providing ready answers to children's "whys". We need to work in their proximal zone of development and give value to the issue of making meaning (Vygotsky, 1934).

4. Digital art and hybrid materiality... at school

Each day relations between the material and the digital become more complex. The two dimensions, which only a decade ago seemed so far apart, are today engaged in constants dialogue, and processes of reciprocal contamination that can only result in redefinition for both (Wilkinson & Petrich, 2013). Children experiment with and try out hybrid processes and forms without prejudice, perhaps because they are more used than adults to passing from one dimension to another without attrition, and because they do not perceive borders and boundaries as limits.

How do schools respond to the cultural exigencies of these children, so capable of going out to encounter the multiple forms of our multi-dimensional future?

In 2015, Italy's Ministry of Education introduced a National Plan for Digital Schools (law 107/2015), an operational vision of the most significant challenges to innovation in the public school system. Central to this vision are innovation in the school system and opportunities in digital education. The plan responds to a call for constructing a vision of education in the digital era, through processes in schools related to the societal challenges of interpreting and supporting life-long and life-wide learning, in all formal and informal life contexts.

Schools must be capable of interpreting and supporting innovation, through digital education capable of confronting the new and unpredictable changes in society, culture, science and technology (Lisimberti & Moriggi, 2020). This is a vital and indispensable transition. Acknowledging children as digital natives does not exclude us from our responsibility of supporting them to be aware of their own reasoning, and to develop their real competencies.

5. Giving shape to dreams

Our times are characterised by hyper-contemporary issues such as digital fabrication, the process in which solid three-dimensional objects are created starting from digital drawings, and indirect manipulation of artefacts, which uses new digital tools while conserving and holding the memory of thousand-year-old traditions.

Figure 4 - Passion flower realised by class 5^ using Sculptris (© Preschools and Infant-toddler Centres – Istituzione of the Municipality of Reggio Emilia).

Figure 5 - Passion flower realised by class 5^ using a 3D pen (© Preschools and Infant-toddler Centres – Istituzione of the Municipality of Reggio Emilia)

Objects, today, can communicate with each other and with us; so called "spime" (space + time), entities drawn in space and time thanks to their IT components (Sterling, 2005). Completing the scenario are the possibilities of 3D printing, which transforms the very concept of what an artefact is. Any object, from a bottle top to an entire building, can be scanned, transformed into algorithm, and re-materialised by a machine that literally sculpts it.

We are already living the future, shaping it now with our gestures, with our hands, but we need to develop new competencies in order to see ahead.

There is an important statistic we cannot ignore provided by a World Economic Forum study: 65% of children now attending school will have jobs that do not exist yet, but that we must try to imagine.

In his film *The Wind Rises* Hayao Miyazaki gives us his definition of a designer, "someone who gives shape to dreams". We believe, and are convinced, that the place where we can begin to give shape to dreams is, and must be, schools.

Notes

- An interesting prompt to reflection on the theme of digital fabrication came in an exhibition held recently at the iMAL Centre for Digital Culture in Brussels, Belgium, on a project titled *Material Want* by Matthew Plummer Fernandez and JODI, which joins Dadaist and Surrealist suggestions with hyper-contemporary issues such as digital fabrication. In the project artists created sculptures assembled in a random way from 3D printed files generated by web users.
- In *Shaping Things* Bruce Sterling calls objects "spime" (space + time), entities that can be drawn in space and time owing to their IT component.

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