



# METHODOLOGY

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OF

COLLABORATIVE LEARNING

*(The Collaborative Methodology)*

Math & Motivation Project  
№: 2017-1-BG01-KA201-036220

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## INTRODUCTION

The knowledge and skills acquired through the education process lie on the basis of the development of modern society. Thus, the rapid progression of today's world needs gaining the same scope of knowledge and skills in shorter time and adding brand new-ones. This could only happen through applying new approaches and methods in education system to respond to those needs.

Basic knowledge and skills of various complexity are becoming crucially important for the inclusion of the citizens as active members of the society. Reports state deficits in literacy, especially of knowledge and skills in the sphere of maths and natural sciences, which result in serious problems in human's development and maturity, such as social issues, social ignorance, unemployment, social exclusion, segregation, etc.

That is why education is so important for the individual and for the society in general. The educational process takes place basically at school and the school is the institution responsible for pupils to gain that new knowledge and skills through the period of their growth. Education needs a new vision and new teachings methods in order to prevent educational reasons for dropping out of school, such as school environment and organization of the learning process.

Furthermore, the presented Collaborative Methodology developed under the Erasmus+ project is an efficient tool for enhancing the basic skills of the students for improvement of their knowledge and practical skills.



## THE MATH AND MOTIVATION PROJECT

Math & Motivation project (M&M Project), №: 2017-1-BG01-KA201-036220 is an Erasmus+ project under Key Action 2 - Cooperation for Innovation and the Exchange of Good Practices, KA201 - Strategic Partnerships for school education. In order to achieve its goals, the project gathers together partners from seven countries: Bulgaria, Croatia, Italy, Poland, Portugal, Spain, Romania and from eight organizations: Regional Department of Education – Sofia-city (Bulgaria), Know and Can Association (Bulgaria), Strojarska tehnička škola Osijek (Croatia), Istituto Statale E. Montale (Italy), Danmar Computers LLC (Poland), EPRALIMA\_Escola Profissional do Alto Lima (Portugal), FYG Consultores (Instalofi Levante SL) (Spain), Asociatia pentru Dezvoltare Antreprenoriala, Pregatire Profesionala si Transfer Tehnologic (ADAPT) (Romania).

M&M Project has seen an urgent matter to attend in Europe regarding learning difficulties, leading to essential school performance problems, and eventual drop out from school of young people. Other probable consequences of this process are unemployment or underpayment, poverty, social exclusion, and segregation. The M&M project believes that creating new methods of learning supplementary to the traditional educational approaches will improve students` learning outcomes in Europe, will reduce the drop-out rate and will increase the level of student`s literacy and numeracy skills of the citizens.

The general aim of M&M project is to be achieved through:

- Applying the present Collaborative methodology and the construction of Collaborative Learning e-Tools afterwards, it will



serve as an online environment for teachers, will be used by students with strong focus on achieving learning outcomes, and will support modern approaches;

- Development and testing of a curriculum under the Collaborative Methodology, it will improve maths and natural sciences knowledge and literacy skills;
- Preparation of a Toolkit for Teachers, it will equip them with methodological guidelines of how to use the Collaborative Method and information about other new methods for students' encouragement and motivation. The Toolkit will also include the curriculum aiming at increasing maths and natural sciences literacy skills that will be tested in each country during national trainings.



## THE COLLABORATIVE METHODOLOGY IN MATHS AND NATURAL SCIENCE EDUCATION. WHY IS A NEW METHODOLOGY DEVELOPED?

Teaching in the sphere of maths and natural sciences is a challenging and complex process. Teachers possess systematic knowledge and competences and constantly improve them. That being an essential, is by far not the only prerequisite for the success of the teaching – learning process. Acquiring fundamental knowledge and practical skills can be less complicated when natural sciences and mathematics are related to other fields of science. Thus, we result in a process which has to be harmoniously balanced in a number of aspects: professional, methodological, scientific, pedagogical and psychological.

Harmony is a challenge in teaching maths or natural sciences, so lapses occur as well as issues of all kinds, which affect the quality of education for students. As a result of these specifics, achieving the main goals of contemporary natural sciences and maths teaching to encourage/facilitate students to work individually and conduct researches, to develop problem solving skills and boost creative thinking, turns out to be a major challenge in education.

Contemporary maths teaching methodology provides a number of ways to solve the problem described above. Teachers can find their ways within the fields of science and scientific research. The principles of didactics are the fundamental ideas and approaches on which teaching is based. The name of each principle illustrates its main characteristic, best known by the

teachers of maths and natural sciences. Consequently, every science or maths teacher not only has to introduce scientific facts to students but also to form in them specific scientific way of thinking, to help them rediscover those natural and maths events which today have scientific proof. Natural sciences and maths teaching has to be the base for further broadening students' competences in that sphere on a higher level.

It is widely accepted that natural sciences and maths knowledge and skills are key for all – adults, children, students, achievers and underachievers, people holding degrees of the higher education and those of lower literacy. Maths appears to be a basic tool of all sciences. Research shows that in the growing complexity of the world we live in basic maths skills such as calculating, for example, are most needed for people to function adequately. Calculation is used in dealing with personal finances and data processing, on the work place and in relations between people.

The basic knowledge and set of skills required in the field of natural sciences and maths reflect in the main goals of the natural sciences and maths education, which are to prepare students for:

- Problem solving;
- Communication and reasoning;
- 1. Relation between natural sciences and maths, and their practical implementation;
- 2. Natural sciences and mathematics literacy;
- 3. Comprehension and evaluation of natural sciences and mathematics;
- 4. Making informed decisions.



Most of these goals are immediately related to general knowledge and life skills, which every adult is expected to possess and consequently can teach these to other people, irrespective of abilities and intelligence. That is why we encourage natural sciences and maths learning by all means.

The Collaborative Methodology is a combination of proven teaching methods such as self/ peer learning, elements of gamification and flipped learning into one methodology that leads to encouragement and motivation.

The Collaborative Methodology will enable students to learn more difficult subjects with less efforts, motivation will be higher, class climate better. The methodology includes check-marking students' achievements while they solve problems themselves with little involvement of teacher, who is in a position of a facilitator (or mediator) of the learning process helping students acquire knowledge by themselves, rather than lecturer presenting that knowledge. These approaches stimulate active participation and creative spirit also expressed by students who are not very enthusiastic about learning and have not shown active participation before.

According to Vygotsky (1978) [1], students are capable of performing at higher intellectual levels when asked to work in collaborative situations than when asked to work individually. Group diversity in terms of knowledge and experience contributes positively to the learning process. In continuation, Bruner (1985) [2] contends that cooperative learning methods improve problem-solving strategies because the students are confronted with different interpretations of the given situation.



## WHAT IS THE COLLABORATIVE METHODOLOGY?

The Collaborative Methodology is an effective method that is developed by the project partners. The methodology includes combination of proven teaching methods into one complex methodology. It combines three basic methods: **self/peer learning**, **elements of gamification** and **flipped learning** into one, which in consequence leads to encouragement and motivation. With its use the students will learn more difficult subjects with less efforts, motivation will be higher, class climate better.

**Self/ Peer learning methods.** Peer learning is not a single, undifferentiated educational strategy. It encompasses a broad sweep of activities. [3] These range from the traditional proctor model, in which student tutors student to the more innovative learning cells, in which students in the same year form partnerships to assist each other with both course content and personal concerns. Other models involve discussion seminars, private study groups, parrainage (a buddy system) or counselling, peer-assessment schemes, collaborative project or laboratory work, projects in different sized (cascading groups), workplace mentoring and community activities. Peer learning should be mutually beneficial and involve sharing of knowledge, ideas and experience between participants. It can be described as a way of moving beyond independent to interdependent or mutual learning [4].

**Elements of gamification.** Gamification refers to the application of game design elements to non-game activities and has been applied to a variety of contexts including education [5]. Various elements have been used in gamification to increase user engagement. As examples of these elements he includes points, badges, leaderboards, and storyline [6]. Educational



institutions are interested in gamification of education, where educators create gamified learning environments to enhance learner engagement and improve learning outcomes [7-9]. Given the potential of gamification of education, we are interested in identifying game design elements that have been used to gamify education as well as the impact on learner outcomes. Hence, in this paper, we review the literature on gamification of education and report our synthesis of the findings from the literature.

**Flipped learning.** Flipped learning is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter. The concept of the flipped classroom was proposed by Bergmann and Sams (2012). They recorded class lectures and provided the videos online to enable students to watch and review the teaching contents more conveniently. With such a strategy, significant results were obtained, which inspired them to further employ it (i.e., instructing via online videos) before classes. In this way, students could prepare for classes by watching the videos and could thus form the basic knowledge before class. Consequently, more in-class discussion or practice could be conducted to engage students in more in-depth learning and help them clarify any misconceptions. [10]

The Collaborative Methodology includes check-marking students' achievements as well, while they solve problems themselves with little involvement of Teacher as a mediator (or a particular student, appointed as a leader), who is a facilitator helping to students find the knowledge, rather than lecturer giving that knowledge. These approaches will stimulate active participation and creative spirit expressed also by students who are not very enthusiastic in learning and have not shown active participation before.

## IDENTIFICATION OF THE BENEFICIARIES

The following factors have to be compliant when using the Collaborative Methodology in planning the educational process:

- Children and students who have difficulties in acquiring certain types of knowledge and skills quickly;
- Current level of preparation in natural sciences and mathematics disciplines;
- The person`s specific needs for socialization;
- Argumentation and proof that there is a connection between game content or the particular activity and real life are needed;
- The implementation of the mentioned benefits needs facilitation.



## IDENTIFICATION OF THE NEEDS

The main target group is students with learning difficulties in natural sciences and maths. It is useful to consider difficulties which could be relieved by the implementation of the methodology. Here are some possible factors which define the type of learning difficulties:

- **Language factors.** Language problems are explicitly visible in the process of teaching natural sciences and maths when students struggle to use terminology, definitions and symbols characteristic for the disciplines, when they cannot present maths/ natural sciences notions and cannot or barely understand explanations. They have difficulties in using and comprehending formal scientific language.
- **Cognitive factors.** They could be related to perceptions, memory, attention or thinking.
- **Meta-cognitive factors.** Meta-cognitive factors are related to being aware of the skills, strategies, resources needed to complete a task as well as the skill to use auto-regulatory mechanisms. Students who have meta-cognitive problems face hardships when they have to choose and use effective learning strategies. Games may provide the tools for dealing with such difficulties.
- **Kinesthetic factors.** Kinesthetic factors include memory of the symbol accompanied by some information (visual and kinesthetic memory). They also include visual perception and transfer (copying). Indicators for such problems are easy to recognize:



badly-shaped symbols, bad control on the space between letters and words, spending longer time on tasks, avoiding written forms.

- **Social and emotional factors.** They cover a wide variety including relationships with adults, cooperation, self-assessment, etc. Games can help teachers deal with those problems.
- **Learning habits.** “Learning habits” relate to how individuals observe and participate in the process of studying, their self-discipline and motivation, goal setting, engagement in learning activities and taking challenges.
- **Previous experience.** In case of negative previous experience, the learner refuses to be involved in learning activities. Games may be the means of solving that problem.



## EDUCATIONAL GOALS AND DEVELOPED COMPETENCES

Collaborative method in gaining knowledge and acquiring skills especially in the learning process is not an end in itself, it complements other methods of teaching. When used appropriately, it plays a major role in building student personality in cognitive, emotional and behavioral aspect.

- Collaborative method brings joy, satisfaction and confidence. Students learn to manage and take initiative. It is a serious activity free from inner restrictions and limitations, and most importantly it is not seen as imposed but as necessary.
- Collaborative method of teaching helps improving the communication between teachers on the one hand and communication between students on the other. It boosts development generally and encourages independent thinking, develops creative imagination and contributes to forming organizational skills.
- Collaborative method in a learner-centered approach focused on students being the active party, it increases the quality of knowledge, skills and competences they gain; it develops critical thinking and creativity; it creates positive attitude and interest in learning and other intellectual activities; it encourages both competition and cooperation between students; it develops skills for self-regulation, self-control and self-assessment; it teaches them how to be team players; students learn to be responsible, respectful, and able to recognize their partners` merits.



## THE NATURE OF THE COLLABORATIVE METHOD

The concept of collaborative learning (grouping and pairing of students for the purpose of achieving an academic goal) has been widely researched and advocated throughout the professional literature. The term "collaborative learning" refers to an instruction method in which students at various performance levels work together in small groups toward a common goal. The students are responsible for one another's learning as well as their own. Thus, the success of one student helps other students to be successful.

Proponents of collaborative learning claim that the active exchange of ideas within small groups not only increases interest among the participants but also promotes critical thinking. According to Johnson and Johnson (1986) [11], there is persuasive evidence that cooperative teams achieve at higher levels of thought and retain information longer than students who work quietly as individuals. The shared learning gives students an opportunity to engage in discussion, take responsibility for their own learning, and thus become critical thinkers. [12]

Advances in technology and changes in the organizational infrastructure put an increased emphasis on teamwork within the workforce. Workers need to be able to think creatively, solve problems, and make decisions as a team. Therefore, the development and enhancement of critical-thinking skills through collaborative learning is one of the primary goals of technology education. The present research was designed to study the effectiveness of collaborative learning as it relates to learning outcomes at college level, for students in technology.

The introduced collaborative method is in complete compliance with the reasons for creating the method described in 2.1.:

- Problem solving;
- Communication and reasoning;
- Relation between maths and its practical implementation;
- Preparation of mathematically literate people;
- Comprehension and evaluation of mathematics;
- Making informed decisions.

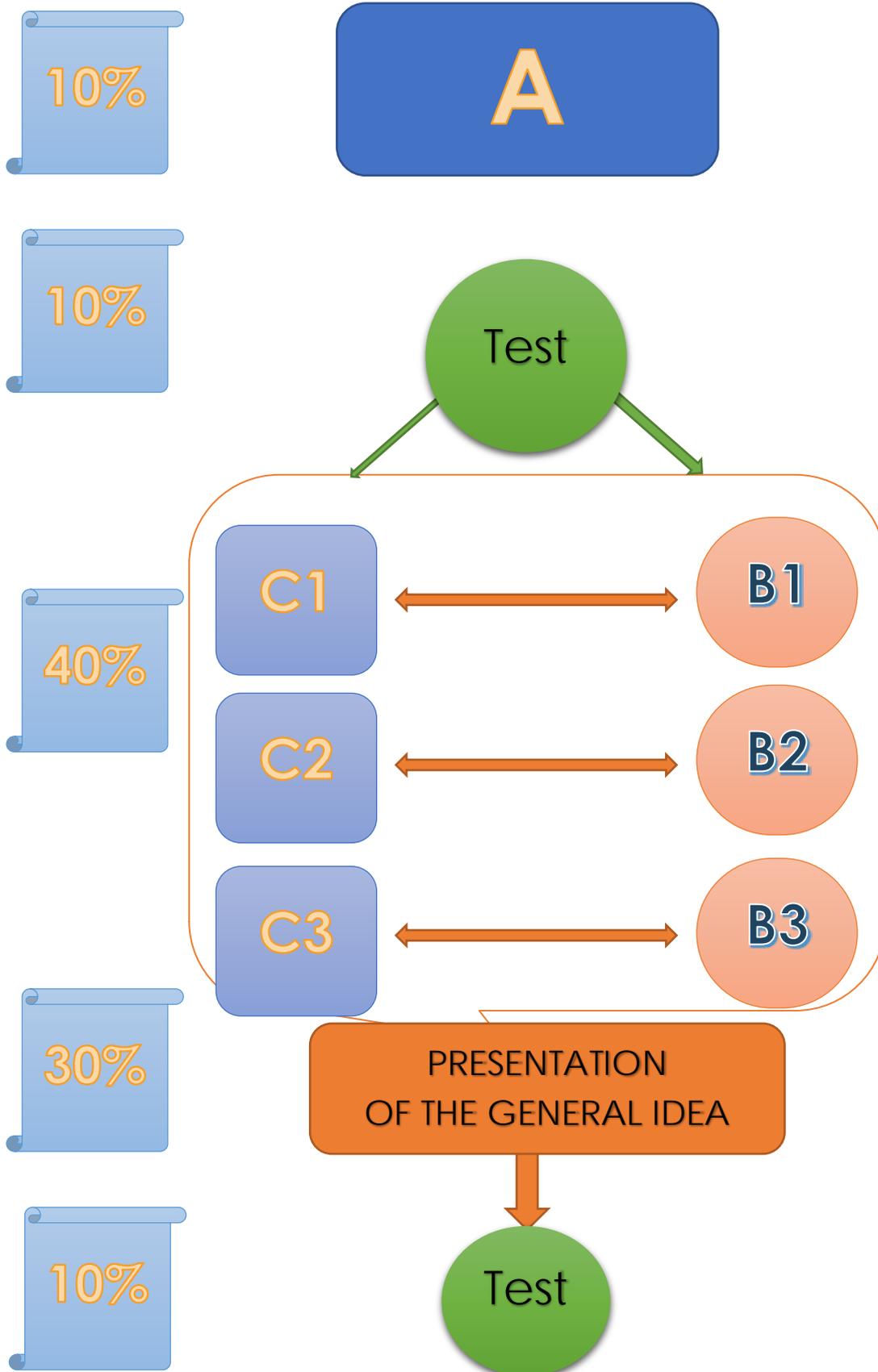
For collaborative learning to be effective, the tutor must view teaching as a process of developing and enhancing students' ability to learn. The tutor's role is not to transmit information, but to serve as a facilitator for learning. This involves creating and managing meaningful learning experiences and stimulating students' thinking through real world problems.

## GENERAL DESCRIPTION OF THE COLLABORATIVE METHOD PROCESS

The Collaborative approach requires groups to come together in order to share their knowledge and ideas on a particular area for improvement. The topic could be on new knowledge or on an area where students have particular deficits. The basic format focuses participants on an identified area for improvement based on frequent assessment.

A group of learners is offered a test connected to a subject or topic which they are currently learning and facing difficulties or is randomly chosen for the task. This group could be formed by a single class or classes. On the scheme this group is presented by shape 'A' The basic framework of applying the Collaborative method is:

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1. **To test team work skills and knowledge on the given topic.** The test is formal and includes basic questions on a current topic (*In the scheme - Shape - Test*). It could include a few simple questions that estimate the student's knowledge and basic skills easily. The test should be estimated easily through measurable criteria corresponding to the weight of the given questions or tasks. Afterwards, students are ranked according to their results. The test is prepared in advance by the teacher in the preparation phase of the activity. Beforehand, the teacher should be aware of the abilities for team work of students though extra psychological testing.
2. **To form groups.** Depending on the number of students represented by group 'A' and their test results, they are divided into groups (*on the scheme – group C1, C2, C3 ...*). Usually there should be two or three groups. The top ranked students or pupils (*on the scheme – group B1, B2, B3 ...*) depending on the chosen number of groups are the so called leaders of the groups, as these students are more competent on the topic. It is possible for a group to have more than one leader (*on the scheme – group B1, B2, B3, ...*). It is very important that the students do not know who the leader is, as the so called leader has top rating results. Depending on the lesson plan those students, appointed as leaders could be called tutors. For example, if the subject is maths, the lesson is "Ratio and percentage" and the collaborative method includes problems related to interest rates, profits, etc., the leader of the group could be named banker and the members of the group – bank employees. The teacher manages the groups and defines the roles of the leaders and regular students inside each group. More possibilities are presented widely at the



description of the activities of the peer learning method. Choosing the proper method varies on the current activity.

3. **In the preparation phase** the teacher supports the leaders of the groups by providing guidelines, proper didactic materials and a lesson plan.
4. **There are some lessons** which duration is longer than the time available. In this case optionally, the lesson could be divided into parts according to the number of groups and those parts can be assigned to the groups. Each group researches their given part, does particular activities. At the stage 'Presentation of the general idea' (See *the scheme*) the presenter chosen by each group gives explanation of the given part or activities.
5. **Regarding each activity**, the teacher has to consider and ensure the following rules: It is a team activity, the teams are formed by representatives of the groups, in order to boost creative thinking, students are not allowed to only watch – everybody should take active participation in the activity.
6. **Main part of the activity.** After grouping the leader, he tutors the group under teacher observation. Under the peer learning model, students with deficits learn, practice and acquire the knowledge and skills according to the main aims of the lesson plan. Through the elements of gamification in the activities the students learn naturally, they motivate each other, etc. And through the flipped learning approach the group learning space moves to the individual learning space, and the resulting group space is transformed dynamically. At the end of the activity the team (the group) should come up with a unanimous solution of the problem. Each team presents a solution to the given problem. The teacher's role is to facilitate and provoke students to discuss and analyze the solutions they suggest.



7. **At the end of the activity** the teacher applies a test form to diagnose the collaborative effort of the teams. The test shows the level of knowledge and skills acquisition on the topic. On condition that 75% of the learners pass the test, the method is considered successful. It is important that the leaders are awarded for their efforts, as well.
8. **The optimum time for each phase of the process.** As the duration of student's classes vary and the time on a particular topic is different, the length of the activities is given in percent:
  - The initial test of knowledge on the topic should be 10%;
  - The teacher forms the teams and defines the roles – 10%;
  - The teams work on the problem – 40%;
  - The teams present their solutions and discuss – 30%;
  - The teacher tests the final level of knowledge on the topic – 10%.

According this timetable, a lesson of 60 minutes of activities has the following phases:

- The initial test of knowledge on the topic – 6 minutes (10%);
- The teacher forms the teams and defines the roles – 6 minutes (10%);
- The teams work on the problem – 24 minutes (40%);
- The teams present their solutions and discuss – 18 minutes (30%);
- The teacher tests the final level of knowledge on the topic – 6 minutes (10%).



## MEANS AND METHODS

Collaborative method includes recommended successful techniques and approaches aiming to:

- Create interest and help initiative. A lesson is a sequence of interesting choices. By involving learners in such processes motivation and thinking should be boosted.
- Use the advantages of the Collaborative method to “win” the learner for the cause of experimental and active learning.
- Interaction within the Collaborative method facilitates better understanding of objects, notions and processes.
- Socialization of the participants based on the competitive element. The Collaborative method is a part of everyday life. This is especially important for less literate people, because their problem might stem from lack of certain social skills connected to real life situations. In most maths problems there are elements that connect the science with real life.
- Create happy and cheerful environment in class. The joy factor is a desired attribute to the learning process.
- The aim of the activity (structure, rules, equipment, problem setting, etc.) is to develop the specific teaching method. The composing elements of an activity can be used to solve problems and give ideas for strategic and critical thinking.

A characteristic feature of the method is that it avoids the element of pressure in organizing the process of learning and activation of mental



powers, resulting from the main purposes of each game – fun and entertainment. Other benefits of playing games are socialization, learning, communication improvement.

Implementation of games under different activities in the learning process is empowered by fantasy and imagination. Every game in or out of educational institutions has a didactic, educational and behavioral goal.

When included appropriately in the process of education, games play an essential role in building student personality not only in cognitive but also in emotional and behavioral aspect. Games bring joy, satisfaction and confidence. Students learn to manage and take initiative. It is an activity free from inner restrictions and limitations, and most importantly it is not seen as imposed but as necessary.

Role-playing (position of a leader, position of a member of a team) means that students put themselves in the shoes of others, think like other people, behave like other people in problematic situations. Role-playing is an excellent strategy to practice skills, gain experience as to how people act in similar situations in real life; increase empathy to other people and tolerance to their point of view; understand students` own feelings.

Through peer teaching students are trained and motivated to engage themselves in conducting formal or informal educational activities with learners at their age (with similar education or interests) for a certain period of time, focused on developing and changing of attitudes, beliefs, and skills in the sphere of human rights and against discrimination.

The role of the adults in this process is to identify the real motivational leaders in a group of peers, to train them and to provide the conditions to implement the program. In the second phase adults play a more passive role of facilitators of the process of teaching. Any attempt to overtake the control will discredit the young teachers in the eyes of their peers. Trust and



unobtrusive help on behalf of the adults are key features of successful projects of the kind.

The game method as part of a particular activity is one of the most popular and intriguing amongst children in the process of education. It means that children have fun while studying. Subject matter together with examples of different types of behaviour lay the fundamentals of such approaches. The method features student autonomy.

For collaborative learning to be effective, the instructor must view teaching as a process of developing and enhancing students' ability to learn. The leader's role is not to transmit information, but to serve as a facilitator for learning. This involves creating and managing meaningful learning experiences and stimulating students' thinking through real life problems.

Future research studies need to investigate the effect of different variables in the collaborative learning process. Group composition: heterogeneous versus homogeneous, group selection and size, structure of collaborative learning, amount of teacher intervention in the group learning process, differences in preference for collaborative learning associated with gender and ethnicity, and differences in preference and possibly effectiveness due to different learning styles, all merit investigation. Also, a psycho- analysis of the group discussions will reveal useful information.

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