

FROM SCIENCE IN ART TO THE ART OF TEACHING SCIENCEDANA CRACIUN¹

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Abstract. *Students, but teachers as well, are mostly unconscious of the connection between science and art or humanist sciences, as a result of the differences between these, sometimes even due to the completely different styles in which the subjects are approached. On the other hand, we can observe that contemporary artists do not only utilize edge technology in their creations, but are also inspired by science and even illustrate scientific principles in their artworks. But if art is inspired and is becoming more and more tied to science, couldn't science be taught starting from art? An inter- and trans-disciplinary approach of science isn't easy to achieve, but if the necessary means are found, this approach could lead to the rise in student's interest towards these disciplines, to the growth of creativity in these fields and last but not least, to a learning experience that involves all the senses. In this study we analyze the way teachers integrate different artistic or human science specific resources in the teaching-learning-evaluation process of subjects from the Mathematics and Sciences curricular area. Differences that arise due to the teaching experience, educational environment or multi-disciplinary training, but also the common interest towards the art-and-science teaching activities and the willingness to participate in educational training programs are emphasized. Such objectives can be achieved by initiating projects based on the European Structural Funds.*

Keywords: *science education, modern teaching methods, transdisciplinarity*

1. INTRODUCTION

Art and science were always considered to be located on opposite poles of the cultural life, sometimes even in antagonistic positions. Still, today, contemporary artists not only utilise edge technologies in their creations, but are also inspired and illustrate in their works recent technological discoveries [1]. Thus, we admire paintings and sculptures based on images of the micro and macrocosmos, which not only describe a fraction of the scientific truth but are also presented in a fascinating and suggestive visual form. To underline this idea, one can be reminded of the online and itinerant exhibitions that are presented in various corners of the world. On the other hand, we can observe that during diverse scientific experiments, simulations in physics, biophysics or biochemistry, images and sounds appear that can compete through their beauty or spectacularity with consacrated works of art [2, 3]. What brought art and science together? What keeps them apart? These are only two of the questions that need to be asked and more important, need to be answered, especially if we are willing to raise the student's interest towards real disciplines. One must underline the fact that although there exists some kind of vacuum between these two „cultures” [4], some

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remarkable personalities like Leonardo da Vinci, tried throughout their scientific and artistic work to reunite them and find common principles among them.

But what reunites art and science?

First, both in art and science ideas, theories and assumptions are mandatory verified in spaces in which the mind and the hand work together in laboratories or workshops. Artists, but also scientists, study materials, humans, phenomena or cultures to gain a deeper understanding in order to model and transform the information into something that can be given back to the population in a different form. Educational animation, for example, can relate science concepts to everyday experiences by using increasing levels of abstraction, starting with real world examples and revealing step by step the underlying phenomena [5]. Second, scientists are creative persons and it is a known fact that art is a fountain of creativity. Scientists that practice art develop their creative thinking, their holistic vision about the studied phenomena, underlining specific aesthetic aspects and the way these aspects are combined with functionality. All attributes of a creative thinking – fluency, flexibility, sensibility towards problems – can be developed through art in its various forms (painting, sculpture, music, creative writing, etc.) [6,7]. Third, art is a direct and pleasant way through which modern theories can reach common people, crossing the barrier of a pure scientific understanding. Even C. P. Snow, who launched the idea of the two „cultures” [4], suggests in the second edition of his book, published in 1963, the possibility of the existence of a third culture which will fill the gap between scientists and artists. Intellectuals from this group are scientists that can reach the public and deliver in various forms scientific knowledge. Thus, both youth and elder, common people as well as licensees, can gain access to scientific knowledge avoiding the need of a fundamental scientific basis. It is a known fact that every lecture, sustained by an adequate visual support [8] has a bigger impact, and if this support can feed both the mind and the soul, the winning is doubled. Last but not least, making art means to create, to act, to produce and to finalize, which represents the passing from an idea to its materialization through an effort of will, through direct involvement. The purpose must be taken into consideration even when undertaking scientific studies of phenomena and the laws that govern them. On the other hand, artists do not only benefit from their inspiration but also from the latest modern technologies when realising their work. The question to ask is if in the adult world, these two „cultures” tend to reunite, to harmonize, to communicate, what happens in the universe of youth? It is worth considering these aspects, since a child is a creative being which throughout its development can become a creative, balanced grownup, sensible to scientific truth but also to the way in which this truth is expressed and influences us in our normal activities. For this, in different european countries, Asia and the U.S.A., educational programs that support teaching science through art developed [9-12], not only for students but also for teachers [13-14]. The necessity of this new approach when studying and teaching science was identified also during the POSDRU 19/1.3/G/15852 program. „The formation of teaching competences in chemistry for secondary school teachers with licenses in related disciplines” at the West University of Timisoara, Faculty of Chemistry. Within this project 62 physic, math and biology teachers are involved, willing to acquire competences in order to teach chemistry. These teachers are multidisciplinary trained, and from this perspective they seized the need of a modern way to approach these disciplines more closely to the reality of the XXI century.

2. MATERIALS AND METHODS

In roumanian education, one can observe that ever less students are attracted to „exact sciences” and don’t agree to the traditional approach of studying these disciplines, namely „observe, measure and interpret”. Also, thanks to the Internet and the new technologies, the student is able to learn from diverse sources, not only in school, which means that more and more persons learn in a nontraditional, modern way. Students are more dynamic, more hasty or exactly the opposite, more uninterested, more moony, more insensible – it’s a world of contrasts, sometimes taken to the extreme. The question is, in which way can we revive the real science education. A first step would be to study sciences (using adequate methods) at an early age, starting from the natural curiosity of the children, a curiosity that can develop further to a better understanding and assimilation of this kind of knowledge reducing so the rejection of these disciplines while turning into an adolescent. On the other hand, studying science through modern, nonconventional, applied methods [7,15] can increase the interest of children that would be considered without inclinations to these disciplines, in a traditional learning environment – one such method would be studying science through art. An inter- and transdisciplinary approach of science can also be used to underline the link between these related disciplines but also to develop an understanding of the interconnectivity of disciplines considered not to be related (chemistry, physics or biology and painting or literature for example), having as the final goal a holistic approach of science, of the universe, of life in general. Last but not least, an approach of teaching science that takes into consideration the peculiarities of each student and their intelligence, developing each child in particular (the individual), but as an integrating part of a whole, of a community (the social) [8, 10] can be considered. In our study we are interested in unconventional ways in which science can be studied and how they relate to teachers. We applied a questionnaire to teachers who are both involved in the project POSDRU considering that they have a multidisciplinary training, and some professors of physics, chemistry and biology who graduated from a single specialization. The study is undertaken to identify the need for unconventional approaches to the study of current topics in science (depending on the level of students) in order to propose training programs for teachers in this direction.

We applied the following questionnaire:

Questionnaire regarding approaching science through artistic activities

1. Which are, in your opinion, the best methods for teaching (learning) science in gymnasium and high school respectively? Why?
2. Do you consider that these methods allow you to approach and deepen specific themes belonging to top domains of science?
3. Do you consider yourself as having a multidisciplinary training? If yes, please specify the domains.
4. Do you consider that themes belonging to top domains of sciences can be studied through artistic activities (painting, sculpture, modeling, drama, creative writing, etc)?
5. Do you consider that artistic activities, done during the science class, may bring science and less interested students closer together?
6. Do you consider that approaching science through art would lead to development of creativity (a), holistic approach of science (b), formation of metacompetences (c), healthy and harmonic development of the student (d), development of social skills (e)?
7. Provide the elements that would in your opinion bind science and art together during class. Do you have competences in this domain?
8. If a program of studies in this direction would be proposed, would you participate?
9. Other comments

At the questions 4-6 the teachers had to choose between the following answers:

- I agree
- I partially agree
- I partially disagree
- I disagree
- I don't know

3. RESULTS AND DISCUSSION

The questionnaire was answered by 72 teachers, of which 41 of the POSDRU program and 31 teachers, graduates of a single discipline. The educational level of the POSDRU teachers is high enough, 2% of them having a doctoral degree and 34% having a master degree and these new competences, added to their previous ones, assure an interdisciplinary view on scientific subjects. It shows a different distribution of the weight of traditional methods in addressing science subjects at both the high and middle school level. Teachers who possess a multidisciplinary training feel more acutely the lack of appropriate methods in the first years of middle school, but especially in the last years of high school. A schematic representation is given in Fig. 1.

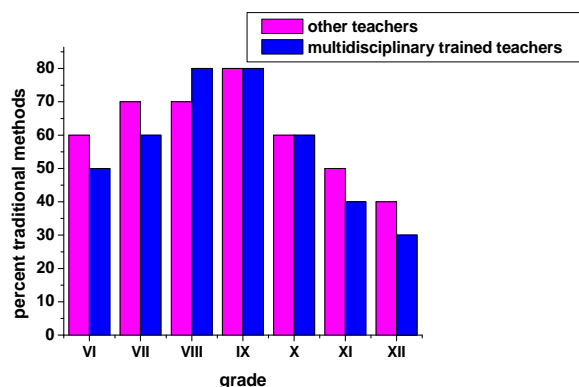


Fig. 1. Weight of traditional teaching methods/ grade.

Answers to questions 4-6 of the questionnaire are summarized in Table 1.

Table 1. Answers to questions 4-6 of the questionnaire.

Q	I agree	I partially agree	I partially disagree	I disagree	I don't know
4	1	51	-	-	20
5	2	60	-	-	10
6 a	70	1	-	-	1
6 b	10	40	2	-	20
6 c	5	40	7	-	20
6 d	59	7	1	-	5
6 e	59	6	2	-	5

A schematic representation for question 6 is given in Fig. 2.

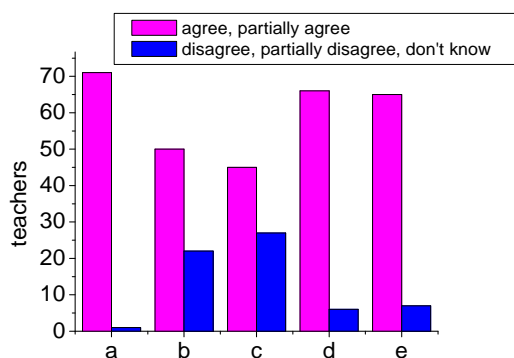


Fig. 2. Distribution of teacher answers regarding question 6

An analysis of the data reveals that 72% consider that some leading issues can be addressed using unconventional methods using for example art; and 86% of participating teachers believe that a creative approach through art can increase students' interest towards science. On the other hand the conclusion that an approach through artistic activities of the science themes leads to the development of student creativity is almost unanimous. The participating teachers believe that this approach could be successful, they admit that they do not have competences in this area (97% of the cases) and would like to acquire them participating in a preparatory program founded of a holistic approach of science. Within the Sector Operational Program for Human Resources Development, new projects could be implemented having as a main objective to form competences to the teachers to combine art and science in their teaching activities with direct consequences into pupils' increased interest for learning sciences.

4. CONCLUSIONS

- In this article we emphasized the need for revival in science education by using unconventional methods in teaching specific subject areas, but also to increase the attractiveness of these subjects. An artistic approach to teaching specific science topics could be the accessibility key for students less interested in science.

- Art and science are not two separate cultures; they can be linked to the teaching-learning-assessment process.

- Although teachers recognize they're not having competences in this area, they still consider that such an approach could increase the students' interest and develop competences that would be harder to earn using traditional methods.

- On the other hand, teachers are willing to participate in programs to develop their teaching competences in this direction, because the use of art can be an exciting way to communicate science.

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