Cultivating Social-Emotional Learning and Deeper Learning Skills through the Design and Implementation of Creative and Improvisational Activities in Science Education

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Abstract
Cultivating Social-Emotional Learning and Deeper Learning skills are some of the central skills of the future, according to the OECD report 'Future of Education and Skills 2030'. These skills should start to be developed by the kindergarten and end up in Secondary Education, even in Higher Education. This presentation refers to the results of a conducted doctoral dissertation with the subject "Creativity and Improvisation in Primary School Science Learning and their contribution to the development of Social – Emotional and Deeper Learning Skills". The research was conducted during the academic year 2019-2020 and the participants were 80 primary school students (grades 4,5 and 6), 3 researchers, and 3 art teachers. During the pandemic, we used the distant learning platform (e-class) from the Hellenic School Network. The methodological framework used was Educational Designed-Based Research. The scope of this research was to create an interconnection of improvisation and creativity through methodological approaches of Art and Science during the teaching in Science Classes. Besides, the purpose of this dissertation was the development of a new pedagogical framework that integrates the dimensions of Improvisation and Creativity in the field of science teaching in Primary School, in such a way as to promote Social-Emotional and Deeper Learning Skills. To achieve the objectives, we designed prototype toolboxes for students, teachers, and researchers where the various activities in the 4 phases of the research were described in detail: a) students' initial ideas, b) scientific knowledge, c) artistic expression, d) evaluation.

Keywords: Social – Emotional Learning, Deeper Learning, Science Education, Primary School, Educational Designed – Based Research

Introduction

Since the beginning of the 21st century, theory and research have tended to link creativity with both cognitive and psychometric, and humanitarian parameters, thus emphasizing different scientific subjects (Caselli, 2009). Thus, more and more researchers recognize that creativity is a social phenomenon with motivation, interaction, and mood as the main elements (Craft et al., 2014). In this context, this research is an attempt to link the concepts of Creativity and Improvisation in the field of Natural Sciences with the skills of Social – Emotional Learning and Deeper Learning.

Initially, the basic concept of this thesis was Improvisation, that is, an articulated multidimensional activity based on an authentic creative performance. Through the experience of improvisation, participants develop aesthetic and perceptual coding, memory and recall, motivational control, and performance monitoring. Concerning education, improvisation relates to several aspects of everyday teaching practice such as creativity, spontaneity, and the collective creative process (Holdhus et al., 2016).

More specifically, the Improvisation Aspects in Education are as follows:
Communication and dialogue: Communication in improvisation can be described as a sequence of two positions: From the internal process of communication to its external intended effect. The goal can also vary by focusing either on the impact of listening or on the inquiry process.

Structure and design: All traditions (theatre, music, business administration, etc.) claim that to achieve professional improvisation, it must also involve structural thinking.

Repertory: The repertoire, which is a system of compiled catalogs that have been formed based on knowledge of content and pedagogical knowledge, is the basic prerequisite for improvisation in education.

Context: Professional improvisation practices are largely interwoven with the relevant reference framework.

The next concept studied was Creativity, mainly in Science Learning, where it is referred to as the "deliberate and imaginative activity that produces original and unique results concerning the student. This is done through the creation of individual or social ideas and strategies, which are critically justified and produce consistent with available data, explanations and strategies" (CREATIONS, Horizon 2020, Smyrnaiou et al., 2020).

Through the study of these concepts, activities were designed and implemented which, in addition to the creation of scientific meanings and the cognitive development of students, were aimed at the cultivation of skills of Social – Emotional Learning and Deeper Learning. Social-Emotional Learning is linked to terms that make up a set of skills such as character, personality, 21st-century skills, soft skills, non-cognitive skills, etc. All these approaches draw their definitions from slightly different theoretical perspectives, and different series of research follow their relevant scientific fields and disciplines (Jones & Doolittle, 2017).

Deeper Learning is a new term usually associated with how pupils must achieve excellence in school through a fair education system. According to the U.S. National Committee of the Research Council (AIR, 2015, p.5) deeper learning is defined as "the process in which

students acquire proficiency in a subject and beyond memorizing facts, concepts, techniques, and processes understand the basic principles and realize when and how they can apply what they have learned in new real situations. In this way, they seek to acquire not only academic knowledge but also the relevant skills".

Based on the above, the purpose of the research is to explore the process of implementing improvisational and creative acts at the level of both exploratory and creative planning that students and teachers will follow, to develop scientific meanings for the natural phenomena under study (Kotsari & Smyrnaiou, 2017). More specifically, the research questions of the study were as follows:

- To what extent do students' improvisation and creativity in the course of the activity develop social and emotional learning skills?
- To what extent do students' improvisation and creativity in the course of the activity develop deeper learning skills?
- How are the aspects of creativity and improvisation linked to the creation of scientific meanings through the process of investigation?
- To what extent are students' motivations for engaging in Natural Sciences affected through creativity and improvisation activities?

Research Methodology

For the investigation of the above research questions, the methodological framework of Educational Research Planning was used, as it includes both the design and development function, as well as a specific purpose to provide theoretical knowledge on how to promote specific ways of implementing activities aimed at developing skills of Social Emotional Learning, as well as Deeper Learning. Educational design research is a methodological framework, Design-Based Research is a method that according to Wang & Hanafin (2005) incorporates the following characteristics:

- bridges theoretical approaches with educational practice,
- focuses on the relationship between theory, the artifacts we have designed and developed, and in practice,
- recognizes the need to go one step further than the limited measurement of learning and leads to results that are not generalized, but relate to the process followed and the characteristics of the framework on which it was applied.

Based on the methodological framework of design research, this study was conducted in three stages (McKenny & Reeves, 2018; Bakker, 2018: During the first stage, the design of the tools of improvisation and creativity was carried out on a specific thematic axis of Optics during the teaching of Sciences in the last three classes of primary school, then an overview of the literature on other applications of similar tools was carried out to promote the design of the appropriate tools and activities of teaching intervention. In the second stage, the intervention was implemented and the data were collected which will lead to findings on the effectiveness and disadvantages resulting from application in the field. Finally, in the third stage, conclusions are drawn which lead either to a redesign of the intervention or to the creation of a new theoretical framework and which are based on research findings on the generalization of this educational application.

Analyzing the general application of this methodological approach, the course to be followed in the conduct of this research focuses mainly on the design and implementation of innovative action that incorporates elements of creativity and improvisation in the teaching of

the thematic axis of Optics in the last three classes of the Primary School. In this dimension, specific toolkits will be created for students, teachers, and researchers, through which the development of creativity and improvisation skills will be studied.

The method applied is the "triangulation" of research data. Triangulation is a research technique and is essentially a way of ensuring validity in quality surveys and can be described as the use of two or more methods for data collection (Cohen & Manion, 2008).
The tools used in the implementation of the activities were:

- Observation key for participatory observation.
- Specially designed research protocols, based on weighted questionnaires on motivations in Science and the dimensions of Social Emotional Learning (the Relation Of Science Education, Ten-Item Personality Inventory (TIBI), The Self-Efficiency Scale: Construction and validation, High self-control predictions good adjustment, The role of trait emotional intelligence , Stories of Tommorrow).
- Specially designed Rubrika Evaluation for Social-Emotional Learning Skills.

The survey took place in 2 Athens Primary Schools during the 2019–2020 school year and involved 80 students from the last three classes of the Primary School, 3 teachers, and 3 researchers, while during the period of exclusion due to the pandemic the activities were carried out through the digital e-class platform, the GSP. During the pilot phase of the survey, the group consisted of 20 students from the 4th, 5th, and 6th grades. Its members were involved in activities of creativity and improvisation in the Natural Sciences, both through the field of art (theatre, painting, music), as well as through the field of science (experiments, scientific meanings, problem-solving).

During the main phase of the research, activities took place in the single framework of the toolkits in 60 students of D, E, and F primary school, both live and mainly remotely, due to the pandemic. The research also involved classroom teachers, teachers of art (theatre, visual arts, and music) as well as two researchers from the University of Athens, and professors of Natural Sciences. The following table [Table 1] summarizes the phases with the activities of the toolboxes with which the students were involved:

Table 1: Table with a Summary of the Activities of the Toolkits

Phase A (2 hours) Selection of a scientific topic	**Phase B (6 hours) "Disciplined Improvisation" Activities**	**Phase C (6 hours) Artistic improvisation activities**	**Phase D (2 hours) Evaluation – SWOT analysis**
a) Presentation of Optics theme in different ways: - simple information – emotional aspect (positive/negative) - Social impact (positive/negative)	a) Offering scientific tools (e.g. scientific dialogue, such as questioning, structuring explanations and engaging in scientific arguments, and debates)	a) Creation (ideological storm, theatrical play, improvisation game, etc.) - scientific content - different contexts - different means of expression	a) Assessment by Students: Includes mini-interviews with open-ended questions, discussion at work tables (focus groups), and a questionnaire on students' interest in Sciences.
b) Pupils' prior knowledge of the subject: - familiar subject -	(b) Development of activities for the development of scientific thinking	b) Presentation of video presentations, cultivation of arguments, focus on	b) Evaluation by Teachers: Includes discussions on the design and application

completely unknown subject	(e.g. linguistic and graphic representations, experimental implementation of scientific concepts).	team skills)	of focus groups a SWOT analysis (Strengths-Weaknesses, Opportunities – Threats)
c) Scientific meanings - possible intuitive knowledge - knowledge of scientific content	(c) Evaluation – Reflection (completion of specially designed skills-related research protocols)	c) Feedback Commentary on presentations, feedback, and focus groups	c) Evaluation by Researchers: Includes evaluation rubric for relevance, consistency, practicality, and effectiveness of both design and implementation.

The toolkit for students was developed in the e-class of the Panhellenic School Network, so that there is a continuation of activities in distance education, due to the interruption of lessons on 11 March 2020 due to the crown epidemic [Figure1].

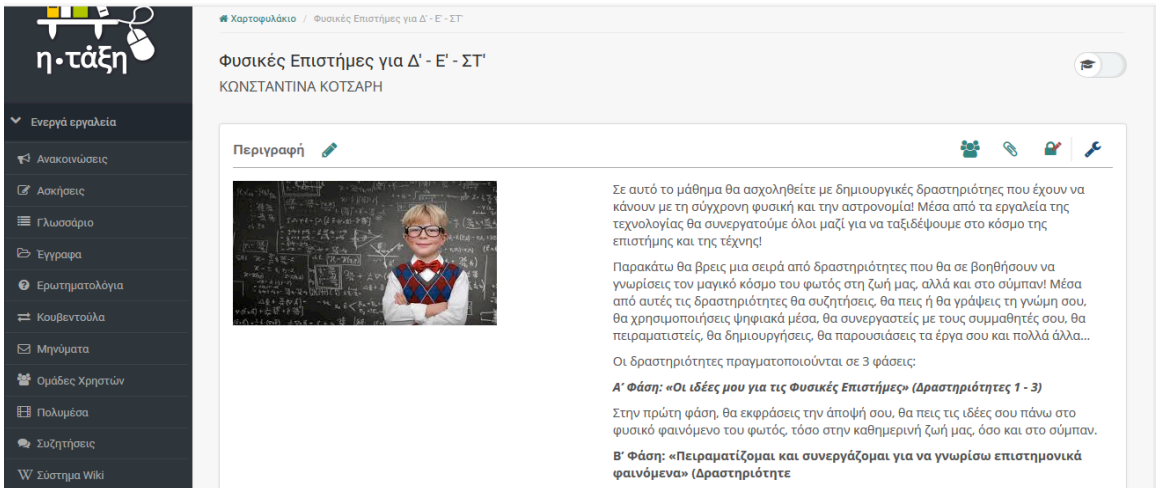

Figure 1: The Toolbox of Students in the E-class of the GSP

In this research, the focus was mainly on the dialogue of students both within the group and in the plenary of the class, as well as on the students' involvement with the proposed activities of the specially designed toolkit distributed to them. For this reason, the following instruments were used to collect survey data:

Participatory observation is a predominant method of recording and analyzing directly accessible external behavioral data. For participatory observation, a specific observation key was created for researchers (presented in detail in the annex and the analysis of the results).

Hypercam for filming verbal information and movements on the interface of the computing environment, where activities required students to engage in simulations and other software or computational environments.
The specially designed research protocols structured based on the theoretical framework and the research questions raised, as presented in the previous sub-section.

Artifacts - produced products through student interaction in distance learning, as well as through usage software and Web 2.0 tools integrated into the online classroom.

Results of the research

Based on the theoretical framework developed as well as the objectives of the study, the method of content analysis was selected for the analysis of the data collected from the survey. The content analysis was based on the data collection tools developed in the methodology chapter and in particular on the observations made by the researcher. In addition to completing the toolboxes, the analysis unit was the thematic episode which refers to the categorization of parts of the discourse corresponding to an idea. Thus, a categorization system was gradually developed, based on covering the main axes as they are structured through the research questions raised. The data analysis tools used were Atlas.ti for qualitative analysis and SPSS for qualitative analysis.

The data collected from the qualitative analysis of the dialogue between the subjects during the conduct of the survey, together with the three research protocols, were codified and entered in the Categories Analysis Tables to extract quantitative findings concerning the research questions of this study. The results of the research were based on the processing of data in conjunction with the coexistence of improvisation and creativity with deeper learning, Social-Emotional Learning, as well as the creation of scientific meanings through the inquiry process.

Concerning the research question concerning the extent to which improvisation and creativity of students in the course of the activity develop social and emotional learning skills, it is noted that through the activities of the toolboxes Social-Emotional learning skills have been enhanced through Improvisation and Creativity mainly in terms of the dimensions of Self-knowledge, relationship skills, and effective communication. Then, to develop Deeper Learning skills, analyses of the data showed that Improvisation and Creativity in the course of activities enhanced both cognitive skills and critical thinking as well as students' motivations for their involvement with the Sciences.

Finally, regarding the creation of scientific meanings through the process of exploratory learning, students developed skills of scientific argumentation and research of scientific content during the exploratory learning process.

Conclusions

Based on the above, we could argue that the integration of the concept of Improvisation and Creativity into the teaching of Physics in Primary School reinforced not only cognitive skills but also Social-Emotional learning and deeper learning skills. This approach was achieved through the selection of various instruments and applications, such as simulations, theatrical events, visual creations, and experiments and, aimed at the multifaceted exploration of the phenomena of physics under consideration. , as well as skills related to the dimension of Social-Emotional Learning as well as Deeper Learning. In particular, evidence was presented that shows that:

- In their involvement with the proposed activities, the students developed improvisational and creative skills that enhanced social-emotional learning skills, as well as collaborative learning, as described in detail in the theoretical framework of the thesis.

- In engaging with the proposed activities, the students developed improvisational and creative skills that enhanced the skills of Deeper Learning, as described in detail in the theoretical context of the thesis. In engaging with the proposed activities, the students succeeded in creating scientific meanings (scientific content, scientific language, and scientific arguments) to a fairly large extent.
- In engaging students with the proposed activities, the aspects of creativity and improvisation were sufficiently linked to the process of investigation, as has been described in detail in the theoretical context of this thesis.
- Finally, during the activities the students seem to have developed incentives for their further involvement with the course of Natural Sciences, both within the school and in their daily lives.

From the above, we could conclude by saying that through the design and implementation of specific activities that enhance Creativity and Improvisation, the skills of Deeper Learning and Social-Emotional Learning of students are enhanced. It has also proved particularly important to negotiate concepts through the collaboration of students both in their creative and exploratory interaction through different means of expression and collaborative learning activities.

At this level, the assumptions that determine the factors influencing the creation of meanings (physical concepts contained in the activities, strategies followed by students, collaboration with each other, verbal interaction of students) were strengthened, but also the importance of the integrated cognitive content of the toolkits, simulations and more generally the various effective learning environments proposed. In conclusion, therefore, we could conclude that it is possible to cultivate skills of Social – Emotional and Deeper Learning, through the creation of a strengthened, pedagogical and cognitive, support framework in the form of tools to promote the teaching practice of Natural Sciences in the Primary School.

However, it should be noted that this proposal should be further explored as a more general pilot application in other schools, different regions, and socio-cultural contexts to confirm the resulting findings as regards the interconnection of creativity and improvisation with Deeper Learning and Social-Emotional Learning, but also in terms of creating scientific meanings and developing student motivations for Sciences.

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