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About Experiential Learning. Example for Higher Education

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Abstract

This paper presents an example of the application of experiential learning in higher education in mathematics. This is one of the actively participatory methods that is of maximum interest to students, but which is applied quite rarely, especially in higher education. The paper contains an overview of the main benefits of interactive teaching strategies, on the advantages and limitations of these strategies. The interactive method of experiential learning is then presented together with how to apply it successfully. Finally, examples of experiential learning activities in mathematics are presented, emphasizing the example for higher education. The conclusion is that experiential learning activities are useful for fixing knowledge in long-term memory, for stimulating a favorable attitude towards learning and for developing critical but also creative thinking. The article will be continued with a study on improving long-term learning using this method and increasing creative thinking.

Key words: Didactic startegies; experiential learning; Mathematics; teaching

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1. Introduction

Education represents "psycho-social activity designed at the level of pedagogical aims aimed at achieving the training- permanent development function of the human personality through a pedagogical action structured at the level of subject / educator-object / educated correlation, carried out in an open pedagogical field" (Cristea, 1998). Perspectives on approaching education focus on three indicators: social, psychological and psychosocial. Relating to these three indicators generates different approaches to education: as a product, as a process and as an activity (Cojocariu, 2007):

- education as a product - essentially reflects the results of education (general and specialized culture, behavior, attitudes, shared values, skills and abilities, motivation, etc.) at the level of personality formation and development.
- education as a process - considers the action of long-term transformation of the human being, from the perspective of explicitly formulated purposes. Education is a specific human process that aims to make the best of the individual's internal potential.
- education as an activity - refers to that set of conscious, systematic actions that an educational subject (the educator) exercises on an educational object (the one who is being educated) in order to achieve a well-defined goal. In optimal conditions, the common and conscious effort of the two actors of the educational act (the educator and the one who is educated) evolves towards a higher stage of education: self-education.

Education is responsible for the actions (deliberate/ unintentional, explicit/ implicit, systematic/ disorganized) of modeling man from the perspective of finalities/ goals anchored in social-historical and cultural landmarks. One of the educational goals of any education system must be the development of efficient, productive, critical and creative thinking. These aspects of thinking will lead to the successful application of theoretical notions in practice. Individuals who think efficiently and productively value both critical and creative thinking. Thus, they think critically to go through a creative process and, conversely, they think creatively to form and develop critical thinking skills.

Referring to the two parts of didactics, modern and traditional, the concept of teaching requires two perspectives:

- in traditional didactics, teaching involves the transmission of information to the educated, the presentation of the subject to be assimilated by the teacher (Joiţa 2003);
- in modern didactics, teaching includes all instructive-educational activities led by the educator, including those aimed at forming emotional, volitional, character psychic qualities; chain of interactions, a process from which the student emerges with a certain personal and social experience (Neacşu, 1990).

Nowadays, in these times when standards are important, many education systems have identified what notions and what content should be taught, at study levels, in certain courses. The year 1998 is the beginning year of the curricular reform in Romania. The result of the first instance of the reform is the elaboration of the new National Curriculum of schools and high schools. For the first time, the curricula are much more flexible and a certain autonomy is given to each educational unit. Even if the learning units are fixed, the teachers have flexibility in the way of organizing and teaching the learning units. There is no optimal way, a perfect recipe for learning unit planning.

The study of Blumenfeld & Meece (1988) corroborated with the statement of Doyle (1983) shows that the design of activities has an impact on school success, and well-chosen and organized complex tasks facilitate the learning and involvement process. At the same time, they come to the conclusion that teachers do not implement these complex tasks even if they have resources and materials at hand, their effort being too great and sustained. Another challenge of education today is to prepare today's pupils so that they can face the future. Today's child/student

will be the adult of tomorrow, able to anticipate future changes, to have in his hand the necessary tools to cope with these changes and to adapt to them. All these involve first identifying problems and after solving them, finding ingenious solutions, using experience in new situations, restructuring the knowledge held, establishing new relationships between them.

The school must form a new active and creative personality, which adapts to the new requirements of society, which is constantly changing. Thus, creativity becomes the core of the learning activity from an early age. The creative potential of the individual is manifested from a very young age in all his activities: in learning (fundamental activity), in playing, in communication activity, through language, in all his daily activities. Grégoire (2016) considered that creative peformance are directly linked by creative potential of a student and education throught intrinsec motivation and original thinking. It is obvious that education may improve other components of the creativity like original ideas, diveregents ideas, flexibility.

Knowing and developing the creative potential of each child becomes the educational purpose for formation his creative personality. For this, the educational act must overcome the closed structures, rigid structures, which are based on algorithmic thinking and which operate in well-defined contexts. To progress you do not have to break completely from the traditional, but you must be permanently open to the new. Sometimes you have to deviate from the usual path, to ask yourself questions, to look for new meanings.

To achieve these goals, the teaching-learning process in school must be creative, emphasize the educator-student relationship, appeal to the creative imagination, activate deep emotional states (Mann, 2006). The teaching process into school must teach the student how to learn. The whole educational process must be focused on stimulating interest in knowledge, curiosity, self-confidence and the need for self-realization. That is why experiential learning should be implemented in schools.

An important place in the study objects, in terms of the influence they exert on the mental development of students, is occupied by mathematics. Mathematics, which uses the logical operations of analysis and synthesis, comparison, abstraction and generalization, problem solving requires the student's thinking. This is because problem solving contributes to maintaining and developing the creative capacities of thinking, to increasing its flexibility, to the anticipatory-imaginative capacities, to the education of insight (Shriki, 2010). When we speak about teaching mathematics we have to think to the main goal of it. The main goal is not to apply formulas or perform calculations quickly (the computer does them faster), but to analyze the problem, solve it creatively, complicate it and find other similar applications.

2. The role of interactive strategies in experiential learning

2.1. About didactic strategies

Active and participatory methods contribute not only to the education of the student, but also to his / her socialization. Jean Piaget pointed out that the transition to active and interactive methods was an objective educational need that emerged as a reaction to the economic, technical, scientific progress of societies. An important role in the lesson/course has the didactic strategy. This is the way in which each teacher approaches learning and teaching, how to combine resources in order to achieve goals. The didactic strategy includes the following branches: the form of organization (frontal, individual, in groups, in pairs), the means of education that are a set of material and technical resources produced, selected or adopted and the methods that represent the necessary way to achieve the objectives of the teaching process. Interactive teaching strategies:

• involve the creation of teaching programs based on the natural need for interrelationship and differentiated response to students' reactions;

• support active learning, the learner transforms the information into his personal grade;

• develops the students' responsibility and increases their degree of participation in the process of building informational meanings;
• develops the self-help spirit of students in the search-research and learning process;
• stimulates individual participation by activating cognitive, affective, volitional and social skills;
• requests and develops students 'ability to adapt to group norms, tolerance of colleagues' opinions;
• develops the self-assessment process.

In the literature are highlighted a number of factors/ variables on which depends the organization of teaching strategies in general and interactive ones, in particular. These factors relate to (Oprea, 2009):

• teacher-dependent variables materialized in the didactic style as a result of the personal pedagogical conception of the teacher, the specificity of the contemporary culture and society and the personality factors of the teacher;
• student-dependent variables - class particularities, group sensitivity, students' cognitive, social, affective-emotional experiences, group size, degree of homogeneity, degree of motivation of students, skills and level of preparation of students for a particular field;
• variables depending on school organization refer to the timetable, school space and material resources involved;
• curriculum-dependent variables that refer to the macrostructural and microstructural purposes of the education system, the degree of accessibility and the ways of controlling their fulfilment, the nature of learning objectives and contents, the degree of adaptability, usefulness and importance of contents for students' activity and life, the learning experiences proposed to the students, the degree of problematization and the required level of interactivity.

2.2. Advantages and limitations of interactive teaching strategies

Interactive teaching strategies increase the degree of student's activism and involvement in the activity. Also, interactivity implies a positive attitude towards human relationships, towards the importance of teamwork and supporting the ideas generated by collaborating with group colleagues. The use of interactive teaching strategies involves diversifying the roles of the teacher, becoming a counsellor, moderator, participant in solving problems and even a member of the work team.

Interactive teaching strategies aim to achieve cognitive level objectives but also socio-affective level objectives such as: developing communication skills, interpersonal and intrapersonal dialogue, stimulating self-confidence, stimulating reflection skills on their own learning approaches - metacognition and stimulating reflection skills on interpersonal relationships, etc. (Oprea, 2009). Also, the interactive didactic strategies emphasize the formative-educational side of the development of the students' personality, offering social opportunities for the formation of character traits, will and perseverance. Interactive teaching strategies require the direct participation of students in rediscovering knowledge through problematization, discovery, collaboration, case study, mutual learning, etc.

The limitations of interactive strategies are mainly due to the demand for a longer thinking time given to students, relationship time, time to present individual/ group ideas, assessment time. Also, interactive teaching strategies require a strong design effort on the part of teachers and a judicious correlation of resources with the methods/techniques and the form of organization of students but also the maintenance of the constant interest of students.

3. What is experiential learning and how does it works

It is well known that teachers in general, and mathematics teachers in particular, use memory as a repository of knowledge. But memory should be used as a support for creativity. Thus, if some teachers aim is to go through the curriculum, others aim is to teach students to think, not just to repeat information. In order to provoke students to think, teachers must challenge them. To do this, math teachers must learn to interrogate creatively about the content to be taught. Questions *Why ?, How ?, Where ?, What is the justification ?, How can I expand the notion?* should be part of their routine. Interrogative exposure will give rise to doubt, doubt will give rise to positive stress that will put pressure on the intelligence and stimulate it creatively. The interrogative exposition conquers first of all the territory of emotion, of logic and only finally of memory. Through interrogative exposition, information is transformed into knowledge, and knowledge into experience (Cury, 2018). Experiential learning is an engaged learning process through which students "learn by doing" and reflecting on experience. Experiential learning activities may include, but are not limited to, practical laboratory experiments, internships, field exercises, studies abroad, university research and studio performances (McDonald, 2020). An old Chinese proverb says: *Tell me and I will forget, teach me and I will remember, get involved and I will learn.*

It is in the pipeline the hierarchy of the most efficient methods (learning pyramid) to fix information in long-term memory:

- teaching others 90%;
- practicing 75%;
- discussing in a group 50%;
- participating to a demonstration 30%;
- listening or watching 20%;
- reading 10%;
- learning by heart 5%.

If this type of learning is widely used in primary and preschool education, the share of use decreases sharply starting with the middle school cycle. This is how the questions arise in the students' minds: why do I need the notion?, what will I use it for?. Experiential learning is the process by which pupils/students learn by doing and reflecting on the experience, especially in today's education conditions when the pupil/student knows that he has the information at a click away (Wurdinger & Carlson, 2010). Thus, experiential learning includes, but is not limited to, laboratory experiments, internships, field exercises, university research, etc. On the other hand, the teacher's question arises: why experiential learning when I can organize a lecture very well? The answer could be that a well-organized, supervised and evaluated experiential learning session can stimulate students' interest in learning, knowledge awareness, but also academic research, civic engagement, interest in career development and other intellectual and professional skills. By learning experientially, students can make analogies and apply theoretical knowledge to real problems that exist in everyday life. Thus, when encountering a similar problem in the future, they will be able to make analogies with the examples and knowledge they have experienced and will find solutions, maybe even creative ones.

Experiential learning is based on reflection, critical analysis and synthesis. It gives students the opportunity to take the initiative, make decisions and be accountable for the results obtained (Cooper et al., 2010). Throughout this learning process, students will engage intellectually, creatively, emotionally, socially or physically. If the experiential activity leads to results with

errors, then there is the possibility to learn from mistakes, the student considering what works and what does not (Voukelatou, 2019). In addition, it can reflect on methods of improvement that he can apply to the next experience to get the desired results.

The experiential learning model was defined by the american psychologist David A. Kolb (1984). He was quick to see the advantages for the positive influence and long-term effects of the learning by doing process. Kolb defined experiential learning as "the process by which knowledge is created through the transformation of experience. Knowledge results from the combinations of grasping and transformation the experience." The experiential learning model introduced by Kolb (1984) involves the integration of acquired knowledge (concepts, notions, information acquired through formal learning), effective activity (application of theoretical knowledge in models, real experiences) and reflection (involves analysis and synthesis of data). Thus, the experience is viewed and understood in two different ways: actual experience and abstract conceptualization. In addition, there are two ways to transform the experience: reflexive observation and reflexive experimentation. Synthetically, Kolb's model is represented in Figure 1.

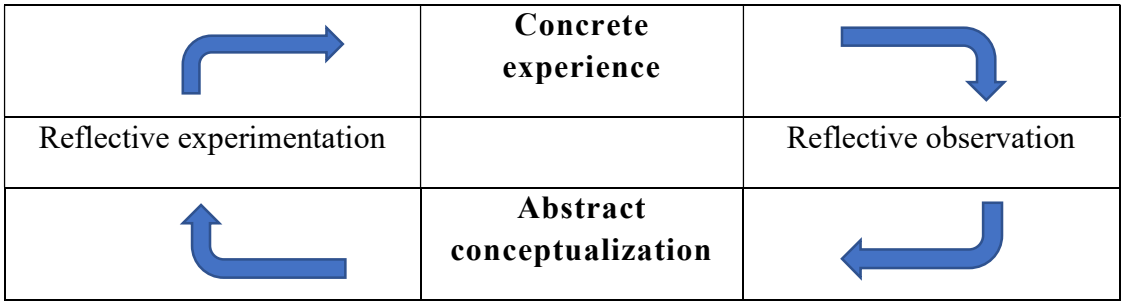

Figure 1. Kolb's Model (Kolb & Kolb, 2009)

According to the Association for Experiential Education (https://www.aee.org/), this type of learning involves the following elements:

- Experiences are carefully chosen for their learning potential (they provide opportunities for students to practice and deepen emerging skills, to encounter new and unpredictable situations that support new learning, or to learn from natural consequences, mistakes, and successes).
- During experiential learning, the student asks questions, investigates, experiments, is or becomes curious, solves problems, takes responsibility, is creative and is challenged to take initiative, make decisions and be accountable for results.
- Reflection on learning during and after one's experiences is an integral component of the learning process. This reflection leads to analysis, critical thinking and synthesis (Schön, 1983; Boud, Cohen & Walker, 1993).
- Students are engaged intellectually, emotionally, socially and / or physically, which produces a perception that the learning task is authentic.
- The relationships with himself, with other students and the world in general are developed.

4. Example of experiential learning for students

From an early age, children learn experientially. Riding a bike is an experiential learning that gradually goes through the 4 steps of the model proposed by Kolb. For preschool education, visiting a zoo for learning by direct observation of animals, in their real life environment, is also an example of experiential learning. Or a visit to the botanical garden is a lesson about the parts that make up a plant and about their life cycle. In primary school, a visit to the market, with a budget and a well-established shopping list for each student, is an experiential learning for monetary units, but also for units of measure for the mass and utility of transformations. A trip can be an experiential learning about the geography and history of the places visited. For middle school education, a visit to a construction site or a location to renovated can be transformed into an experiential learning about calculating surface areas, side areas and total body areas, units of measure and transformations. Also, a shopping session in the market can offer a live lesson about comparing decimal fractions, about adding them.

Personally, I always wanted to be listened (to gain a hearing), not just heard. Being directly interested in the active involvement of students in teaching-learning activities and wanting to prevent questions such as - what do we need? - I set out to apply experiential learning in university education. I chose the second year students from the mathematics study program of Vasile Alcesandri University of Bacau, where I took the course and the seminar on Differential Equations. Thus, I transformed a seminar in which students usually solve algorithmic differential equations into an experiential seminar.

I started the course. I gave a lecture on first order linear differential equations with the corresponding theory and as an example I considered Newton's law of cooling. I stated it physically, I discussed it and transcribed it in mathematical language and using the theory we found the solution. And of course, the question arose: what do we need? So at the seminar that was immediately after, taking advantage of the fact that about 10 students were present at the mathematics class, I armed myself with 2 thermoses with hot water, tea, hot chocolate, instant coffee, 2 thermometers that measured up to at 100° C, glasses and cups for everyone. And I invited them to serve what they wanted. The aim was to associate the experimental learning process with a pleasant activity so that students remember in time the experience they had. As the water was hot, they could not do so immediately. The water had to cool so the cooling law started to work. The ten students were divided into two working groups and we considered the text of a problem with spaces to fill in.

In the seminar room we have a constant temperature of _____° C. A cup of coffee cools in minutes from _____° C to _____° C.
Determine how long it takes until the coffee reaches 35 ° C, to be consumed with pleasure?

The students were trained to fill the blanks with their own data, measured by them, after we poured hot water into 2 work cups (one for each team) and introduced the thermometer. They were trained also with the rules for labor protection, but also with the correct way of reading the thermometer in order to minimize errors (great care must be taken when reading the thermometer - not to get out of the water because larger errors occur in the calculation).

The ambient temperature was read from the classroom thermostat.

Because the measured and mathematically calculated results were very close, the students were very excited.

Example of the result obtained

By measurements		**By calculation**
T_i=65°C	28 minutes 40°C	*k = 0,0311*
39	**11minutes** **minutes**	*t = 28minutes+10minutes 45seconds*
T_a=22°C	T_f= 35°C	*t = 38minutes 45seconds*

To promote critical reflection during the proposed experiential learning, I used the simple and practical questions from the questionnaire proposed by Jacobs and Ruddy (Jacobson & Ruddy, 2004):

1. Have you noticed ....?
2. Why did this happen?
3. Does it happen in other situations?
4. Why is this happening?
5. How can you use this?

Thus, the students found other real examples in which the differential equations can be used. It all culminated to the possibility of determining the time at which a certain crime was committed. As a curiosity, I told them that the writers of detective novels know that maintaining a high body temperature can lead to the wrong calculation of the time of death. In this manner the main character will be able to create a suitable alibi to escape. I have shown them a reading book in which the writer uses this law of Newton to create an alibi for a character - Federico Axat - The Last Escape.

Conclusions

It is obvious that modern and current teaching-learning styles are creative. Some teachers find it harder to accept, others easier. Some teachers show more flexibility in teaching than others. They accept new ideas and experiences, show courage, are more independent in thinking and teaching, but at the same time take risks (such as those related to the volume of content taught). The teacher's desire to apply new practices is marked by traits such as collaboration, cooperation, trust in others (Wubbels *et al.*, 1999). In terms of benefits for students, experiential learning initiates deep and lasting connections with course material, supports students' motivation for learning, increases the impact of emotion on learning, and promotes critical reflection learning, strengthens collaborative relationships among collegues. The student will have the information fixed in the long-term memory and will be able to find solutions, sometimes creative, to other problems that occur in real life. He will have the opportunity to reflect on how his result is related to theory and how it is different from that of his colleagues. This analysis will help him understand how he will be able to apply the concepts learned in other real situations.

In addition, analyzing mistakes will make them understand that some methods work better than others. Mistakes will no longer be feared, but will themselves become an element of learning. The article will be continued with a study on improving long-term learning using this method and increasing creative thinking.

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