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Educational Robotics and Video: An Experiment of Integration of Languages

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Abstract

This paper aims to present the results of an experimental activity in Media Education and Educational Robotics, based on the integration of the audiovisual language (video) and the Robotics language (LOGO). We want to educate students to communicate and produce meanings. They should acquire technological skills and digital competences, and overcome some learning difficulties. We use educational robotics to increase some basic notions about the visual and spatial skills (in kindergarten and primary schools) and to help students acquire some processes of reasoning, such as the creative problem solving and the logic of sequencing. We experiment with an innovative methodological approach to realize storytelling videos with robots (we are also introducing and teaching this method to future school teachers). Students create short films, starting from their imagination and working on the storytelling process; robots (above all, Bee-bot and Pro-bot) are the protagonists of these videos. Students must ideate the tale (which is about a comparison between the traditional age and the postmodern-technological age), build the scenography, programme the robots and realize the video, thinking about how robots can move and interact with others and with space, according to the script. In this way, students must consider the skills to realize a communicative video and, at the same time, the code requirements to move a robot as well as how it is possible to create a meaningful product with these technologies. This case study is part of a wide research about the role of the multimedia language and innovation in Education, Pedagogy and Anthropology of Media and base for university courses of science teaching education. Renato Grimaldi wrote paragraph 1; Lorenzo Denicolai 2 and 3; Silvia Palmieri 4.

Keywords: *Educational robotics; storytelling; audio-visual language; Innovative methodologies*

1. Introduction. From Complexity to Robotics

The social complexity of our age requires us to develop conscious approaches to better address the increasingly difficult demands of the technological world. Among the various challenges that this condition poses, education is certainly important. In fact, educational and training institutions should train young people to anticipate the future [1], that is, to feel ready to be the protagonists of tomorrow's world. Based on the assumption that in the presence of an appropriate logical-formal construct it is possible to *imagine the future* [2], over the last few years we have structured an *Educational Robotics Laboratory* (conceived and directed by Renato Grimaldi), with which we carry out a research and experimentation project, both in academia and in regional schools. The aim is to promote a humanistic and technological-scientific education to help the young acquire useful skills.

The use of educational robotics allows the student to transfer the cognitive process that has led him to write a program with a formal language into a robot's body and motion; some neuroscientific studies also show that this operation enhances the acquisition of knowledge as it can activate mirror neurons [3, 4, 5].

At our educational robotics lab, we experienced the effective use of some mini robots, particularly BeeBot with primary school pupils and ProBot with secondary school pupils. While BeeBot moves 15-centimeters back and forth and rotates by 90 degrees, left or right (in the latest version, called BlueBot, it is also programmable via smartphone, has the "repeat" command and can also rotate by 45°), ProBot incorporates the Logo language and – like Papert's turtle – can leave a trace on a white sheet and thus draw geometric figures or different paths.

2. Audio-visual Language as the Robotics' Voice

Starting from these introductive guidelines, we want to present an experimental integration between the Educational Robotics' logic and the audio-visual language. Our daily technological communication is often based on images and videos: we are referring to current many possibilities to watch and 'write'

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with audio-visual and media languages. Thus, with our smartphones, we can say something with images, emoji or mini-video; we can tell brief narrations with video on social media platforms. [6, 7, 8]. This activity has two types of finalities: first, we think it is possible to educate students to express an idea (or argument) through a 'dialectical' exchange between mini-robots (Bee-bot, Blue-bot and Pro-bot) and video; secondly, we want to help students to develop a conscious approach with languages and environments of the technology. In this way, we think it is possible to make them aware of the potentiality of communicative media and dynamics [9], also favouring a conscious and active participation in knowledge-making phases. Students should work on a continuous *translation* of language codes, encouraging a more conscious acquisition of theoretical-practical skills in the use and design of a technological and communicative artifact. Reflecting on some interdisciplinary lines of research, such as Zeki's neuroscientific one [10], as well as those inherent in a probable correlation between the cinematographic image and mirror neurons [11, 12], we chose to focus on the audiovisual language as a synthesis of a potential - and complex - semiological generation system (also with a film education orientation). Writing with the media also means knowing and understanding how to use the rhetorical power of the image (both the iconic image and moving pictures), thus practicing how to compose a sentence and how to orient it from the semiological point of view. In a word, it is important to be familiar with the fundamental tools of the audiovisual medium, thus distinguishing a lexicon, grammar and syntax and trying to practice the typical understanding of rhetoric, which recent lines of study have proposed in a more congenial re-reading (for today's type of communication), namely Digital Rhetoric [13]. Starting from their experience of TV (and videos) audience, students should analyze principal types of shots, framing and picture composition, to understand how they can be used and why; then, students should set up their stories also according to these visual elements. Knowing how to make videos thus means, in this perspective, learning to translate a thought (and a text) into images and to syntactically order the latter through a continuous verification of the causal relationship between them, that is, between the different scenes; in this way, it is also possible to understand, for example, the importance of editing in the audiovisual field and, above all, to re-read it in a formative key (as well as other production phases). We have therefore begun to integrate the movements of mini-robots with video frameworks, thereby creating a sort of new digital storytelling, which could be called robot storytelling, with which students have the opportunity to work on creating a story that has robots as its protagonists.

According to the Wing's theory [14], the creation of short films featuring robots as actors-protagonists of the narrative can also work on multiple levels of abstraction, aiming at the creation of a complex narrative and communicative system resulting from a structural simplification process based on the identification of algorithms (i.e. of procedures) and a continuous verification of causal relationships. In addition, the audiovisual language allows one to focus on basic space-time skills that are usually studied and practiced with mini-robots: in this sense, producing a short film means putting into practice both programming skills and the analytic elements that allow one to organize the sequential actions of robot-actors, according to the chosen narrative plot.

In addition to the so-called Digital Rhetoric mentioned above, these ideas should be integrated with those of *multicoding* [15] and of *multimodality* (Kress, 2010), which are elements typical of media communication. The first, understood as a sharing of linguistic codes in the production of the text - or of the media performance - allows one to create narrative products where dialogue between media (understood as expressive technologies, as tools and, in the strictly educational context , as far as mini-robots are concerned, as guiding characters). The second, theorized by Kress, emphasizes how it is possible to construct meaning in a complex and multilayered technological environment such as ours, dominated by Jenkins's transmedial logics [17].

3. Methodology

The students involved have to make a short film in which mini-robots are the protagonists of the narrative. Language integration allows them to concentrate on programming and communicative skills; in fact, they also have to think about how mini-robots can express something through their movement and, above all, through the chosen shots and the dubbing of the protagonists' voices. As with pure coding, we have set up a procedure for the realization of these products, enabling students to practice a number of parallel skills that belong to multiple disciplines. We developed this procedure also to realize other audiovisual products with stop-motion's technique [15]. The production of a short film involving robotics unfolds according to these steps: plot ideation; translation of the idea into the script and Logo language exercises; storyboarding; realization of the sets; programming and shooting; post-production; return. It is important to highlight that students, imagine how to shoot robot characters and how get the robots themselves to communicate the actions they are supposed to represent and,

during the shooting phase, they verify the communicative effectiveness of each created scene. Also in this way, we think it is possible to train them to express with media and allow them to control the meaning of coding [9] and audio-visual language. At the same time, during the post-production, students can work on the syntagmatic organization of their shots. This is a very interesting phase from the educational point of view, since they can experiment with various narrative modes and, above all, have a first way to check the effectiveness of the communication and programming of the mini-robots' movements. In addition, it is possible to further work on space-time skills (especially with younger students) and on the consistency of the actions.

4. Conclusion

The activity described here is part of a broader experimentation of integration between the audio-visual language and educational robotics, in an attempt to analytically connect videos with computational thought. This activity is currently at an exploratory stage, the purpose of which is to verify all possible modes of teaching innovation and application in different educational contexts (currently, we are testing it in some primary schools, and in university teaching courses) [18]. Content creation has allowed the participants to learn to work on different parts of a project (video, robotics, puppets, but also the ideation of the story, its preparation), by training to think by simplifications, in order to achieve a complex educational *artifact* whose parts appear as the result of a series of logical-formal procedures. Finally, the activities have also been subjected to a quantitative and qualitative evaluation, according to a formalized scheme from TCR model.

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