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Applications of Experiential Learning in Science Education Non-Formal Contexts

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Abstract

Education represents a process in constant evolution, which continuously adapts its structure and vision, objectives and strategies in order to successfully meet the challenges and significant changes occurring in society, but also in the psychical structure of its actors. As a suitable alternative to traditional learning, the experiential learning directly capitalizes skills and attitudes related to critical thinking and problem solving, being less anchored in mechanical learning and memorizing.

The experiential learning includes learning by doing, through experience, through exploration and discovery, having the aim to teach the student how to learn, to develop his/her skills by individual work, to emphasize his/her creativity and originality, but also its self-confidence.

The paper has an exploratory character, its aim being to discover how experiential learning can influence the student's motivation, knowledge transfer, creativity, self-confidence and how may be created learning opportunities, which can influence development of metacognitive skills, practical and independent work skills, exploratory skills and efficient learning through non-formal activities. The paper also highlights on the students' perception related to their involvement in a series of non-formal activities, organized in the frame of the EU FP7 project entitled: "*IRRESISTIBLE - Including Responsible Research and Innovation in Cutting Edge Science and Inquiry-based Science Education to Improve Teacher's Ability of Bridging Learning Environments*", and dedicated to the promoting of cutting-edge scientific subjects, together with the disseminating of *Responsible Research and Innovation* (*RRI*) dimensions. The feed-back offered by the students - who expressed their degree of interest and their openness to such activities - led to the conclusion that those contexts could create proper opportunities to facilitate the knowledge transfer, emphasizing more on developing practical skills and producing a sustainable learning.

Keywords: Experiential learning, non-formal activities, students' feed-back, IRRESISTIBLE Project.

1. Introduction

Starting with the second half of the past century, the research in the area of education has focused increasingly on the experiential learning issues. Among those who considered this type of learning as an efficient alternative to the traditional model, we can mention important pioneers as: J. Dewey, K. Lewin, D. Kolb and C. Rogers. As principle, this type of learning relies on the practical aspects, the experience being considered the key of success in the educational act. This approach based on experience turns to good value the student's individuality, develops his/her action skills, reflection skills, critical and innovating thinking, initiative, motivation, curiosity and the trust in his/her own person. In other words, the experiential learning offers to the students the chance to become active co-participants of their own training.

2. The Experiential Learning

The experiential learning (known also as the learning based on experiences) represents the way in which students' direct experiences can be turned to good use, in order to realize an efficient and sustainable learning. By action, by exploration, by discovery, by active participation, the metacognitive skills, through individual and collective work, begin to be developed, being useful for the students not just during the tuition process, but also later on, in their life. The theories in this area have tried to explain different perspectives on the way this learning takes place, yet the complexity of the phenomenon determined the appearance of several directions and conceptions regarding the learning as a feasible and effective process. The theory lying at the basis of this type of activity based on experience is a constructivist one and can be expressed briefly by the principle of *learning by doing* (Cocoradă, 2010). The specific of this constructivist theory is the fact that students are considered active partners in the learning process, previous experience being the fundament on which the present learning is built. In addition, learning by cooperation or collaboration with other students becomes more efficient and the learning tasks are connected to the real world, in which students are living (Perkins, 1999).

John Dewey (1938) is the one who attributed for the first time to *experience* a fundamental role in learning, considering that *learning from experience* or *learning by doing* is an important key to reach the success in education. In his works, he highlighted a progressive approach of education, profitably using the specific and individuality of the students and giving them freedom of experimentation and discovery to attain a projected aim and a clear finality which can be found in the real life. Dewey considers that learning by experience requires going through certain steps or stages on the mental level, such as observing an event, remembering a similar previous experience and reflecting on or evaluating the importance of the experience. The psychological mechanisms by which learning is realized (in the brain, as a process) involves organizing and structuring the new knowledge into connected concepts networks, the new knowledge being connected or linked to the previous knowledge. The learning involves the construction of mental models (schemes) in which information gets reorganized; the richer the relations between the new information and the already existing information are, the better the

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knowledge gets engraved and the easier it can then be found and applied in new situations (Wirth & Perkins, 2008)

Kolb (1984) considers also that learning begins at the moment when the student interacts with the environment, having in this respect, a clear experience.

According to Kolb's theory, the process of experiential learning follows a four-stage cycle (figure 1): starting from the concrete experience, then observation and reflection on that experience, which leads to the formation of abstract concepts (analysis) and generalization (conclusions), which are then used to test the hypothesis in future situations, the result being concretized in a new experience. Thus, each stage relies on the previous one.

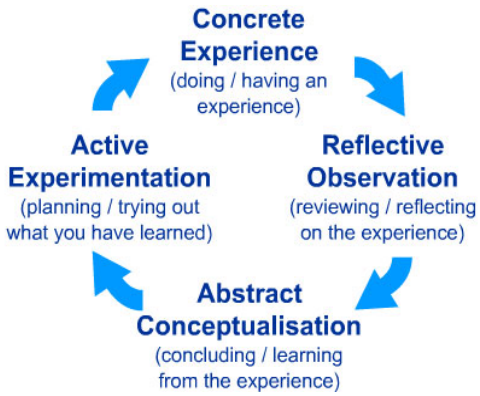

Fig. 1. Kolb's Experiential Learning Cycle

Usher and Solomon (1999) consider that learning by experience takes place in the daily contexts of the life. It relies on the understanding acquired by the aware or unaware interiorization of one's own experiences or of the ones observed, in close connection with the already existing experiences or knowledge. Boydell (1976) considers that experiential learning is synonymous to learning by discovery, which requires the pupil to select and restructure his perceptions regarding events or acts that take place. McGill & Warner Weil (1989) see experiential learning as a process in which the individual - alone or together with others - gets involved in direct activities, in a deliberate manner, in order to reflect, analyse, transform, give a personal meaning and integrate knowledge, consequently discovering possibilities that cannot be obvious in other ways than by direct experience.

The positive attributes of experiential learning can be noticed on the psychical level, especially by the creation of special conditions meant to facilitate learning. The acquisition of the knowledge is realized much easier, because the students seize much better the connections between the theoretical concepts and their applicability, the duration of storage of this knowledge is much longer in time because it relies on logical thinking; the motivation for learning is much greater than in the traditional activities due to the fact that students are involved in experiences which relevance is obvious to them - they are more motivated to learn when they are provided with opportunities for practice, but also a proper feed-back (Ambrose et al., 2010).

Experiential learning develops the student's autonomy. By experiential learning, the students are faced with unknown situations and tasks in a real context. To finish those tasks, the students need to realize what they know, what they do not know and how to learn. This demands the students to reflect on their previous knowledge and go deeper into it by reflection; this is how the transfer of previous

learning into new contexts takes place. Finally, those skills make students learning throughout their life, as autonomous students.

3. The Instructor's Role in the Experiential Learning

In the activities that involve learning by experience, the teacher's (instructor's) role is different compared to the traditional model, in which he/she is like the *authority*, the main task being to transmit the knowledge; thus, the teacher has the role in counselling, selecting the adequate experiences that can be used, offering adequate resources to students, creating conditions of physical and emotional safety and facilitating the learning process. The teacher must recognize and encourage the spontaneous learning opportunities, get students involved in difficult situations, of experimentation and discovery of proper solutions. The teacher helps the students to observe the connections between one context and other, between theory and experience, and encourages the students' initiatives. As methods, there can be successfully used: observation, heuristic conversation, brainstorming, case study, role playing, educational games, simulation, presentation, group-work methods etc.

The teacher needs to carefully choose the experiences with a great learning potential, those situations offering to the students the possibility to practice and go deeper into emerging, gaining new skills, facing unpredictable situations supporting learning, generating learning from natural consequences - even mistakes and successes. The teacher's role in experiential learning is oriented on guiding or facilitating / assisting the students in the learning process.

4. The Student's Role in the Experiential Learning

Throughout the experiential learning, the students - as main participants in the learning process - need to be actively involved, encouraged to present questions, to investigate, to experiment, to show their curiosity, to get involved in solving problems, to assume responsibilities, to be creative, to have initiative, to make decisions and to be responsible for the results. The reflection on learning - during and after the new experiences - represents an essential and necessary component of the learning process. This reflection leads to analysis, turns to good value and develops critical thinking and the synthesis abilities (Boud, Cohen & Walker, 1993). The experimentation in which the students participate helps them to understand theoretical elements and to observe their practical applicability in real life situations.

The students are involved intellectually, emotionally, socially and/or physically, which triggers important changes on the level of the cognitive, affective and social acquisitions. The relations between students are more serried and become stronger.

The students use as basis the previous knowledge on which the new experience is built. In other words, the student is the main beneficiary of the learning activity, setting to the teacher an active role, not a passive one, which makes the students responsible and motivated.

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5. Methodology

Having as main objective to measure the students' perception regarding their involvement in several non-formal activities which proposed a series of experiential learning sessions, undertaken in the frame of the European FP7 project entitled "*IRRESISTIBLE - Including Responsible Research and Innovation in Cutting Edge Science and Inquiry-based Science Education to Improve Teacher's Ability of Bridging Learning Environments*", the research methodology was based on the students' feedback using a dedicated questionnaire, prescribed with the occasion of the activities gathered under the logo of "*Nano-World and its practical applications*", which were organized during the national program "*A Different School: To Know More, To Be Better*" (April 2015). The questionnaire had three pre-established answers to all the items: *do not like*, *indifferent*, *like*. The number of the students involved in the research was 50, all of them from high-school - 25 coming from the 9th form, and 25 from the 10th form. The data processing was realized using the quantitative statistical method, having the format of percentage analysis.

6. Results and Discussion

Following the abovementioned undertaken activities, the students offered a positive feed-back to the experiential situations they participated in, showing great interest throughout the activities carried out and being actively involved in the proposed practical activities.

Students were asked several questions related to their willingness to participate in the experiences proposed during the organized activities. In this sense, it is important to notice the concluded image (figure 2) resulted as their feed-back to the following questions: (a) *Are you ready to perform scientific experiments?* (b) *Are you interested on making research?* (c) *Are you interested on participating in scientific studies?* (d) *Are you interested in performing experiments in a scientific laboratory?* (e) *Do you read books and scientific journals?* (f) *Do you use scientific concepts (learnt in school) for scientific purposes?*

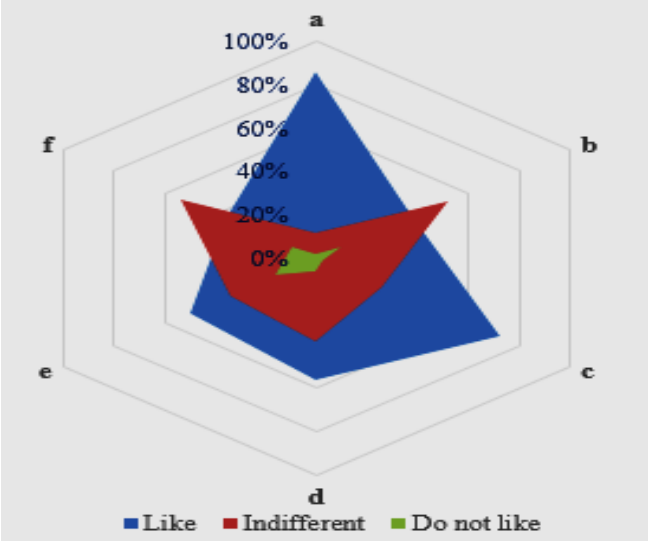

Fig. 2. Distribution of the students' answers concerning their desired involvement in experiential activities and related activities – (a) willingness to perform scientific experiments; (b) interest on making research; (c) interest on participating in scientific

studies; (d) interested in performing experiments in a scientific laboratory; (e) pleasure for reading books and scientific journals; (f) using scientific concepts (learnt in school) for scientific purposes.

As seen in the figure, students' answers were generally favorable for performing experiential activities. Even a great majority like to be involved in scientific experiments (86%), the interest for undertaking research activities is still moderate (38%), and the usage of the learnt scientific concepts in solving scientific problems is also under the expected level (36%). For the other requested issues, it was obtained a good feedback rate (over 50%).

This means that the Romanian teachers' work has to be more oriented on practical aspects, on solving real life scientific problems using the gained knowledge, but also on attracting students to scientific area, minimizing in this respect the number of the students who are indifferent to experimental / research purposes. Explaining the meaning of research represents a provocation also for teachers, but is obvious that the non-formal settings constitute real opportunities which facilitate the knowledge transfer, with a real accent on the development of practical skills with the view to produce sustainable learning.

But the obtained results indicated an important degree of interest for the experiential activities conducted with high school students in the non-formal scientific educational activities, and the positive effects that such activities have in the learning process. Experiential learning develops critical thinking, intrinsic motivation, creativity and originality of student's, desire to learn and skills of independent work and also skills of teamwork.

7. Conclusion

The principles of modern education, derived from the changes that take place at the level of the society, impose the shaping of the educational skills, taking into account the students' personality, being capable to assure their success in the real world. The elimination of the gap between theory and practice, the creation of connections between formal and non-formal/informal education, highlighting the practical character of the taught concepts, can contribute to remove the redundant, useless knowledge and to develop those skills and abilities necessary for the integration on the labor market and to face the life challenges. Those issues suggest that experiential activities can be considered a viable approach in non-formal education, if the key conditions imposed by their specific are respected.

Based on the personal perception of experimentation, this type of learning stimulates the students' ability to motivate and explain a subject, from a personal perspective, in a group. There is no substitute for experience and any experience can be turned into a context generating education.

In the presented case, the students' feed-back provided with the occasion of their involvement in non-formal activities related to the topic of "*Nano-World and its practical applications*" indicated a strong degree of interest and a major openness to this kind of activities. The obtained results can constitute departure points both for future projects related to non-formal/informal activities, but also examples of learning situations that can be integrated into formal contexts.

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