

Teaching Object-oriented Programming in the Context of Collaborative Planning Through the Creation of Two Student Communities of Practice Under the Auspices of an Inter-School Partnership

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Abstract: An inter-school activity allows the creation of an alternative pedagogical framework that promotes forms of teamwork, solidarity and a critical approach to the subject of interest. Inter-school programs contribute to the strengthening of respect and acceptance of otherness, to the promotion of consistency and therefore play a decisive role in the socialization of students, but also in the prevention and avoidance of selfish behaviors in the school and wider social surroundings.

In the context of the inter-school activity, the two classes of students without ever meeting in person, through a series of educational activities feed each other with data. In particular, the team of the 17th Upper High School of Athens searches, organizes and sets record of materials related to recycling. The team of the 2nd Model Upper High School of Athens of Athens develops applications for recycling by writing code in the programming environment of Alice3.0 in accordance with the Computer Science Curriculum.

Key words: inter-school activity, teamwork cooperation, object-oriented programming, Alice3.0, communities of interest, communities for practice, research

1. Introduction

The paper was carried out during the 2019–2020 school year and the last part was completed in the midst of the COVID pandemic. On the side of the 2nd Experimental Lyceum of Athens with a group of 19 students of the A' Lyceum in the context of the course “Applications of Informatics” is referring to the development of an application following the object-oriented programming approach in the programming environment of Alice3.0 for the recycling issue.

On the side of the 17th Lyceum of Athens, the 22 students of the A' Lyceum prepare their work in the context of their research activity on recycling.

2. Theoretical Framework

In this particular inter-school activity, many challenges came up. Firstly, the groups of students of each school had to handle a different subject. The students of the 17th Lyceum of Athens (hereinafter Sch.1) class were assigned

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the elaboration of a project on recycling that is titled “Waste Management — Recycling And Ecological Consciousness”.

The class of students of the 2nd Experimental Lyceum (hereinafter referred to as Sch. 2) was assigned with the development of an application in the programming environment of Alice 3.0.

While the two groups seemingly had similar characteristics (age, class of study, social background) the approaches to the tasks assigned to them were completely different, which made collaborative planning an unknown challenge.

Specifically, the focus was on the process of designing digital material for the recycling issue, by a couple of classes of students coming from different Schools with a strong element of diversity between them for the reasons mentioned above. A reduction in the model of “symmetry of ignorance” was sought, on the basis of which a Community of Interests (CoI) was created — the definition of the inter-school community — in which two different communities of practice (Community of Practice (CoP)) interacted — the community of students of Sch.1 and the community of students of Sch. 2). (Fischer, 2001).

In the following analysis, an attempt will be made to prove that the continuous effort for communication and interaction between the different practices of the groups and the knowledge they acquire through indulgence, can be transformed into a new content in the frame of Community of Interest CoI that will prove a source of creativity.

The duration of the inter-school activity unfolded in face-to-face teaching conditions lasting twelve weeks, in total for both schools and was related to the subjects of the A' Lyceum of Gel, Applications of Informatics, (Panselinas G., Angelidakis N., Michailidis A., Blatsios C., Papadakis S., Pavlidis G., Tzagarakis E., Tzorbatzakis E.) and the training of Research Work-Project (Matsangouras, 2012).

3. The Research

In this article it is analyzed the way that Sch1 students became more creative as a group thanks to their diversity, whilst provoking the creativity of Sch2 students who used the material produced by Figure 1 to create material with their own content in another form (transformation of knowledge into another form).

For the joint design and dialogue between them they used a digital tool of non-live communication, the workflow of google widely known as digital classroom (google classroom). In the second phase the material created by Sch.1's CoP was used in the classroom by Sch.2's CoP (a community of practice with the same interests and goals) through programming in the Alice 3.0 environment.

4. Methodology

In the first phase (in the design phase) the two professors (hereinafter Prof.1 and Prof.2) for the understanding and description of the assigned tasks informed their students about the inter-school action they had in mind and explained to them the role of each department.

The feasibility of teamwork was analyzed to the students and the dual form it can have, i.e., often we cooperate with known people, but there is also the possibility that there is a need to cooperate with unknown people. The group teaching contributes to the development of cooperation both among students, and among teachers and students. In a classroom in which a group-based way of teaching is applied, the expressions “I” or “each one on his own” have been replaced with expressions such as “we”, “you will work together”. The mutual aid, the exchange of views between the students during the educational process, strengthens the students who feel creative, accepted and equal

members of the school class (Vriza, 2018).

By implementing the brainstorming method guided by their teacher, the students of Sch1, after the introductory discussion between them on recycling topic, approached research fully the individual thematic axes that were defined. Thanks to the brainstorming technique, which was used in the first two lessons, the title of the research paper emerged. The deluge of ideas enhanced the spontaneous expression of the students' ideas for an environmental topic and offered the potential to investigate the multiple aspects of the subject. There was a direct involvement of all students, and as a result their knowledge and mindset on the subject were investigated and the title was formed according to their knowledge and preference. The students gave keywords which they wrote on colorful papers, a compilation of all the words was made, a process which was challenging for everyone. The words were grouped together and the title was derived based on the composition of the Brainstorming words (Divanis, 2012).

During the implementation of the Research Project, the group of Sch. 1 students goes in an organized manner (on foot) a short distance from the school, in the wider neighborhood area, in order to deal with pre-planned activities. The students were divided into subgroups and each subgroup had a different subject of research. The purpose of this transition was to examine the real state and the Recycling conditions applied in the Municipality of Athens where the school unit belongs, the existence of “Green Points”, and of course the awareness of students and citizens on the subject of recycling. Everyone is concerned about the environment and in order to achieve the goals of sustainability and viability, everyone’s active participation is necessary, starting from the youth and advancing towards the older people (Trikaliti, 15 December 2002). There was observation, recording, photoshooting and a group interviewed by the citizens. Through the study in the field, an experiential excursion emerged material which was provided to the team of 2Th Experimental Lyceum.

The same students, after seeking, investigating and making cross-reference of the material, created a complete cooperative presentation. The material was posted in a specific hive of the e-me platform created by consultation between the two Professors¹.

When the Sch.1 students’ activity was completed, the generated material was then uploaded in the hive in which the Sch. 2 had also applied to become members. Thus, the students of Sch.2 could be informed about the topics, make comments in its peers and finally stir up the two sections, which resulted in the feedback of the students of Sch.1 from the interfering with the students of Sch.2.

It was confirmed at this stage that feedback is the most apparent improvement factor for students influencing the improvement in the effectiveness of their teamwork (Antoanrta P. Friday, November, 2021).

In google docs with an account re-created for the purpose of the program, the students of Figure 1 co-created per groups the relevant questionnaires in order to have primary research data to complete additional research.

In the second phase of the planning of the activity, the methodology followed by the students of Sch.2 is explained.

In order to ensure that the students of Sch.2 do not act as programmers exclusively, within the limits of a teaching hour there was an introductory discussion about recycling after the projection of a relevant video and a discussion relating to it.

Alice3's programming environment has elements that can play the role of a cognitive tool and support exploratory and discovery type of learning states regarding the formulation of data structures (control conditions).

¹ Available online at: <https://e-me.edu.gr/groups/17lyk-athin-A4-project/wall>.

5. Implementation in the Class

In the second stage the students of Sch.2, after they had studied and provided feedback on the material that the students of Sch. 1 had posted in the hive, they were asked to design their proposed scenarios.

The students of Sch.2 were motivated to address this demand-problem in order to design performance scenarios on the issue of recycling in a way that has a personal meaning for them.

It is necessary to mention that it was preceded, in the context of familiarization with the logic of formalism, by a one-hour teaching intervention regarding the investigation of association between the learning process and the digital tool used by the students (Dimoula E. & Ziaka E., 2017).

For the interpretation of the students' creative activity, the criterion is the original handling of specific approaches, and their performance in a strictly structured programming environment.

The scenarios that emerged from the design of the students of Sch.2, were then asked to implement them in the programming environment of Alice 3.0 (environment that had already been taught as to its structural elements and their use).

In order to implement the educational scenario, the students needed to recall the theory that they were taught, to describe the structure of the class and to understand the classes, their structural elements that are the objects and in the end to become familiar with object-oriented programming. In addition, they learned to incorporate functions both numerical for scoring calculation and boolean logics for the creation of the interactive question quiz in Alice 3.0. Figures from the available libraries of Alice 3.0 were used. (Panselinas G., Angelidakis N., Michailidis A., Blatsios C., Papadakis S., Pavlidis G., Tzagarakis E., Tzorbatzakis E.)

The aim of the scenario is for the students to actually implement an integrated application in the modern environment of object-oriented programming, following step by step all phases of the application lifecycle.

The students were already able to:

- 1) create a virtual world in the three-dimensional (3D) Alice environment with dynamic character movements and user interaction,
- 2) recognize concepts: class, object, property, method and inheritance in an object-oriented programming environment.

It is worth noting that not all the proposed scenarios from this activity of Sch.2 students were completed in a computer program, but the aim of approaching the creation of personal meanings was achieved.

The students of Sch2. attempted, with different strategies, to complete the implementation of the scenarios without necessarily everything being successful and correct.

The analysis focuses on the ideas of the students in a 3 members group for the resolution of the activity. This group proposed solutions that were unique compared to anything else proposed in the classroom. Specifically, they produced a complete educational script on: Definition of the Ecologist Class With Questions and Interactive Question Quiz.

Regarding the complexity of Alice3 to represent the various algorithmic structures, it was indicated to the most experienced students how to guide the weaker ones and this was almost easily overcome (model of constructivism with exploratory, collaborative and free learning). In this way, everyone understood the importance and dynamics of learning communities, in this particular case of community of practice. The management of the number of students, the available computers, the required time and the group way of working (2 students per group and 3 excellent students who acted as assistants).

Completely unplanned, the students of Sch.2 were forced to change the physical space of their laboratory that led to an unexpected positive result to enhance the mobility of students and their further familiarization with the electronic circulation of their work.

Peers who do not even know each other, nor have they ever met, have learned to collaborate electronically and in a group cooperative way for the partial completion of a particular assignment with the guidance of their teachers. There was absolute cooperation and trust between the stakeholders of the two schools (students – teachers) and the work is the product of good communication and a very good social climate. With the various roles that each and every one of them took up in the team, with proper coordination, working collaboratively and utilizing technology, the teams achieved the desired result.

Moreover, it was deliberately intended to assign roles (after communication between the trainers), i.e., the best students were encouraged by the teachers to facilitate and guide the others and all together as a group learned to ask accurately and to explain again accurately in order to further enhance the cultivation of a spirit of cooperation and teamwork, as well as the development of participatory processes in teaching practice.

Added value is also the spontaneous pronouncements of the students of both schools for expansion of the scenarios, thus leading to the logic of continuity and construction.

In the context of this inter-school project, the participants as groups communicate, inform each other, cooperate, one is a source of inspiration for the other. Of course, the benefits are many and concern all involved, the teachers, the students of the two schools and of course for the school units.

Through the whole process, the students managed to develop their communication skills. Teachers were encouraged to develop good practices in their teaching, to deepen and explore good practices that have already been effectively implemented in other school units. Through the cooperation of the students, their communication network of acquaintances with their classmates was expanded, resulting in the future exploitation of them. Their self-confidence has improved, their self-esteem believes more in their abilities and abilities, they have been strengthened. They gained additional motivation to improve their knowledge and technical skills. Their communication with the whole learning environment has been improved.

Through this process, teachers had the opportunity to improve their social and communication skills. Their self-esteem has increased, they feel satisfied with their work. They can easily perceive developments. They, in turn, expand their network of acquaintances. They can serve as a role model for other teachers. They were given the opportunity to transmit their knowledge and techniques and achieve their individual improvement. They felt, professional satisfaction from their offer.

As far as the school unit is concerned, the general framework of operation of the school changes, the whole culture changes. Participation is strengthened, team spirit is cultivated, mutual support for the achievement of goals is cultivated. Members of the school community become more extroverted and communicative. They become positive about new practices, innovative programs, open schools, innovation, entrepreneurship. This results in new prospects for this particular school unit. One teacher is a role model for the other, prompting a significant number of teachers. Everything results in the better functioning of the school unit since in it are active teachers with high self-confidence, increased interests and willingness to constantly improve their abilities (Mouratidis M., Stamouli N., Aggelakopoulos V., Sioula E., Riga A., Vlahadi M., 2018; Dimoula E., 2021).

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Analyzing the actions of the students, it seems that, through their efforts to implement the already expressed ideas in new content, it is that can be characterized as original and become an argument in favor of the appearance of creativity in the group.

6. Conclusions

The crucial role of teamwork was developed in two axes through the interschool activity. On the first axis the process of planning facilitated the transformation of diversity, from an obstacle, to a factor of appearance or enhancement of creativity within the community of interest — CoI (both for the assignments of the students of Sch.1 and for the students of Sch.2). In relation to the development of group-cooperation regarding the second axis, the students' actions were completed consequently knowing that the actions of the students of Sch.2 who used the product of the design of the Sch.1 students, to transform it by using the Alice 3.0 application and operating within the defined curriculum framework.

Within the frame of this particular interschool activity, the Community of Interest (CoI) that was formed, effected positively the harmonic operation of the aliquot Communities of Practice that were established in each of the two schools.

Therefore, before the conclusions are generalized, it is worth exploring which interventions can transform diversity from an obstacle to an advantage in the case of the composition of heterogeneous student groups in order to enhance their creativity.

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