

Romanian Teachers Opinion about Teaching Sciences

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Abstract: *The Romanian Law of Education of 2011 includes the principles regarding the non-formal way of teaching Sciences. In a modern society, where there is a load of information and knowledge surrounding us, the interest towards Sciences, and especially practical Sciences, has increased. In order to maintain this interest, teachers have to use and apply modern teaching methods and tools. The present research aims to conclude the teachers' opinion whether non-formal teaching methods, interactivity in the process of learning have had an effect on the teaching of Sciences, the teachers' viewpoint regarding the introduction of competence-based teaching. We led our research among the teachers working in secondary schools, as well as in non-formal educational centres, with the help of an online questionnaire. (N=102). The results of the research show that the non-formal after school activities, together with the formal ones, help the teaching and learning of Sciences. Most of the teachers asked agree that the non-formal activities help in the development of the key competencies. Our research shows the lacks and drawbacks of the teaching of Sciences, both in formal and non-formal teaching.*

Keywords: competence, non-formal, education, science, information.

Introduction

Today's educational system lacks interdisciplinarity, the teaching of skills and competences, as well as the acquisition of practical knowledge¹ In the 1990s the aim was teaching and learning on an academic level, while in order to develop the child's personality the gain of experiences, the participation in the process of learning is/was inevitable². The modern world is in a constant change, the industrial society has gradually turned into a society of information or knowledge. Information with the difference of significance is the core of modern society and has become primordial, it does not "circulate" freely neither in the universe nor in the human mind³. The Internet, society or globalization cannot transform information into knowledge; to achieve this either formal, non-formal or informal education, and especially a technological education are required to understand this complicated "road". "An informed man is a strong man"⁴ but only if we can use and transform it into something useful to society, and this can only be achieved through education, lifelong learning. Information must go from the

¹ L. Nagy-Czirok, *International experience of Hungarian school headmasters in Finnish continuing professional teacher training environment*, Budapest, Opus et Educatio, 2016.

² I. Albulescu, *Pragmatica predării. Activitatea profesorului între rutină și creativitate*, Pitești, Editura Paralela 45, 2008.

³ M. Drăgănescu, *De la societatea informațională la societatea cunoașterii*, București, Editura Tehnică, 2003.

⁴ A. Martin, *John D. Rockefeller*, New York, Encyclopedia Americana, 1999.

sender to the receiver, and those channels that often depend on education sometimes give very poor feedback, see national, international assessments. In order to keep up with the explosion of information and technological development, we need positive feedback, knowledge that we can accumulate only through education. The formal education should be enlarged with the teaching of competences.⁵

The lack of children's interest in natural sciences, mathematics, chemistry, physics, biology, computer science, technology can be said to derive from negative feedbacks, either from the lack of equipment of laboratories, or from teaching and learning methods which are no longer attractive for the Z generation, and will trigger or have already triggered a lack of interest towards technical subjects, lack of specialists in the field, lack of children in vocational schools and lack of specialized teachers in the mathematical curricular area, and natural sciences, technology.

The role of modern education is to stimulate children's interest in technical and scientific fields, to motivate children to rediscover the beauties of life through chemistry, physics, biology and technology, to experience their importance in everyday life and progress, to develop and to become pillars for supporting modern society. Known, subsequently aware and assumed ethical and moral values support the formation of socio-emotional abilities. Successful educational solutions aim at developing the socio-emotional dimension of human personality.⁶ Changes in the education system with strong reverberations at the level of all the components of society generate the guiding and decisive line for moving to a new type of society. Specifically, we are witnessing the imperative of permanent learning, the involvement of the individual in self-improvement of living conditions and the realization of desirable projections.⁷

Theoretical premises

There are children awarded in natural sciences, children who build robots and compete with their toys at an international level, and yet we can state at the level of Covasna county and across the country that the curricular area has lost ground to other subjects, it cannot be said that students are motivated to learn chemistry, physics, biology, technology even at the level of non-formal activities, the technical-applicational circles are disappearing. The

⁵ M. Bocoș, D. Jucan, *Teoria și metodologia instruirii, Teoria și metodologia evaluării*, Pitești, Editura Paralela 45, 2017; V. Flueraș, *Prolegomene la o posibilă teorie a competenței*, Cluj-Napoca, Editura Casa Cărții de Știință, 2014.

⁶ Adriana Denisa Manea, "Features of Educational Activities in the Contemporary Society", in *Astra Salvensis*, VI(2018), no.12, p. 245-253.

⁷ Adriana Denisa Manea "Educational management and the dynamics of educational models", in Ion Albulescu, Adriana Denisa Manea, Iuliu-Marius Morariu (eds.), *Education, Religion, Family in the contemporary society*, Saarbrücken, Lambert Academic, 2017, p.75-83.

acute shortage of teachers within the curricular mathematical area and natural sciences – in Covasna county there was not one candidate signed up for the final exam – the lack of modern teaching material, discrimination between children from rural and urban schools, between “trendy/elite” and neighbourhood ones is not a good environment for the curricular area. The modern world needs specialists in the field and the re-launch of these materials, activities is largely in the hands of teachers and the investment in equipping the laboratories with modern equipment and specialized educational software. The role of the pedagogical society within natural sciences is to know the way of thinking of the Z generation, to find the factors that generated the removal from the respective materials. Motivation towards natural sciences, the development of logical thinking, creativity, the rediscovery of the beauty of chemistry, physics, biology, technology, of extracurricular activities in which the sense of beauty, skillfulness develops – these are just a few points which require an answer⁸. In modern knowledge-based society, in the sphere of information and the technological world, it is necessary to attract the interest of children at natural sciences beginning in primary school and to apply student-centred interactive learning⁹. The interest and motivation of children for the natural sciences can be preserved if we apply modern teaching methods and we have a modern material base and advanced technology – these requirements become the supporting pillar of education¹⁰. Interdisciplinarity, practical education, skills development and aptitude are the shortcomings of the modern education system today¹¹. Non-formal education contributes to the partial or complete development of competencies, which complements formal education but loses ground in the already overloaded system¹².

The National Education Law no. 1 of 2011 includes both forms of education, formal and non-formal¹³. Non-formal education within the palaces and clubs for children is regulated by Order no. 4624/2015 of the Ministry of National Education – the amendment of appendix no. 1 to the Regulation of units providing extra-curricular activity¹⁴.

⁸ D. Daniel, *Psibologia poporului român*, Iași, Editura Polirom, 2015.

⁹ N. András, *Oktatáselméletés technológia*, Eger, Oktatás- És Kommunikációtechnológiai Tanszék, 2010.

¹⁰ S. Cristea, *Educația. Concept și analiză*, București, Editura DPH, 2016.

¹¹ L. Nagy-Czirok, *International experience of Hungarian school headmasters in Finnish continuing professional teacher training environment*.

¹² M. Bocoș, D. Jucan, *Teoria și metodologia instruirii, Teoria și metodologia evaluării*. V. Flueraș, *Prolegomene la o posibilă teorie a competenței*. K. J. Puskáné, *Az iskolánk kívüli iskolarendszerű oktatás szerepe a tehetség gondozásában*, Budapest, Editura Professzorok a köznevelésért, 2008.

¹³ Legea educației naționale nr. 1 / 5.01. 2011, Monitorul Oficial nr. 18 din 10 ianuarie 2011.

¹⁴ Ordinul ministrului educației și cercetării științifice nr. 4624/2015 pentru modificarea anexei nr. 1 la Regulamentul de organizare și funcționare a unităților care oferă activitate

According to the Law on National Education, non-formal education alongside informal education, is an integrated form of planned activities, it does not follow a separate curriculum and is complementary to formal education.

At national level, non-formal activities have been included in the national educational system since the 1950s, in Covasna county, the Children's Palace in St. George, also known as the Pioneers Palace, is for the benefit of the community and children since 1954.

Non-formal education through its practical activities based on a student-centred curriculum was the lever that made the transition from curriculum centred on material to student-centred curriculum, this being formulated in the National Education Act no. 1 of 2011 and the introduction of the School Programs for the fifth grade, in Appendix 2 of OMNE no. 3393/28.02.2017 to be applied in the education system starting with the 2017/2018 school year centred on key competences, – a few changes that help children to be motivated and to prepare the particular subjects¹⁵. The development of key competences is important for the development of children's personality, but it is also very important to develop *learning strategies* by using those *methods* that favour the development of both the child's knowledge and personality, creativity¹⁶. These non-formal activities come to the benefit of children who attend these activities, either organized by the Children's Palaces and Clubs or by NGOs, to complete their knowledge, to develop children's skills and personality. If it can be said, it is the VAT of formal activities.

Purpose of the Study

The study analyses the positive and negative valences of these "shortcomings" listed above and the lack of interest in natural sciences and technology in middle school and how it is "affected" by non-formal activities.

To what extent do the interactive methods contribute to the development of science and technology skills, and what is the opinion of middle school teachers on competence-based teaching.

The study was conducted at county level, in Covasna county, on a sample of 102 middle school teachers. The questionnaire contained 26 online questions and 82% of the teachers teaching natural sciences in middle school responded.

extrascolara, aprobat prin Ordinul ministrului educatiei, cercetarii, tineretului si sportului nr. 5567/2011 a fost publicat in Monitorul Oficial, Partea I, nr. 599 din 7 august 2015.

¹⁵Ordinul ministrului Educației Naționale nr. 3.393/28.02.2017 privind aprobarea programelor școlare pentru învățământul gimnazial Monitorul Oficial nr. 164 bis/07.03.2017;

¹⁶I. Albulescu, „Pragmatica predării. Activitateaprofesorului între rutină și creativitate, Pitești, Editura Paralela 45, 2008.

Research Questions

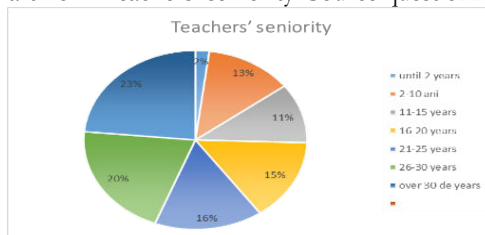
1. To what extent do non-formal activities contribute to the development of skills in the natural sciences, technology?
2. To what extent does the transition to competency-centred curriculum affect children's motivation for natural sciences?
3. The interactive methods used are more effective in organizing and conducting learning?
4. At middle school level, do the non-formal activities in the field of natural sciences place the student in the centre of the educational process?

The aim of the questionnaire was to draw the attention of teachers to the regression of natural sciences in Covasna county, and to achieve a more meaningful vision among teachers in mathematical curricular area and natural sciences regarding the introduction of 8 key competencies, to find the role of non-formal activities that would help motivate children for these subjects, and find solutions to achieve better outcomes in national and international assessments, refresh modern teaching methods used by teaching staff for a better approach of the generation of the modern world, to motivate students on the importance of knowledge of phenomena, modern technology and to reduce functional illiteracy among children. It can be said that the main factor in the informational revolution is the “informational crisis”¹⁷, because children have reached the limit of their possibilities of receiving information. The storage and applicability of this information cannot be achieved through national evaluations that are based on standards that without prior knowledge, without a dose of internal motivation cannot progress the motivation of students to learn, and especially to learn natural sciences or to attend the courses of non-formal activities.

Research results

The number of teachers in mathematical curriculum and natural science is of 150 teachers who teach chemistry, physics and biology, including the teachers of the scientific and technical circles of non-formal activities at the Children's Palace and Clubs in Covasna county. The questionnaire was answered by 102 middle school teachers.

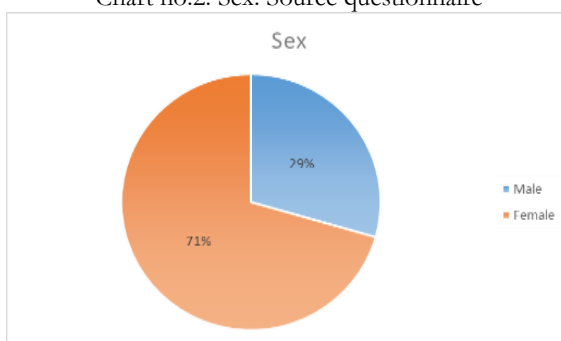
Chart no.1. Teachers' seniority. Source questionnaire



¹⁷ S. P. Capiță, *Interviù cu savantul*, Chișinău, Biblioteca Nationala Chisinau, 2003, p. 4.

Seniority along with teachers' age should not affect students' motivation to engage more in science, but it can be seen that 36% of teachers have been working for over 25 years. The problem is not age or seniority, rather the lack of young teachers, of students who would become teachers in natural sciences. This can be noticed at county level, 2% of the teachers are beginners, 11.2% are debutants in the county and it can be estimated that 9.2% are non-qualified teachers, which means that they are first-time teachers with a graduate degree or young pedagogues who are not motivated to follow professional training in the field, they choose to teach what is left after the allocations.

Chart no.2. Sex. Source questionnaire



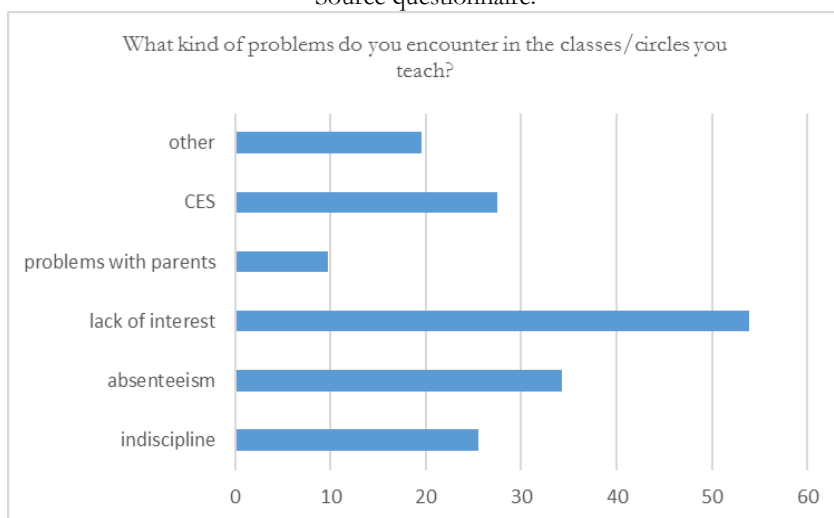
Gender equality has shifted in education and natural sciences to the detriment of teachers, according to the census of the population and the 2011 census. Within 30 years, the ratio of female and male teachers in the field of natural sciences has reversed, and almost a third of the teachers are male teachers. The students' results are not affected by this impediment, perhaps in the technical-scientific circles, we could say that the activities in Covasna county are not attractive for female teachers; it is probably the lack of practical skills that keeps them away from these extra-curricular activities. It can be said that the county of Covasna is facing a lack of teachers in the field, which is also supported by the statistics of Covasna County School Inspectorate through the list of vacancies and the list of the teaching staff registered in the exam sessions of 2016, 2017, and 2018. The acute lack of the interest in natural sciences does not derive from gender equality or the age of teachers, but it is alarming that in Covasna county out of 15 technical-science circles only 6 remained within a period of 10 years, and the students who choose these activities are fewer and fewer, this is also mentioned in the 2017 statistics of CCSI¹⁸.

The alarm signal exists at a European level as well as in the Romanian education system, and the lack of interest towards the natural sciences is also visible from the questionnaire conducted at the level of the county.

¹⁸ Indicatori de calitate, (2017), ISJ Covasna.

Lack of interest in the subject is the first obstacle that a teacher has to face in formal and non-formal education. 53.9% of teachers considered this a first obstacle, followed by absenteeism 34.3%, and children with special educational needs 27, 5%. The SNE in the questionnaire refers to hyperactivity or lethargy, lack of concentration of students, patience, or children who can solve the problem, but cannot practically apply and functional illiteracy among 6, 7 and 8th grade children. The issues listed in the questionnaire do not refer to children with mental, psychic disabilities, but a great number of children have the capacity to understand the problem, the information, but because of some psychic factors they are overwhelmed by the tasks and give up, they remain indifferent to school, to knowledge, are bored and often abandon school, respectively the circles.

Chart no.3. What kind of problems do you encounter in the classes/circles you teach?
Source questionnaire.



Researches in the field of education sciences, school psychologists – who are very rare, 27 out of 2238 teachers are school psychologists, that is 1.20% – are meant to find the best modern methods and procedures in view of achieving the proposed objectives. The passage of the priority given to the subject to the favouring and prioritization of the student¹⁹ depends on the teacher, the methods, techniques, the modern teaching and evaluation tools that are used in the instructive-educative process, and with the help of which students can be motivated.

¹⁹ R. E. Clasen, & W. E. Bowman, “Toward a student-centered learning focus inventory for junior high and middle school teachers”, in *Journal of Educational Research*, 68(1974), no. 1, p. 35.

Modern technology, educational software, experiments simulation programs offer a helping hand to teachers. The lack of these modern tools aggravates the current situation of the Romanian education. Obsolete, and in many cases non-existent facilities in schools, lack of specialized laboratories, disadvantages students especially in rural schools, the total number of middle school students in the 2016-2017 school year was 8650 out of which 4293, namely 49.63% learn in rural areas and there will be an acute shortage of specialists in the field, especially in the rural areas.

Children's interest in mathematical curricular area and natural sciences is influenced by several aspects, the intervention of "professionals in the field", media coverage among parents, inclusion of civilians in debates, school psychologists, investment in technology, educational software, professional trainings – these elements would keep the natural sciences on track. National Education Law no. 1/2011 states: "The national curriculum for primary and secondary education focuses on 8 key competencies that determine the student's training profile", (Appendix 2. OMNE No. 3393/28.02.2017) and is applied in the education system starting with the 2017-2018 school year, it is the continuation of the National Education Law no. 1/2011 for middle school and school curriculum, it is structured on the eight areas of competence.

The advantages of the curriculum centred on competence can be normative, scientific, methodological, value and evaluative. It is possible to structure the contents in a modular and interdisciplinary view depending on the characteristics of the students, thus motivating them to be interested and to develop their own personality, according to the mental capacity of each child, and to develop the general culture and knowledge in the field of natural sciences, fact also mentioned in NEL no. 1/2011.

Learning centred on developing the 8 key competences involves combining modern and traditional methods to meet the needs of students and modern society. Introducing the competence-based curriculum marks changes among teachers and students. Starting with the 2017-2018 school year, the 5th graders have learned according to the new program centred on the 8 competences, the 3rd and 4th graders had natural sciences, introduction to the world of sciences included in the national curriculum. The programs require improvement after each cycle so that interdisciplinarity and educational finalities have the purpose of carrying out the activity of training and developing the child's personality. The rupture that exists between primary and middle school can also be observed in the natural sciences. 5th graders have encountered difficulties in understanding the subject matter caused primarily by the accelerated rhythm dictated by the school curriculum. The new curriculum seeks to unify the large discrepancy between the curriculum of primary and secondary education and focuses on the

formation of key competences as a whole, focusing on the student as the main character of education.

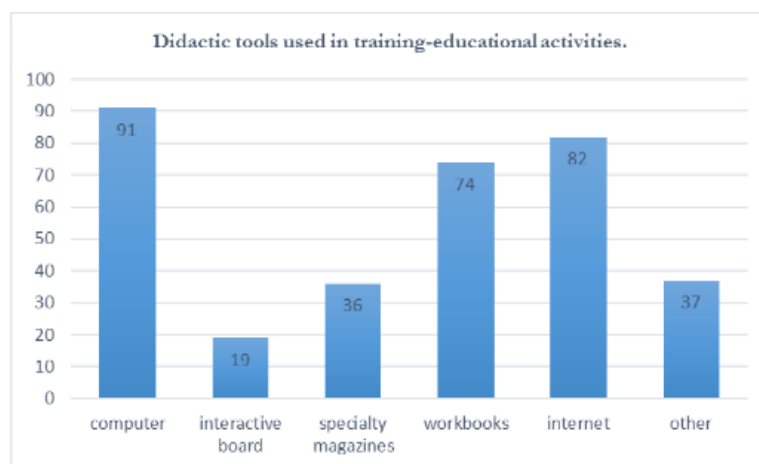
Secondary school teachers have to adapt to the new school curriculum with the changes that will take place with the introduction of the new national curriculum.

In the preparation and development of the instructive-educational process, modern teaching tools are used.

The computer, workbooks with the manual and the internet are the most used ones. Equipping classes with interactive boards, educational software on chemistry, physics, biology, computer technology would help teachers, experiments with the help of educational software can stimulate, motivate the children of the Z generation, children who are familiar with modern technology. But there is a lack of interactive boards, 19 out of 102 teachers use this teaching tool.

Computers, the software in the laboratories are outdated, cannot handle the programs, the educational software, and if yes, there is no Internet or the laboratories are not used for the assigned purpose. The use of these modern tools requires extra training but it is worth the effort, the motivation of the children will be greater to learn the natural sciences and the understanding of the phenomena will be much easier.

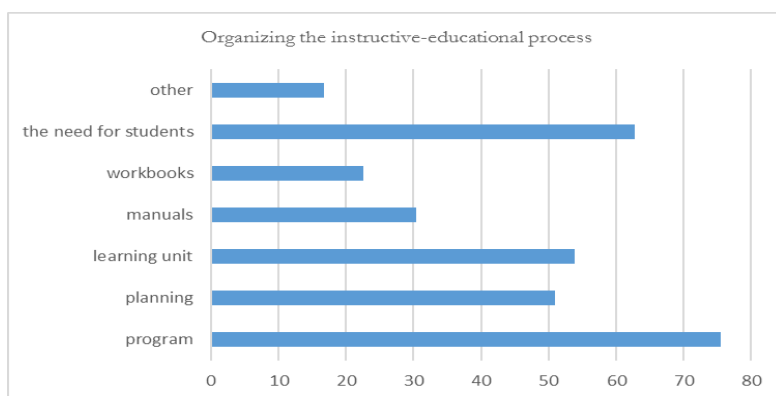
Chart no.4. Didactic tools used in training-educational activities. Source questionnaire



The organization of the educational instructive process is directly proportional to the tools used to prepare and run the educational program. Natural sciences and technology are materials of a formative nature and their development is a priority. It can be seen from the teachers' answers that the curriculum is combined with the group's need which is a very important thing, and it can be deduced that the learning is centred on the student,

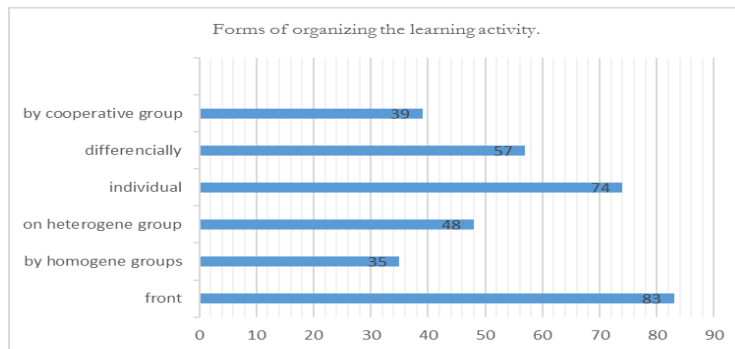
taking into account the composition of the group. School curriculum, planning and learning facilities together with content are informational means through which skills are formed and developed. The content proposed by the teachers allows for a flexible teaching approach and can be adapted to the individual development levels and to the students' different learning needs.

Chart no.5. Organizing the instructive-educational process. Source questionnaire



In selecting learning methods and organizational forms it is very important to take into consideration the composition of the class, the level of knowledge of the children. The graduation of complexity must also respect differentiated learning that must match the needs and interests of students capable of performance. One can observe differences in organizational patterns: 83 teachers use the form of front organization and 74 the individual one, normally each activity must contain these forms of organization, but learning must be centred on students and then the most motivating forms of organization in which the student is the main character are those on groups together with differentiation because not all students have the skills for natural sciences, in middle school there should be an initiation of these subjects to develop key competencies, personality and to show students to the beauties of these subjects and to motivate them to choose a similar career.

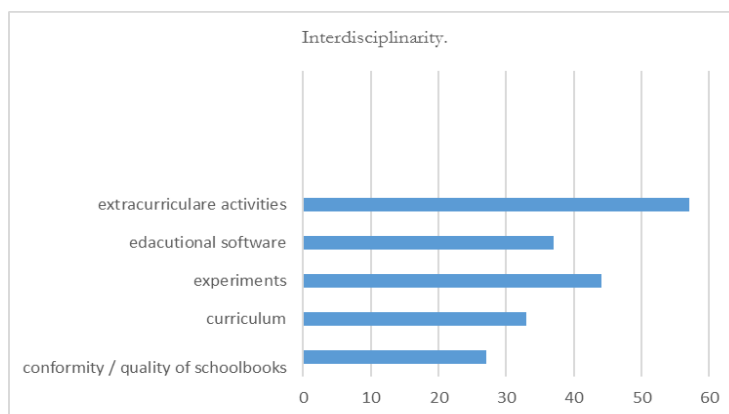
Chart no.6. Forms of organizing the learning activity. Source questionnaire



Promoting interdisciplinarity is a necessity imposed by cognitive changes and accumulations in multiple areas of knowledge, as well as by the complexity and diversity of the problems faced by children in different subjects. Cooperation between subjects and sciences, respecting the logic of each individual, adapted to the particularity of the didactic law, aims at forming a unitary picture of reality and an integrative thinking in students. At the same time, there must be a way of organizing learning content and a connection of explanatory languages meant to break the boundaries between subjects. Teaching content from an interdisciplinary perspective has multiple advantages, allows the learner to gather in-depth information in the following years, and allows the application of knowledge in practice. These include the advantages of shaping the personality of the student on various levels: intellectual, emotional, social, aesthetic and physical. The design of interdisciplinary education can be promoted both through the National Curriculum and through school-based approaches; that is, an interdisciplinary didactic approach can be done through CDS (Curriculum at the Decision of the School) or through extracurricular activities.

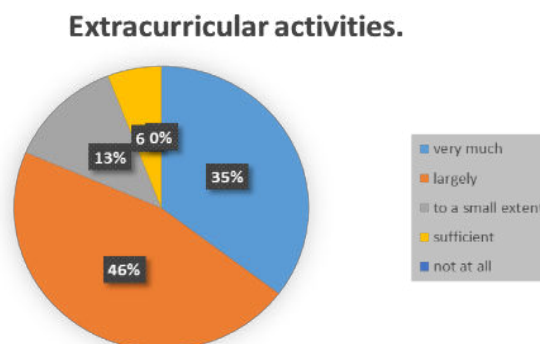
Transdisciplinarity is viewed as a superior form of interdisciplinarity and involves concepts, methodology and language that tend to become universal (robotization, modelling). It also assumes the discovery of new investigative fields, focusing on real life with its many problems. The role of non-formal activities is to create those fields in which transdisciplinarity can be achieved and developed. The questionnaire at county level conforms the theory, 57 teachers consider that extracurricular and after school activities play an important role in the creation of interdisciplinarity, joint projects with other curricular areas, educational software, experiments are the most important aspects of interdisciplinarity that depend on the professional training of teachers, the curriculum and the conformity or the quality of the textbooks should be updated and analyzed after each cycle to make changes, occurring slippages to be fixed, taking into account the educational-instructive process and the opinions of the teachers.

Chart no.7. Interdisciplinarity. Source questionnaire



85.3% of the teachers consider that specialized and interdisciplinary competitions have a major role – first of all, it is a feedback to teachers and students, and it is a fair self-evaluation and a source of motivation to participate more actively in these extracurricular activities. It is worth mentioning that 81% of the teachers have done extracurricular activities, activities that help to develop technical, social skills, cultivation of interest in the material, cultivation of young talents.

Chart no.8. Extracurricular activities. Source questionnaire



Each teacher must have an open mindset and to take into account, first and foremost, the interests, goals and needs of students. This can be done with professional training and – very important in the field of natural sciences – a change of mentality among teachers. The Ministry of National Education through the "Relevant Curriculum, Open Education for All" project (RCOE) is helping teachers with competence-centred education. Students' motivation must be the catalyst of the instructive-educational process. Students of the Z generation need to know the benefits of motivation, they need an interesting and attractive content to keep their motivation "on fire". Rewarding with praise, thematic excursions, practical things, modern pedagogical tools, are some of ways to motivate teachers and parents in the race to abolish boredom and indifference to see the beauties of the material.

Discussion, conclusions

The scientific research was carried out on a sample of 102 teachers from the total of 150 teachers in Covasna county which teach natural sciences, except for Maths, and it studied the analysis of teachers' views on the introduction of competence-centred education, which are the areas where changes will be seen, which are the external and internal factors that influence students' attachment to mathematical curricular area and natural sciences. The questionnaire also conducted a survey on non-formal, after school and extracurricular activities that help develop children's skills and personality. The study revealed the importance of non-formal, after school and extracurricular activities carried out in schools, in Children's Palace, Clubs, activities that are complementary to formal activities. Children's motivation for chemistry, physics and biology is largely influenced by after school and extracurricular activities, by the personality of the teachers, and by active methods used during lessons and circles.

Combining and finding the ratio between traditional and modern teaching methods is a positive thing for teachers to raise children's motivation for the curricular area. This can be accomplished through more professional training along with the changing mentality of teachers. The introduction of student-centred learning requires, and in the opinion of the participating teachers, represents the transformation of students from simple receptors into active "elements" of the instructive-educational process²⁰. Transforming teachers, especially the leaders of thematic circles, into facilitators to find out what the child wants and transform the student into an active seeker of knowledge²¹.

²⁰ S. W. Harmon, & A. Hirumi, "Systematic Approach to the Integrating of Interactive Distance Learning into Education and Training," in *Journal of Education for Business* 71(5), pp. 267-271. May, 1996.

²¹ Ghid pentru profesori și formatori, *Învățarea centrată pe elev*, (2002).

Analyzing teachers' attitudes towards the introduction of competence-centred learning, it can be concluded that there is a desire on the part of teachers to shift from traditional learning to student-centred learning by changing their mentality and using traditional methods in combination with modern methods to prepare the future generation, to introduce them in the modern world, the world of information, and to motivate the students to increase their "hunger for knowledge" offered by the natural sciences, their importance in the everyday life of the children, the harmonious development of their personality, the rediscovery of the beauty of the subjects in the curricular area. Revaluating technology, increasing the quality of education, using interactive teaching methods, will increase the motivation for learning natural sciences, forming attitudes, getting involved in school life. The mastery, the personality and the creativity of the teachers will help in recovery of the natural sciences and in educating generation Z for the everyday life of the 21st century.

This research helps to identify deficiencies in formal and non-formal education in as far as curricular area is concerned, and, in general, education in the field of natural sciences, in technology, and these results can contribute to highlight the gaps in natural science education and to provide a starting point for further analysis.