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Transformational Processes in the Activity System and in the Educator/Designer through Design Procedure under CHAT

Marianthi Nastou[1,*] & Katerina Plakitsi[1]

[1]Dept. of Early Childhood of Education, University of Ioannina, Ioannina, Greece

*Corresponding author: Dept. of Early Childhood of Education, University of Ioannina, PO Box 45110, Ioannina, Greece. Tel: 30-697-289-8463

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Abstract

This study analyses the role of design procedures under Cultural Historical Activity Theory (CHAT) in the system of the activity and in the educator/designer's professional and personal skills. Our effort has come as metacognitive outcome of a research that took place at a Contemporary Art Museum and in a classroom for students (11 years old). The purpose of the initial research was to highlight how an educational program under CHAT in a Contemporary Art Museum with the Life Cycle of Materials, as its Object, could affect students' sustainable literacy, motives and relationships. As a metacognitive process the educator/researcher, who was simultaneously the designer, also studied the transformational processes of all Subjects of the activity system as well as her professional and personal transformations as an internal study for self-literacy. This paper describes trajectories of strategies, interactions, and expansions to the activity system, and puts forward for discussion the use of theoretical tools and epistemological principles of expansive learning for metacognitive analysis. Practical engagements with the theoretical framework of CHAT, came out as an important factor in the development of transformative agency and self-literacy at a professional level.

Keywords: double stimulation, mediation, design tools, educators' professional development, transformative agency, interaction

1. Introduction

The Cultural Historical Activity Theory - CHAT is the theoretical and philosophical framework for the analysis of professional practices and organized actions. With CHAT we can investigate internal processes that take place within the individual, and interpersonal processes as well as interactions that take place in learning groups and communities (Plakitsi et al., 2018). According to CHAT, development is a dialectical movement and interdependence between the individual mind and the surrounding world (Vygotsky, 1978) while learning is a social process in which knowledge is co-constructed in a cultural - historical context (Engeström, 2015).

The distinguishing feature of activity theory is a developmental theory concerned with qualitative transformations over time in human practice. Its central tenet is how human beings can become agents who can change themselves as they change their own institutions and practices in a way that mobilizes their collaborative agency (intellects and energies to act) (Yamazumi, 2009).

Expansive learning results in significant changes in learners' activity and in the world beyond the confines of a classroom. The meaning of things is built when the person is involved in common activities (Engeström, 2019). In important transformations of our personal lives and organizational practices, we must learn new forms of activity which are not yet there, and they are literally learned as they are being created (Engeström, 2001), within innovative environments for learning and development. According to the above, the cultural-historical researcher is interested in the use and development of tools that change understandings of a situation and responses to it (Edwards, 2017).

This paper utilizes the results of design and implementation of an educational program under CHAT, to identify and define the transformational processes and existing grids of interactions in the system and the elements of the activity, and especially in the subjects that constitute the learning community. In addition, the article studies how the processes in the activity system can change and expand the activity itself and lead to transformative practices and development of the subjects of the activity. It also explores the teacher’s professional literacy, as a result of the becoming in the community, and the learning environment.

For this paper, the initial research took on a transitional character. Its initial stage was about designing educational activities for students about concepts for sustainability in a non-formal learning environment (museum). While the final stage was about, how the designed actions could become conscious actions and function as presumptions for mastering the essence of the object of design and self-literacy at a professional level for the teacher, as well as their conversion to a stable, dynamic, and transformative tool.

Thus, bypassing the question of the original research: “How does an activity in a non-formal environment affect the acquisition of concepts of sustainability, learning motivation and relationships between students”, where answers were given through the processing of research data, the meta-analysis indicated the following secondary questions: “How does a design process under CHAT affect the teacher / designer in terms of work practice. Which

interactions and transformations affect them and have a reference to other factors of the system of activity (e.g., students)".

The new research questions restate the boundaries of the study in the activity system by shifting the unit of analysis. In this sense, our research takes two levels of analysis. In the first level the object of analysis is the transformation of the group of students, while in the second level the object of analysis is the teacher / designer's transformation.

In the general context of the activity, the teacher / designer is both the subject and the object of the activity.

The paper includes a theoretical approach to CHAT epistemological principles related to the specific study, a brief presentation of the educational program under CHAT analysis, and its design principles, as well as an analysis of nine levels of interaction and metacognitive processes, and their transformational action to the subjects of the activity.

Data consisted of the researcher's field diary, students' texts and sketches, which capture the lived experience in the activity, and the photos / snapshots of the educational occasion. A combination of observations, repeated readings, and the study of all the above data enabled detailed examination of social interactions, expansions, embodied actions, and motives.

2. The Theoretical Framework

2.1 Creating Environments for Development and Growth

Cultivating skills such as critical thinking, creativity, collaboration, communication, adaptability, initiative, organizational ability, empathy, and problem-solving pose new challenges for teachers. On the one hand, there is the challenge of planning, and conducting activities in new environments, on the other hand, the pursuit of collaborations with organizations or individuals, in order for teachers to design, and organize activities by themselves, based on the needs of their students for each educational occasion. The goal of creating such learning environments is the development, as described by Holzman (2016), "… not as something that happens in or to the individual, but as ongoing, continuously emergent, social-cultural, relational activity that people themselves create".

To achieve the above requires a change in the teacher's professional perspective in the direction of an individual who faces creativity as a new form of literacy. This change of teachers from "implementers" of pre-designed practices, to designers of innovative actions, could lead to the transformation of the school system with the aim of development and not just the acquisition of knowledge.

For Vygotsky, "…learning, as a thing in itself, was not of interest but learning in its relationship to development was fascinating" (Holzman, 2018). "Also, for Vygotsky, learning and development, as social-cultural, relational activities, are inseparable; they are a unity in which learning is connected to and leads (dialectically, not linearly) to development" (Holzman, 2016).

In education, teachers can develop agency for development by designing course programs around students, and by motivating them by acknowledging their previous competences and values (Morselli, 2021). In the context of their new role, teachers must construct their own interventions, invent, and develop the teaching practice by choosing appropriate tools, and developing skills to face the new reality. Through such trajectories teachers can be led to professional development and self-literacy and this can lead to the development of their students.

Taking into consideration that from an early age positive attitudes, and attitudes towards the environment can be developed in students (Plakitsi, 2013; Roth, Goulart & Plakitsi, 2011), as well as the importance of experiential field actions as life-learning experiences and a value-forming factor in day-to-day educational practice (Zachariou et al., 2008; Sandell & Öhman, 2010; Daskolia & Grillia 2012; Nastou, 2019), the design of educational activities, and the management of learning resources are required as part of the daily practice of teachers. However, most of the time, the teachers themselves do not realize that these are design activities and find it difficult to integrate their practices under methodological frameworks or to devote time to systematic reflection on tools and learning environments.

Research by Huzinga et al., (2014), shows that teachers do not have the appropriate tools and strategies to design educational processes, and are not experienced in handling design tools and methods. In addition, the same research highlights the need to support teachers with their specialization in program designing.

Further, research shows that participation in design activities organized by researchers or scholars is a successful process that leads to professional development (Huzinga et al., 2014; Kyza & Nicolaidou, 2016).

In traditional school activity, the object of educational work is classroom-based teaching that transfers the given contents of textbooks to individual students. Educational institutions are tightly closed activity systems that have little impact on societal activities outside in the real world. To go beyond this closed idea of school and demand serious expansion of school activity, we must focus on such forms of school activity in which various involved parties and partners inside, and outside the school, collaborate and reciprocate with one another; participating organizations and actors potentially share expanded new objects of educational work (Yamazumi, 2009).

Sannino (2008) suggests that metacognitive actions could help document transient innovative activities over time and contribute to understanding and consolidating changes after interventions. According to the above, our effort is to study metacognitive and expanding processes in our system of activity, accepting that the expansive learning offers to teachers, children, and participants a learning experience as a collaborative, self-organizing process for developing transformation, and innovation from within.

In this way, every participant in the school community should be seen as an expansive learner who is willing to make school innovations together with others and become a collaborative change agent by turning the school institution into a collective instrument for everyone. The

expansive learning approach opens qualitative new possibilities for a school innovation called school as change agent (Yamazumi, 2009). Furthermore, in this direction volitional actions could be regarded as at the core of transformative agency (Haapasaari, Engeström, and Kerosuo, 2016).

2.2 Epistemological Principles that Guided the Study

Activity theory is known for its modelling of activity systems as prime units of analysis, for its emphasis on the object-oriented and contradiction-driven character of activity, for the theory of expansive learning, as well as for the more recent methodology of formative interventions and studies of transformative agency by double stimulation (Engeström & Sannino, 2020).

According to CHAT, activity as a collective action is an organized system with core elements the subject, object, tools, rules, community, and division of labor (Engesrtom, 1993, 1999). Object is what the activity is oriented toward. As the true motive of the collective activity, the object gives the activity its identity and direction (Engeström & Sannino, 2020). The subject is a person or a group of individuals with a shared object for the activity. Subjects participate in the activity community with actions performed in the activity toward the object using tools (the available mediation resources, such as language, computers, artworks, materials, or theoretical objects). Vygotsky argued that artifacts mediate all human action. Mediation occurs between the subject and the object of the activity. The activity is regulated by the rules. The larger social group, that the subject is a part of, is defined as community (Engeström, 2015; Vygotsky, 1978b).

The community consists of the participants engaged with the activity's object, along with other individuals who are connected with the object of activity. The object defines the community and distinguishes it from other communities. Within this system, the division of labor specifies the roles and responsibilities of all the participants. (Engeström, 2001).

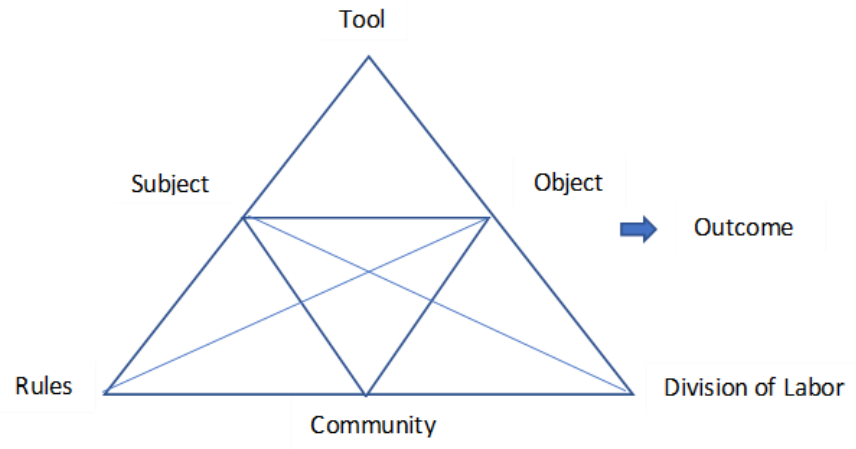

Figure 1. The Activity System (Engeström 2015)

The outcome is the actual result of the activity. Outcomes describe developments arising from tool use affecting new responses. This model can be used to identify, capture, and change multi-mediational processes in human activity with a focus on tensions and contradictions at systemic levels (Engeström, 2015; Vygotsky, 1978b).

Schools have a tremendous and unexploited potential to renew society (Engeström, 2020).

Expansive learning in schools according to Engeström, (1991b), would construct a new, expanded object of learning by connecting the following different contexts of learning with each other: the context of criticism (the powers of resisting, questioning, contradicting, and debating), the context of discovery (the powers of experimenting, modeling, symbolizing, and generalizing), and the context of practical social application (the powers of social relevance and embeddedness of knowledge, community involvement, and guided practice). This kind of an expansion in the object proceeds to break the "encapsulation of school learning" within the confines of the school texts and thus implies a qualitative transformation in the entire activity system of school learning (Yamazumi, 2009).

According to Engeström and colleagues (Engeström & Sannino, 2010) an ideal expansive learning cycle includes the following seven steps: Questioning, Analyzing, Modeling New Practice, Examining and Testing the New Model, Applying / Implementing the New Model, Reflecting / Reflecting on the Whole Process, Consolidating and Generalizing new practice.

In our study, this model was used by the teacher / researcher to analyze her work practice and address issues at a systemic and professional level, expanding her skills for future work practices.

Specifically, issues that became visible and needed to be addressed, were work practices for the designing of interdisciplinary activities, addressing conflicting curriculum requirements, managing museum resources, creating links between museum resources and program objectives, and the cultivation of collaborative practices, and relationships at the level of an expanded learning community.

The process allowed for significant reflection on the role of the teacher, who as a designer of complex, collaborative, learning experiences, can meet the needs of students and integrate non-formal learning spaces into school practice, with the rules of activity in harmony with the school's rules, in order to overcome several types of contradictions. All these were examined in relation to concepts, objects, and materials, translated into embedded, auxiliary tools of the educational situation.

Subsequently, the activity was analyzed with the following tools: a) the activity triangle b) the levels of interaction into the system of the activity c) the double stimulation in two levels of transformations and b) the stimuli and conflicting stimuli and motives and conflicting motives of the whole activity.

2.2.1 The Double Stimulation

The concept of double stimulation was adopted in this article, to define and analyse the transformational process. In Vygotsky's work, double stimulation is a framework and method

in psychology that sets two groups of stimuli (Vygotsky, 1987). According to Engeström & Sannino (2020), "transformative agency by double stimulation, as originally described by Vygotsky (1997), is a process through which human beings can intentionally break out of conflicting motives and change their circumstances. The starting point of double stimulation is confrontation with a problematic situation which triggers a paralyzing conflict of motives (first stimulus). In trying to cope with the problem, learners turn to artefacts and invest them with meaning (second stimulus). They decide to rely on these artefacts when instances of the problematic situation reoccur. Each new instance of the problematic situation is cognitively, and emotionally critical in that it reactivates the conflicting motives. When learners put into use the second stimulus, this implementation helps them to gain control of and to transform the problematic situation into one that is more understandable and manageable. The repeated implementation of the second stimuli to deal with the problem or specific aspects of it strengthens the learners' understanding of the problem, and their capacity to take further actions, which in turn strengthens the longitudinal "rope" of the expansive learning process. As a result, both the problematic situation, and the learners are transformed".

The two types of stimuli serve the purpose of objectifying inner psychological processes to trace the development of higher mental functions, and reveal their structure (Sannino, 2015). The first stimulus is created through a task for the participants, and guides the activity, and the second stimulus is set with signs or objects/artefacts that are given and help in the development of the activity (Vygotsky, 1987). In an intervention that applies this principle, the first stimuli are generated by the researcher through the analysis of the current situation to make visible contradictions and motivational conflicts. This is usually achieved by representing them in the triangular CHAT model (Figure 1. Engeström, 2015).

Double stimulation, besides being a method, is a principle of volitional action which distinctively characterizes all higher mental functions (Sannino, 2015); involves complexes of decisions and actions that are repeated over time and "progressively cultivated" (Sannino & Engeström, 2016), and can be understood as the process whereby people use tools in a way that fundamentally changes the way they work on a problem or a situation (Hopwood & Gottschalk, 2020).

Furthermore, "the method of double stimulation is a developmental quasi-natural experimental setting in which the subject who participates in research is provided with a richly structured environment, which can be re-organized in a goal-oriented way" (Valsiner, 2000). Also, we can examine double stimulation in relation to cycles of expansive learning at a systemic level (Sannino, Engeström & Lemos, 2016).

Transformative agency by double stimulation transpires in a problematic situation, in which people evaluate and interpret the circumstances, make decisions according to the interpretations, and act upon these decisions. Together with the two stimuli conflicts of motives constitute the core of a strategic setup that human beings establish to intentionally affect their behavior, and the world around them (Sannino, 2015).

Double stimulation has recently been investigated in relation to several activities such as in encounters between home care workers and their helpless elderly clients (Engeström et al.,

2015), in services for families with children at risk (Hopwood and Gottschalk, 2017), in leadership development in early child education (Nuttall et al., 2018), in teachers' work and learning at a professional development activity with a participatory design project, for Ocean Literacy (Augustsson, 2020), in a three-level analysis in a Change Laboratory intervention with teachers (Morselli, 2021). According to Sannino (2015) studies such as those by Hopwood and Portes et al., are rare attempts to understand the interactional dynamics involved in double stimulation.

Double stimulation, as a principle of agency and change, should be more systematically investigated particularly in connection to the development of intervention methods within cultural–historical activity theory and related approaches (Sannino, 2015). While diverse authors advocated double stimulation as an epistemic principle characterizing the Change Laboratory (Engeström, 2007, 2011; Engeström and Sannino, 2010; Sannino et al., 2016), a comprehensive analysis of this process is still missing (Morselli, 2021).

3. Analysing the Intervention

The educator/researcher designed the activity, and in a context of reflection, defined 9 levels of interactions. Each of the interaction levels was analysed using CHAT's tools to identify expansive transformations in the activity system for the teacher / researcher and students.

Data for the analysis were the researcher's visits to the museum several months before the design procedure of the program, the recording of the field study, the findings of the interview with the creator of the Museum, the sketches and texts of the students in the teaching intervention, the snapshots of the program, the worksheets completed by the students, the worksheets created by the students and notes from the researcher's field diary.

The core elements, for the program's design, were the subjects (students and teacher/ researcher), the object(s) (concepts, relationships, motivations and disincentives for action and learning, interaction), tools (museum resources, works of art, materials, collaboration methods, rules), collaboration framework (roles and tasks within the group), community (student-teacher-museum founder), the division of labor (assumption of a role by the subjects and its responsible management). The factors of the activity in the Museum are depicted, with a triangular analysis of CHAT, in Figure 2. The time required to complete the educational program for students was 4 months.

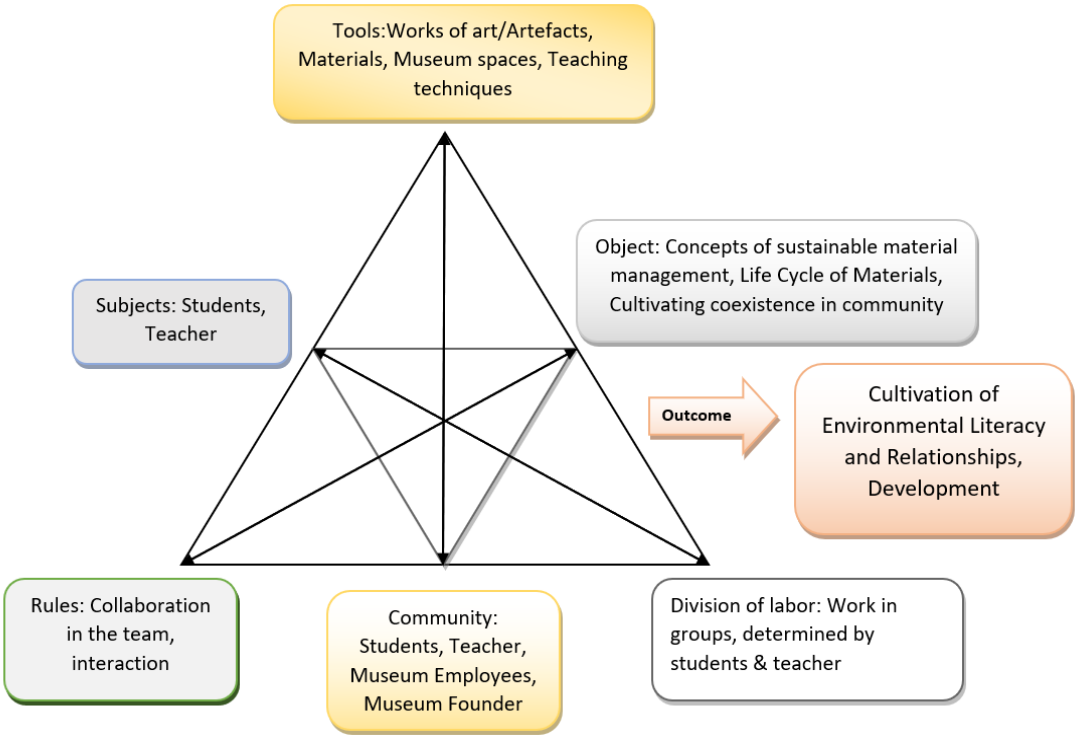

Figure 2. The Triangle of the Activity in the Museum

The educational program was designed to include actions oriented to the concepts of the activity. It was the tool of mediation between the subjects (students) and the objects (sustainability concepts) of the activity as well as the tool of mediation in the social relations of the learning occasion. In short, the actions were:

1) Discovery "hidden treasure game" in which students in groups searched for the materials in the exhibits, pondered and discussed their origin, properties, durability, ways of managing them and their hidden stories. The students were guided by the worksheets and by the researcher who was in the role of teacher/animator.

2) Interview with the founder of the Museum by the students to investigate whether the materials he chose for his works, were new, old or a little used and why he chose them that way.

3) Creative writing with the exhibits of the Museum as heroes. Students were asked to include the concepts-goals of the activity in their stories. The action was aimed at developing relationships, exchanging ideas, accepting the other's opinion, acquisition of concepts.

4) Creation of worksheets by the students where they drew with sketches their own life cycles for a product or object in daily use which they described with texts. The worksheets were processed in the plenary meeting, supplemented, where necessary, with additional parameters that affected the production stages.

Each of the activities produced results that were captured in the students' responses to the

worksheets, sketches, photos of the project and the researcher's field diary.

3.1 The Multiple Levels of Interaction

The research process and the result of the intervention in the Museum, took their final form through transformations, interactions, emerging relationships and connecting nodes that were formed between the subjects, the objects, the space, and the tools of the activity. Thus, new meanings emerged in the original research idea under the influence of the evolutionary stages of interaction, which are presented in Figure 3 and further analyzed in Figure 4.

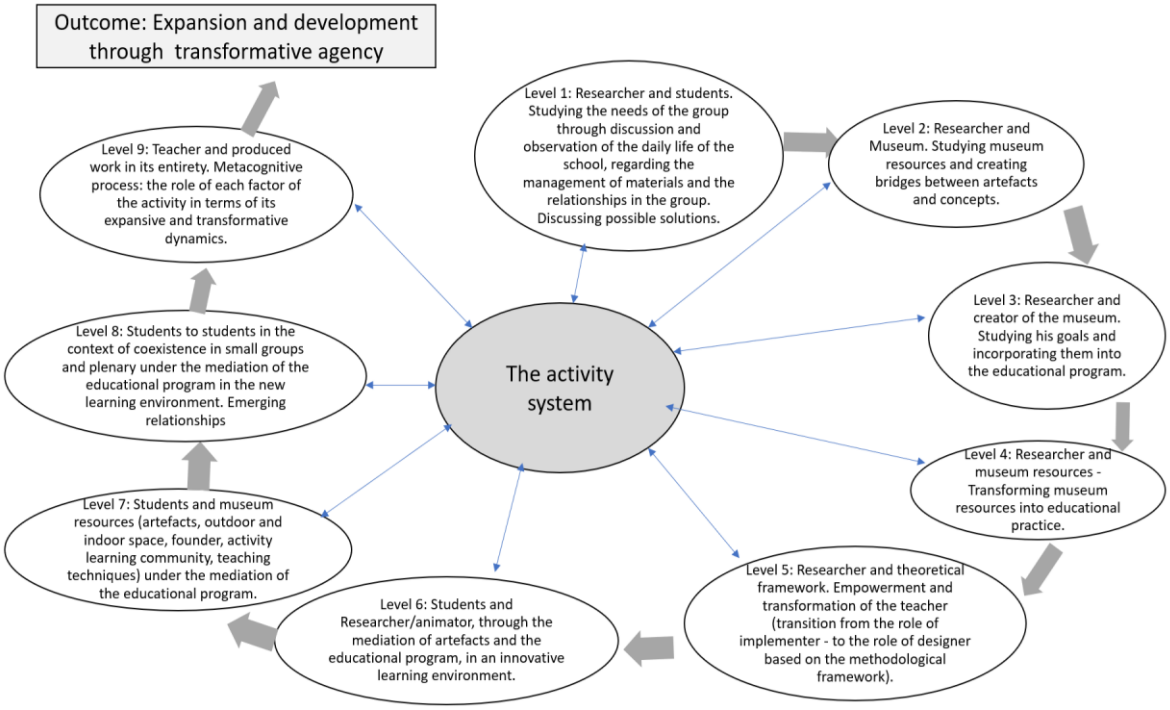

Figure 3. The 9 Levels of Interaction in the Activity

1st interaction: The Teacher / Researcher and the Students. At this level, through a discussion about the daily life of the school, regarding the management of materials and the relationships in the group, the problematic situation (1st stimulus) was identified. Thus, the first stimulus emerged, which concerned the needs of the group for the cultivation of environmental literacy (recycling, material and waste management, product production processes) as well as the cultivation of relationships between the students, and possible solutions for all the above were discussed.

Contradictions were identified here by the students themselves in their behavior as while they had participated in a recycling program, and they claimed that they wanted to help the environment they did not properly manage their waste on the school premises. Another contradiction students identified here, was cooperation problems in their relationships they would like to face.

In addition, at this level, the first stimulus (for the teacher's transformative procedure), emerged, regarding the way in which the teacher could transform her practices and actions, to ascend from an applier of ready-made practices to a designer and creator of her own actions, so as to respond to needs of her students.

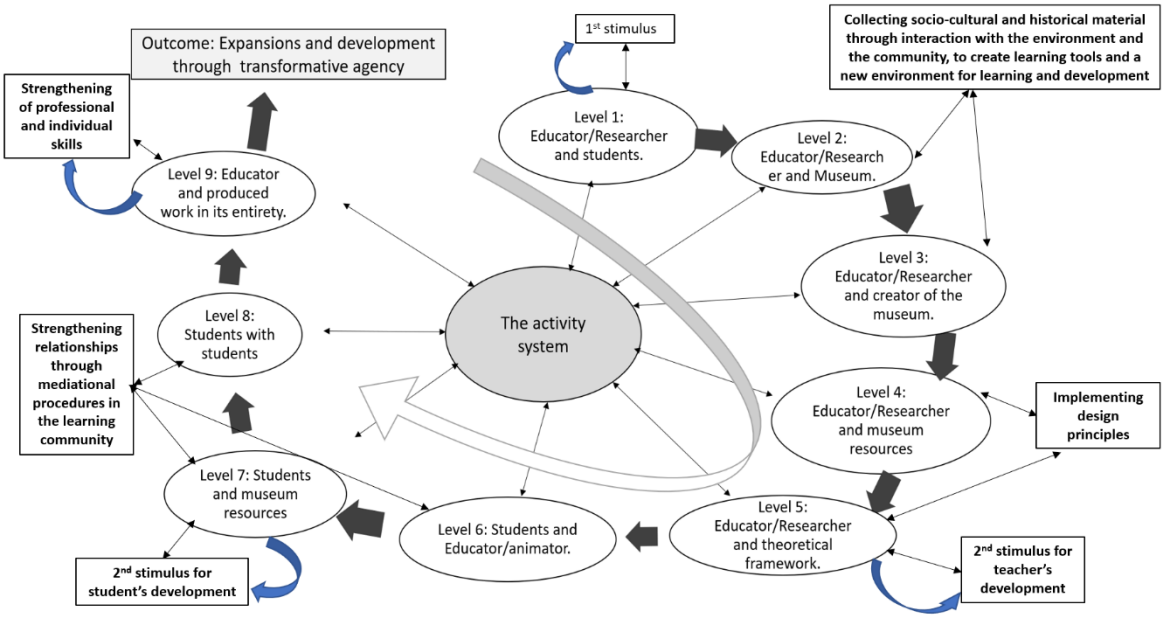

Figure 4. Analysis of the Transformational Process to the Activity System

2nd interaction: The Teacher / Researcher and the Museum. By studying Museum resources and creating "bridges" between artefacts and concepts, the researcher gathered socio-cultural and historical material to create the new environment for learning and development.

For this purpose, the researcher considered the Museum of Contemporary Art Th. Papagiannis, as a suitable place, due to the nature of the materials of his exhibits (useless materials, recyclable, collected from landfills and yards), the subject matter of its works of art, and the possibility for indoor and outdoor activities, as well as the embodied experience of the community, in the museum. The researcher visited the Museum about three months before the implementation of the program (November 2020). During the first visit, she researched, recorded, and categorized the museum resources, and following her original idea, she organized the first plan of her educational program.

Then, she planned the development of the activity by defining study stations based on the objectives of the program. For each study station she formulated questions on worksheets (for the students) in the form of a “hidden treasure hunt” and quest game.

Each study station had a specific purpose (e.g., the initial station was the works of art in the courtyard of the Museum, with the aim of highlighting human attitudes towards the natural world and the use of materials. The next station was placed on the entrance stairs of the Museum, where the exhibits, in the form of mythical creatures, were explored as symbolic

entities for nature).

All the information from the field study was recorded, studied, analysed, and transformed into educational material under the design principles (Table 1) and the CHAT analysis tools (triangular model, double stimulation, conflicting stimuli, and motives) (Figure 2 & Table 4). Design tools and CHAT's tools were the 2nd stimulus for the development of teacher's skills (Table 3).

3rd interaction: The Researcher / Teacher and the Founder / artist of the Museum. About fifteen days after the first visit to the Museum, the artist/founder of the Museum, Th. Papagiannis, gave a semi-structured interview, with open-ended questions, to the researcher.

The aim of the interview was to highlight the meanings and messages (environmental, social, etc.) that the artist incorporated in his works of art, and in general his philosophy, values and influences from artistic or environmental movements that were embodied in his works.

From the recording of the interview data it appeared, that the purpose of the founder was to "house" in the Museum his own memories and experiences, those of the community and the place, in the form of works of art. Beyond their materiality, and transformed into art, they function as carriers of concepts and meanings. In addition, taking on artistic, environmental, folklore and historical dimensions, they convey cultural and historical elements, while highlighting the uniqueness and history of the local environment, local materials, and the community. Reference to problems of the environment and sustainable management of raw materials in the past and today, through symbolic forms, were the founder's goals.

4th interaction: The Researcher / Teacher and the Museum resources. The data of the interview were used to update and enrich the initial plan of the educational program, to meet the possibilities of the space, to incorporate the objectives of its establishment and to meet the needs of the students. Through this process the museum resources were transformed into potential teaching tools through the mediation of the teacher. The didactic transformation emerged from this procedure.

5th interaction: The Researcher / Teacher and the Theoretical framework. At this level, the empowerment, and transition of the teacher from the role of implementer to the role of designer of educational activities came out through the mediation of the methodological framework.

The teacher/researcher was transformed mentally, by studying the theoretical framework, by reflecting on the stages of material processing, by applying design principles, but also by communicating and interacting with the space, the objects, the materials and their stories, with the founder of the Museum and his philosophy and, primarily, with the students, whose educational and social needs she, ultimately, aimed to serve. The transformations and mental modifications were an internal, ideological, and emotional reorganization of the researcher. The theoretical framework provided the teacher with useful tools (2nd stimulus-for the teacher) to strengthen her professional and personal skills.

6th interaction: The Students and the Teacher / Animator. At this level we can identify the

strengthening of the relationships of the members of the learning community with mediated activities in the field.

During the implementation of the program, the researcher takes on the role of animator. She encourages, guides, and accompanies students on their exploratory journey to the Museum. At the same time, she takes on the role of observer. In this role, she observes the students, their interactions with each other or with the people, the space, and the artifacts of the Museum. She records the relationships, the quality of communication, the reactions, analyzes them, receives the messages of dysfunctional relationships, and organizes their management. The task for the researcher is to hear and respond to the message. From this level, the researcher has to consider how she can handle children's messages that are often unclear, and perhaps contradictory to what they appear on the surface. For example, when a child is removed from the group and isolated or withdrawn from the activity for some time.

7th interaction: Students and Museum resources through the mediation of the educational program. At this level we analyze how the students experienced the discovery process in the Museum. This experience concerned students' interaction with the museum resources, the materials, and the ideas that emerge through them for concepts of sustainability (reuse, characteristics of materials, memories through materials, second life of materials / as artefacts, values, and cultural elements of the community).

Guided by the mediation with the objects and tools of the activity and through actions, hypotheses, conclusions, and reflections, the acting subjects (as participating and interacting active beings) are transformed mentally, cognitively, socially, and relationally. The above is the 2nd stimulus for the students and seeks to respond to the initially problematic situation (1st stimulus) of the activity.

After being discussed with the students in the classroom, where its implementation was simulated (a process that functioned as a pilot application), the Educational Program was discussed again, in detail, in the courtyard of the Museum.

After the necessary explanations for the rules of operation, and the roles within the groups (which were decided by the students in the classroom), the students moved freely around the Museum premises. The evolution of the process took the form of a game.

During the teaching intervention, the students explored the works of art, materials, and space to respond to the "hidden treasure game". Commitment to the rule's framework led students to behave responsibly, mediated both by the tools of the activity (teaching techniques) and by their interaction with the "other" (classmates, learning community).

The students enjoyed their participation, moved freely around the Museum, "absorbed" in the activities of the "hidden treasure" and behaved as in their own, free game. Their impressions and feelings were captured with visual expressions, sketches and verbally (in the form of texts) on worksheets and assessment tests. Students' interaction with the activity was valued by them as an experience they will never forget.

8th interaction: Students with Students. The students worked in groups of two and three

(more) and in plenary meeting (less). The groups were formed by the students themselves who chose to work with a classmate, who, until then, they had not developed relationships with, to get to know each other better through joint action in the activity. More specifically, the goal was to strengthen relationships, develop collaboration, and produce collaborative writing. The students' interaction in participatory activities in the field led to the improvement of their relationships as they themselves noted that "they all learned together" and developed "cooperation".

9th interaction: The Educator and the produced work as a holistic approach. The last stage is metacognitive and concerns the interaction of the researcher with the final produced work of the research process. The researcher, reflecting on the overall process and studying the research findings, is led to conclusions on how to handle the research method, the management of the student group needs, the definition of research questions, methodological tools, the results produced, the role of each factor of the activity in terms of their expansive and transformative dynamics but also the techniques she used.

In this way, ideas, and new models for the elaboration of corresponding topics in the future are highlighted, as well as ideas for ways of applying the research findings in the daily educational practice of the school.

The result of this interaction seems to be the qualitative upgrade of the researcher's educational practice and the development of self-literacy. The result can also be the presentation of her experience as a proposal for implementation in the educational community with the aim of expanding the application of innovative practices. Another result is the submission of a proposal for the integration of art spaces and museums in the daily practice of the school community and their connection with the curriculum and the needs of the learning community.

3.2. The Design Principles

Table 1. Design Principles of the Educational Program

Design Principles of the Educational Program	
What to do	A structured activity with actions to develop transformative agency for sustainability issues in an innovative learning environment.
For whom	For 11-year-old students who have already studied sustainability issues at school.
Why	Aiming at sustainability and environmental literacy, the cultivation of Thought for the Life Cycle of Materials (TLCM) and developing relationships between the learning community.
Location	In a Museum of Contemporary Art.
How	With the mediation of the Museum's artefacts that have been created with a variety of materials at different stages of their lives.
With which tools	a) With a discovery “game of hidden treasure” in the Museum. b) With collaborative creative writing with heroes the works of art of the Museum. c) By communicating with the people of the Museum. d) By implementing the museum resources that have been transformed into educational tools.
In what order	With study stations on the premises of the Museum designated by the researcher but also, with free movement around the area.

According Engeström (2007), the use of mediating tools by the educator connects different epistemic levels of mediation, addressing questions of what to do, how, in what order, in which location, why, where etc. For the design of our program, we followed such design principles, their summary is presented in Table 1.

3.3 The Double Stimulation of Our Intervention

The present study comes as an attempt to understand the dynamic interactions and the development of transformational practice in the structured system of activity, and to the teacher / researcher who is simultaneously the designer of their own actions. The interactions are examined as to their relationship with the CHAT's design and analysis tools. Also, in the present study we attempt the identification of these tools in the system of the activity at the Museum of Contemporary Art, according to two levels:

a) The first level which is concerned with the formative transformation of students at the Museum. For this level, first and second stimuli are presented in Table 2.

Table 2. Double Stimulation for Student's Transformative Agency

Double Stimulation for Student's Transformative Agency	
First stimulus	The students did not incorporate and did not apply sustainable practices to waste management in the school's daily routine at a satisfactory level, even though they had participated in a recycling program the previous year.
Second stimulus	An educational program for the Life Cycle of the materials, experientially, in a new learning environment (Museum of Contemporary Art) enriched with mediating learning tools.
The second stimulus provides participants with the tools to overcome the difficulties and find themselves close to positive outcomes in terms of the goals pursued.	

b) The second level, which is concerned with the teacher's metacognitive analysis of her agency, about her transformational experience from an "implementer" to a designer, and about the interconnected transformations of all the actors in the activity. For this second level, the first and second stimuli are presented in Table 3.

Table 3. Double Stimulation for Teacher's Transformative Agency.

Double Stimulation for Teacher's Transformative Agency	
First stimulus	The teacher seeks ways to meet the needs of students in new learning environments and to develop professional skills and transformative agency
Second stimulus	Design tools and CHAT's tools.
The second stimulus provided the teacher with the tools to overcome the difficulties and find close to positive results in terms of the goal of developing professional skills and self-literacy.	

3.4 Stimuli and Conflicting Stimuli – Motives and Conflicting Motives

Moreover, following Sannino's (2015, p. 10) and Hopwood's (2020, p. 3) model, stimuli and conflicting stimuli, motives and conflicting motives were identified and defined in the teacher's transformational process on three topics, presented in Table 4. This comes as an effort to trace the path of the double stimulation, and its hints of the less visible tracks, which lead to the fully visible tracks of mediation by symbolic tools (Sannino, 2015, p.12).

Table 4. Conflicted Situations in Teaching System of Activities.

Activity	Stimulus	Motive	Conflicting stimuli	Conflicting motive
Development of transformative practice	The teacher needs to plan activities for the needs of his students	The teacher should develop design skills and related knowledge	The usual practices so far want the educator to be a simple implementer of ready-made programs	Teachers to avoid the ease of applying ready-made practices and to develop skills and volition to create and to act transformatively
Creating bridges between artefacts & concepts	The teacher to function as a researcher and creator	The teacher should be able to discover the potentials of the environment and to connect them with the concepts that they have set as a goal in their teaching	The teacher, usually, at the museum does does not create, only implements activities that are already made for a random group of students. Teacher does not organize and does not spend individual time	The teacher, to avoid the implementation of ready-made activities which have been created for the needs of a random group
Cultivation of relationships and interactions between the subjects of the activity	The teacher to function as a member of the community	To create a culture of community learning & to cultivate interactive relationships between the subjects of the activity	The usual practice in schools concerns individual work for individual evaluation	Lack of training for joint action aimed at collective development

4. Discussion

This study showed that the design activity allowed the teacher to analyse and reflect on her work practice, to develop skills and new innovative ideas for future learning activities as well as her individual and professional skills. The dual objective of the activity set out in the present study concerned:

a) the teacher who designed under the mediation of the space, the materials, the embedded ideas, the people of the museum, the needs of the students, and the theoretical framework and its tools. Through this network of interacting factors, the teacher developed her professional skills and self-knowledge.

b) the students who have learned and developed by playing with their peers, through the mediation of the curriculum, space, materials, and embedded ideas and meanings, the teacher / designer and animator, in a zone of proximal development, in an alternative learning environment. In this context of interactions and actions the students created meaning, developed their social and individual skills, and gained knowledge.

The use of methodological design tools and the analysis of the factors of the activity, the interactions between them, the contradictions, the methodological principles (double stimulation, germ cell) created a new framework of understanding for the teacher.

An expansive activity that took place between two systems of activity, the School, and the Museum was also studied. Achieving transformative practice in educational activities in these two systems and expanding its application could have an impact on the wider context of the overall Educational System, which could be considered as a third system of the activity.

5. Conclusions

We presented the analysis of a design intervention in an educational activity taking place in an innovative learning environment. This analysis allowed us to answer the research questions that were set at the beginning of this paper and concern: a) how the design process under the CHAT methodological framework affects the teacher / designer in their daily practice and b) what interactions and transformations affect the whole system and the factors of the activity.

Regarding the first question, the article agrees with Holzman (2016), that the design of activities and the creation of new learning and development environments is an innovative and substantial challenge for teachers. It is a continuous process of development and evolution that takes place within the socio-cultural environment that the participants themselves (teacher, students, etc.) create. For the creation of such environments, the use of auxiliary design and analysis CHAT tools leads the teacher-designer to personal development but also provides the opportunity for critical reflection and reformulation of their professional practices and therefore leads them to professional development. CHAT design and analysis tools, as analyzed in Table 1 (design principles), Table 2 & 3 (double stimulation) and Table 4 (conflicted situations and motives), are a solid basis for educational design and clear

definition of the structural terms of each activity and analysis of how learning develops. They are also particularly effective when the designing of interventions is based on the learning profile and the needs of the team to which they are addressed, as supported by the relevant literature (Severance, Penuel, Sumner & Leary, 2016; Augustsson, 2020; Morselli, 2021).

In our intervention, the methodological context (Figure 2 & Figure 4 - the factors of the activity and the cycle of transformational process to the activity system) helped the educator make new connections between ideas, situations, practices, and embodied actions and find new possibilities for acting as a designer with tools that help in resolving conflicts (Table 4). All the above led to changes in diverse situations, such as new forms of collaboration in educational situations in non-typical environments, including changes in the educator's sense of self. Transformative agency can emerge when educators put auxiliary tools to use expansively to promote new understandings and new actions in several environments for learning, leading educational procedures to epistemic developments, as argued by Hopwood & Gottschalk (2020).

Regarding the second question about the interactions and transformations in the activity system (Figure 3 and 4), the article agrees with previous articles (Sannino, 2008) that metacognitive actions can help in understanding the changes and the factors that lead to changes but also in consolidating any change after long-term implementation. A new situation with diffusion throughout the activity system and the systems interacting with it can arise after long-term active participation in corresponding activities. The responses of students (11-12 years old) who participated in such interventions for an extended period describe long after the intervention that it was "… an experience I will never forget" or "… it was the best program I experienced throughout the school". In addition, in discussions after the intervention, the students suggest the implementation of other similar actions outside the classroom because, as they claim, "… they help us to bond as a group and to resolve the differences between us". Finally, the specific students, after participating in respective interventions at repeated intervals, seek to participate in activities of a discovery, interactive nature and are able to suggest interesting and original activities. This gives the teacher the opportunity to expand the activity in the direction of co-designing.

From the above, qualitative transformations emerge in the overall system of the activity and in each of the factors (teacher, students, learning community) involved in it, as supported by the literature (Yamazumi 2009; Haapasaari, Engeström, & Kerosuo, 2016), while at the same time it seems that the educational work, the quality of life and the quality of the relationships in the school community are being transformed. However, strong data can emerge only after longitudinal implementation of such educational activities with the use of transformative agency tools.

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The research on which this article is based took place at the Museum of Contemporary Art Th. Papagiannis, which is in the village of Elliniko, Ioannina (Greece). It is structured according

to modern conceptions of art, with strong historical, folklore, ecological references through the experiences of the sculptor and founder Mr. Th. Papagiannis. The Museum hosts sculpture symposia, a variety of activities for the community as well as for schools. We are grateful to Th. Papagiannis for the valuable information and his permission to carry out the investigation.

References

Augustsson, D. (2020). *Expansive design for teachers. An activity theoretical approach to design and work integrated learning.* University West, Department of Social and Behavioral Studies, Division for Educational Science and Languages. Sweden.

Daskolia, M., & Grillia, P. (2012). Important Life Experiences as parameters of our relationship with the environment. A review of their contribution as a research field in the context of environmental education for sustainability. In E. Protopapadakis & E. Manolas (Eds.), *Environmental Ethics, Challenges and Prospects for the 21st c.* Democritus University of Thrace, Department of Forestry & Environmental Management and Natural Resources, 51-63. Orestiada: Publications of Democritus University of Thrace.

Edwards, A. (2017). Revealing Relational Work. In Working Relationally in and across Practices: *Cultural-Historical Approaches to Collaboration*, edited by A. Edwards. 1-21. Cambridge: Cambridge University Press. https://doi.org/10.1017/9781316275184.001

Engeström, Y. (1991b). Non scholae sed vitae discimus: Toward overcoming the encapsulation of school learning. *Learning and Instruction: An International Journal, 1*, 243-259. https://doi.org/10.1016/0959-4752(91)90006-T

Engeström, Y. (1993). Developmental studies of work as a testbench of activity theory: The case of primary care medical practice. In S. Chaiklin & J. Lave (Eds.), *Understanding practice: perspectives on activity and context* (pp. 64-103). Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511625510.004

Engeström, Y. (1999a). Innovative learning in work teams: Analyzing cycles of knowledge creation in practice. In Y. Engeström, R. Miettinen, & R. Punamaki (Eds.), *Perspectives on Activity Theory.* New York: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511812774.025

Engeström, Y. (2001). Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work, 14*(1), 133-156. https://doi.org/10.1080/13639080020028747

Engeström, Y. (2007). Enriching the Theory of Expansive Learning: Lessons from Journeys toward Configuration. *Mind, Culture, and Activity*, *14*(1-2), 23-29. https://doi.org/10.1080/10749030701307689

Engeström, Y. (2011). From design experiments to formative interventions. *Theory and*

Psychology, *21*(5), 598-628. https://doi.org/10.1177/0959354311419252

Engeström, Y. (2015). *Learning by expanding: An activity-theoretical approach to developmental research* (2nd ed.). Cambridge, UK: Cambridge University Press.

Engeström, Y. (2019). *Expansive learning and concept formation: cycles, germ cells and formative interventions. Keynote at International Conference ISCAR, Crisis in Contexts, March 19- 24*. Ioannina. University of Ioannina.

Engeström, Y. (2020). Ascending from the abstract to the concrete as a principle of expansive learning. *Psychological Science and Education*, *25*(5), 31-43. https://doi.org/10.17759/pse.2020250503

Engeström, Y., Nummijoki, J., & Sannino, A. (2012). Embodied Germ Cell at Work: Building an Expansive Concept of Physical Mobility in Home Care. *Mind, Culture, and Activity, 19*(3), 287-309. https://doi.org/10.1080/10749039.2012.688177

Engeström, Y., Kajamaa, A., & Nummijoki, J. (2015). Double stimulation in everyday work: Critical encounters between home care workers and their elderly clients. *Learning, Culture and Social Interaction, 4*, 48-61. https://doi.org/10.1016/j.lcsi.2014.07.005

Engeström, Y., & Sannino, A. (2010). Studies of expansive learning: Foundations, findings, and future challenges. *Educational Research Review*, *5,* 1-24. https://doi.org/10.1016/j.edurev.2009.12.002

Engeström, Y., & Sannino A. (2020). From mediated actions to heterogenous coalitions: four generations of activity-theoretical studies of work and learning. *Mind, Culture, and Activity, 28*(1), 4-23. https://doi.org/10.1080/10749039.2020.1806328

Haapasaari, A., Engeström, Y., & Kerosuo, H. (2016). The Emergence of Learners' Transformative Agency in a Change Laboratory Intervention. *Journal of Education and Work, 29*(2), 232-262. https://doi:10.1080/13639080.2014.900168

Holzman, L. (2016). *Schools for Growth. Radical Alternatives to Current Educational Models.* Routledge. New York.

Holzman, L. (2018). Zones of Proximal Development: Mundane and Magical. In J. P. Lantolf, M. E. Poehner & M. Swain (Eds.), *the Routledge Handbook of Sociocultural Theory and Second Language Development*. Routledge Handbooks in Applied Linguistics.

Hopwood, N., & Gottschalk, B. (2017). Double stimulation "in the wild": services for families with children at-risk. *Learning, Culture and Social Interaction, 13,* 23-37. https://doi.org/10.1016/j.lcsi.2017.01.003

Hopwood, N., & Gottschalk, B. (2020). From volitional action to transformative agency: double stimulation in services for families with young children. *Pedagogy, Culture & Society, 30*(1), 35-52. https://doi:10.1080/14681366.2020.1805494

Huizinga, T., Handelzalts, A., Nieveen, N., & Voogt, J. M. (2014). Teacher Involvement in Curriculum design: Need for Support to Enhance Teachers' Design Expertise. *Journal of*

Curriculum studies, *46*(1), 33-57. https://doi.org/10.1080/00220272.2013.834077

Kyza, E. A., & Nicolaidou. I. (2017). Co-designing Reform-based Online Inquiry Learning Environments as a Situated Approach to Teachers' Professional Development. *International Journal of CoCreation in Design and the Arts, 13*(4), 261-286. https://doi.org/10.1080/15710882.2016.1209528

Morselli, D. (2021). A three-levels analysis of double stimulation in a Change Laboratory. *Journal of Workplace Learning, 33*(7), 505-522, https://doi.org/10.1108/JWL-08-2020-0128

Nastou, M. (2019). Experiential field actions as life-learning experiences and a value-forming factor in day-to-day educational practice. In Plakitsi, K., Kolokouri, E., Kornelaki, A. C. (Eds.), *ISCAR 2019 e-proceedings*, pp. 331-344.

Nuttall, J., Thomas, L., & Henderson, L. (2018). Formative interventions in leadership development in early childhood education: the potential of double stimulation. *Journal of Early Childhood Research, 16*(1), 80-91. https://doi.org/10.1177/1476718X16664555

Plakitsi, K. (Ed.). (2013). Activity Theory in Formal and Informal Science Education. Series: Cultural perspectives in science education: research dialogs. Series editor: K. Tobin, City University of New York, USA, and C. Milne, New York University. Editor and Co-authors: ATFISE group of the University of Ioannina (K. Plakitsi and PhD students). Rotterdam: Sense Publishers.

Plakitsi, K., Stamoulis, E., Theodoraki, Ch., Kolokouri, E., Nanni, E., & Kornelaki A. (2018). *The Activity Theory & the Natural Sciences. A new dimension in STEAM education.* Gutenberg. Athens.

Portes, P. R., Smith, T. L., Zady, M. F., & Del Castillo, K. (1997). Extending the double stimulation method in cultural–historical research: Parent-child interaction and cognitive change. *Mind, Culture, and Activity, 4*(2), 108-123. https://doi.org/10.1207/s15327884mca0402_4

Roth, W. M., Goulart, M. I., & Plakitsi, K. (2013). Darkness|Light. In Roth, W.-M., Goulart, M. I. M., Plakitsi, K., *Science Education during Preschool Years. A Cultural-Historical Approach.* Dordrecht, 111-138. The Netherlands: Springer.

Sandell, K., & Öhman, J. (2010). Educational potentials of encounters with nature: reflections from a Swedish outdoor perspective. *Environmental Education Research, 16*(1), 113-132. https://doi.org/10.1080/13504620903504065

Sannino, A. (2008). Sustaining a non-dominant activity in school: Only a utopia? *Journal of educational change, 9*(4), 329-338.

Sannino, A. (2015). The Principle of Double Stimulation: A Path to Volitional Action. *Learning, Culture and Social Interaction, 6*, 1-15. https://doi.org/10.1016/j.lcsi.2015.01.001

Sannino, A., & Engeström, Y. (2016). Relational Agency, Double Stimulation and the Object of Activity: An Intervention Study in a Primary School. *In Working Relationally in and across Practices: Cultural-Historical Approaches to Collaboration,* edited by A. Edwards. 58-77. Cambridge: Cambridge University Press. https://doi.org/10.1017/9781316275184.004

Sannino, A., Engeström, Y., & Lemos, M. (2016). Formative Interventions for Expansive Learning and Transformative Agency. *Journal of the Learning Sciences, 25*(4), 599-633. https://doi.org/10.1080/10508406.2016.1204547

Sannino, A., & Engeström, Y. (2017). *Co-generation of societally impactful knowledge in Change Laboratories. Management Learning, 48*(1), 80-96. https://doi.org/10.1177/1350507616671285

Severance, S., Penuel, W. R., Sumner, T., & Leary, H. (2016). Organizing for teachers Agency in Curricular Co-Design. *Journal of the Learning Sciences, 25*(4), 531-564. https://doi.org/10.1080/10508406.2016.1207541

Valsiner, J. (2000). *Culture and human development.* London: Sage.

Vygotsky, L. S. (1978). *Mind and society. The Development of Higher Psychological Processes*. Cambridge: Harvard University press.

Vygotsky, L. S. (1978$_b$). *The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1987). *The Collected Works of L.S. Vygotsky. Problems of General Psychology, 1*. New York: Plenum Press.

Vygotsky, L. S. (1997). Self-control. In R. W. Rieber (Ed.), *the collected works of L. S. Vygotsky: The history of the development of higher mental functions*, *4*, 207-219. Plenum.

Yamazumi, K., (2009). Not from the Inside Alone but by Hybrid Forms of Activity: Toward an Expansion of School Learning. *Actio: An International Journal of Human Activity Theory, 2*, 35-55.

Zachariou, A., Kaila, M., & Katsikis, A. (2008). Sustainable School: Findings, Aspirations and Prospects. *Science and Technology in Education, 1*(3), 269-288.

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