Spontaneous Cooperation between Children in Automata Construction Workshops

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Abstract

This paper describes the Automata for STEM Erasmus+ project, its aims and activities, in particularly spontaneous cooperation between children while participating in automata construction workshops. Taking as a starting point the need to motivate students in the areas of science and mathematics at an early age and also the characteristics of automata, involving two parts, a narrative and a mechanism, the Automata for STEM project aims to explore automata as a strategy to plan and implement contextualized and interdisciplinary activities which involve reference to science concepts or phenomena. The present work focuses on the analysis of spontaneous cooperation between children who participate in four project's workshops. The pedagogical general method followed in all the workshops involved the presentation of automata, children being challenged to plan and construct their own automata, with no cooperative learning structure imposed. Data were gathered through participant observation, registering field notes, photos and videos. Based on the content analysis, categories and subcategories of spontaneous cooperation were identified. In summary, data analysis pointed that despite the characteristics of cooperative work were not formal established, spontaneous cooperation between children emerged. This spontaneous cooperation can take different features, namely, to decide to work on the same automata or to develop their own automata while cooperating in informal way with colleagues. In this case, cooperation can be seen in dimensions as observing each other work, sharing materials, to help with the construction, to imitate and being inspired by the colleagues' work. Spontaneous cooperation also varied according the children age, the context, structure and organization of the workshop, e.g. the seating arrangement. The mechanism used seems not associated with the characteristics of the cooperation.

Keywords: *Automata construction, spontaneous cooperation, children, STEM*

1. Introduction

Taking as a starting point the need to motivate students in the areas of science and mathematics at an early age, the Automata for STEM project aims to explore the use of automata (moving toys) as a strategy to plan and implement contextualized and interdisciplinary activities in STEM [1].

Automata are mechanical toys, constituted by two fundamental parts: on the one hand, a figure, or a set of figures that can represent an idea or narrative; on the other hand, a mechanism allowing the movement of the figure(s). An automaton might be seen as a syncretism between engineering, cultural awareness and artistic expression. A pedagogical approach to use automata in class can be based on the combination of narratives and mechanical movement toys, using science stories suitable for young children. Automata can be built to represent characters or scenes in the story. Stories that include Automata can introduce elementary mathematics, geometry, engineering and physics, geology and other science contents while enhancing other abilities and attitudes with very affordable equipment made solely of recycled materials. The characteristics of the automata, namely the fact that they have a narrative part and a mechanism, allow, in a playful approach, to implement activities related to the planning and construction of those toys and to enhance skills such as observation, problem solving and cooperation.

Since one of the transversal competences that is intended to be developed with the activities of the project consists of cooperation, although cooperative learning strategies have not been introduced, we

tried to observe how spontaneous cooperation forms emerge, which can be suggested by the dynamics of the activity proposed, the habitus, culture and classroom arrangement, age of the children and attitude of the educators. Cooperation is a form of interaction between two or more individuals. What distinguishes cooperation from other forms of interaction is the fact that it takes place according to an objective common to these two or more individuals. In this way, cooperation emerges as a way to achieve a goal that individually could not be achieved [2]. Indeed, cooperative learning is now advocated as a form of high-impact instruction [3], which refers to various strategies used in the classroom, designed to create active learning and involvement among students. These strategies are based on principles and procedures, which are different from ordinary group work, constituting an alternative to competitive and individualistic structures, contributing to better cognitive learning and the development of social skills, assuming different structures and syntaxes, which individualize them (jigsaw, cooperative scripting, learning together, group investigation). Hargreaves [4], a defender of these strategies, considers that these should be included in the repertoire of teachers, and should be used with flexibility and discretion, recognizing that their introduction in schools and classrooms constitutes a safe simulation of the forms of collaboration more spontaneous that are possible among students, which have been somehow eradicated by the school and teachers, through discipline control and assessment practices. These forms of spontaneous cooperation are of great value and unpredictability and the locus of control of cooperation is in the student.
One of the components of cooperative learning consists of positive interdependence, which assumes several modalities, namely, interdependence of purposes, when group members work towards a common purpose, of task, when “two hands are not enough”, of resources, (scissors, paper, glue, etc.), and the environment / space where the group works, which can become an unifying element [5]. It is in this sense that we consider that these forms of interdependence can be observed in the realization of the workshops, among others, without having been instructed for this type of learning. So the objective of this study is to identify spontaneous forms of cooperation among children who participated in the toy construction workshops that move.

2. Method

The present work focuses on the analysis of spontaneous cooperation between children who participate in AuotSTEM project's workshops**.**

2.1 Corpus

Four workshops were considered, with approx. 20 children each, from six to nine years old.
Workshop 1 and Workshop 2 had a very similar structure – in each one were present 22 students of the 2nd grade of a Basic School with ages between 6 and 7 years. The sessions lasted two hours. In these sessions was presented the rotation mechanism with different narrative parts.
Workshop 3 took place in class, 24 children, first grade, 6 years old. Linkages and lever automata were presented and each children built two automata. The session lasted three hours .
Workshop 4 had two sessions, three hours in total, with 21 children, the first, and 19 children, the second, ages between 9 and 10 years. In this workshop were presented different automata as the one with the rotation mechanism, with the lever, the linkages.

2.2. Pedagogical approach

The pedagogical general method followed in all the workshops involved the presentation of automata and children being challenged to plan and construct their own automata.
However, there were some differences in the workshops: in three of them, a poem about the earth was presented, one of the workshops took place in the library, while the others occurred in class. with children seating in pairs or in large classroom arrangement. There were different class arrangements: in pairs, in round tables, presentation format. Teachers scaffolded the process, however in the library workshop there was a minimum of instructions, while in the classroom workshop several instructions were presented. The class teacher as not present in the library workshop. From the instructions about how to construct the mechanism to the final product, several processes took place, namely spontaneous cooperation between children emerged.

2.3 Data analysis

Data were gathered through participant observation, registering field notes, photos and videos. A report for each workshop was elaborated. Data were analyzed through content analysis.

3. Results

Content analysis of different types of data identified categories, subcategories and indicators of spontaneous cooperation and pointed to different features spontaneous cooperation can take. Results are presented in Table 1.

Table 1. Categories and subcategories for spontaneous cooperation during AutoSTEM workshops

Categories	Subcategories	Indicators
General characteristics	Working modality	Each children develop their own prototype while cooperating in informal way with colleagues
		Children spontaneously decided to cooperate and build a group automata
Dimensions of spontaneous cooperation	Transversal to both working modality	Informal distribution of tasks
		Sharing materials
		Observing each other work
		To help with the construction
	While working on the same project	Interdependence of purposes
		Coordinating actions
		Shared tasks
		All ideas are considered and included in the automaton
	While working on separate projects	To imitate and being inspired by the colleagues' work.
		Selfless willingness to help a colleague
Influencing factors	Children age	6-7 years old - cooperate while developed their own project
		9 years old - decide to working on the same project
	Teacher guidance	More guidance - children cooperate while developed their own project
		Less guidance - children decide to work on the same project
	Seating arrangement	Pairs or presentation - children cooperate while developed their own project
		Round tables - children decide to work on the same project
	The presence or not of their everyday teacher	Teacher presence - children cooperate while developed their own project
		Teacher is not present - children decide to work on the same project
Impact	Work developed	When working on the same project, the automata produced is more complex
	Creativity	When working on the same project, the automata produced include differences from the automata initially presented
	Positive emotions	Expressions of satisfaction and joy when presenting the automata developed together

In summary, results pointed that despite the characteristics of cooperative work were not formal established, spontaneous cooperation between children emerged. This spontaneous cooperation can take different features, namely to decide to work on the same prototype or to develop their own prototype while cooperating in informal way with colleagues. Spontaneous cooperation appears to respond to the difficulties experienced by children both individually and in groups. What is often seen is an altruistic attitude in helping the other to solve the problems he encountered in the construction of his automata. Often there is also spontaneous cooperation in sharing ideas and materials that leads to group work to build a group automata or to build their own individual automata. Some dimensions of

spontaneous cooperation are transversal to both work modalities while others are specific of each one of them.
Spontaneous cooperation also varied according the children age, the context, structure and organization of the workshop, e.g. the seating arrangement. The mechanism used seems not associated with the characteristics of the cooperation.

4. Discussion

Within the scope of the AutoSTEM project, the cooperation that arises is what was then called spontaneous cooperation. The activities developed by the project are not directed to group work, however, and given its free character, situations of cooperation among students arise several times due to numerous factors. This cooperation falls under the category of informal and spontaneous since the educators never ask for children to work together but they still do, and it contributes to the success of the task. The spontaneous cooperation between children that emerged during AutoSTEM workshops shapes Hargreaves' proposal [4] to use cooperation with flexibility and discretion and to promote more spontaneous forms of collaboration. The pedagogical approach used on AutoSTEM workshops allowed the emergence of different dimensions of cooperation. These different dimensions of cooperation identified also showed that children's spontaneous cooperation emerged in a continuum that goes from what is considered cooperative learning, strictly, when children decide to work on the same project, for what is considered collaboration, when children cooperate, but each developed their own project. The results also point to the multiple factors that can influence spontaneous cooperation and its positive impact on the work developed, on creativity and well-being, skills communication and involvement.

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