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Original Article

An Analysis of Students' Drawings for the Purpose of Considering the Efficiency of Teamwork (Programme Content: Marine Life Community)

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Abstract

In this paper, a comparison is made between the levels of efficiency achieved when applying team teaching vs. conventional expository teaching, in the framework of the teaching unit "Marine Life Community", involving the students of the sixth grade of "Dvadeseti oktobar" elementary school in Belgrade. In order to accomplish the tasks of this paper, a model of a pedagogical experiment with parallel groups [experimental (E) and control (C)] was applied, involving 100 students.

The aim was to identify and measure the differences and compare the efficiency of these two teaching approaches through an analysis of students' drawings.

Group E was presented the course content through teaching instruction, which included the presentation of an educational film, after which the students were shown printed photos. In group E the biology teacher presented the characteristics of sea-living communities, and the art teacher presented the distribution, different shapes and colours of marine organisms. Group C was presented the same content through traditional teaching methods: oral presentations, illustrations and demonstrations.

The results of our research show that the students who participated in team teaching demonstrated better drawings according to the number and variety of marine organisms.

The results of our study reflect the greater productivity of the students and the higher degree of motivation and activity.

These results are based on the application of a great number of visual teaching technologies in the didactic model of team teaching.

Keywords: *Biology/art; students' drawings; interdisciplinarity; team teaching*

Introduction

Interdisciplinarity

The interdisciplinary linkage of programme contents can contribute to the teaching process; such an approach is holistic and allows the transfer of information from one area to another. One problem can be seen from many different angles: visual (artistic), auditory (musical), verbal (linguistic), kinetic (movement, physical), through natural or social sciences. Including art in science classes provides a stimulus for understanding and solving various problems in the process of learning and creative expression. Although each school subject has a specific curriculum, integration is possible through direct correlation (Stanisavljević & Filipović, 2015).

The students that learn in the traditional ways are expected to demonstrate their understanding of natural phenomena by explaining them orally or in writing. However, when working with students in lower grades, i.e. with children of younger ages that still do not have sufficiently developed verbal and writing skills, the teaching method applied needs to be updated to approach children and assist them in learning and development (Beal & Arnold, 1990).

In the mid 1980s, many studies confirmed that the application of informal methods of teaching led to better results in the process of learning. Some of the modernized teaching approaches are informal discussion, concept maps, drawing and more. When drawing, students are given the opportunity to show their mental picture display much better than in verbal or written explanations (Dempster & Stears, 2014).

To obtain information on students' ideas, teachers can use a large number of diagnostic tools, such as animated films, students' drawings and written works. Through their drawings students can show what they have learned and what they consider important (Chin & Teou, 2010).

Students who usually do not want to reveal their opinion are willing to share their ideas through drawings (Keogh & Naylor, 1998, 1999). Drawing is just a way to express things that students cannot express verbally in the early stages of their schooling. In that way we can effectively monitor their development (Katz al., 2014).Visual presentation is especially useful for students with literacy disabilities, and, therefore, is particularly suitable for primary school pupils (Chin & Teou, 2010). Drawing techniques are especially valuable in encouraging children of younger ages who have difficulty expressing themselves verbally (Holliday et al. 2009).

Drawing is involved in many learning activities. When students draw in school, they do it in the company of their peers. Socio-cultural studies in education show that children interact with each other when drawing, for drawing and talking with peers often go hand in hand (Hopperstad, 2008).

Karlavaris (1991) believed that games were not enough to involve a child in the complex process of artistic design. Games were just a stage in the process, but information given to students and experience were truly vital. In addition to the creative factor, Karlavaris specified formative factors as a condition for the creative process, relating them to perception, motor skills, intellect and emotion. Those factors were interconnected and enabled the emergence of creative results. Karlavaris considered that each of those factors had its own qualitative and quantitative aspect. He made a difference between exact observations as a quantitative factor on the one hand, and sensitive observations and sensitivity as qualitative factors on the other. In the field of motor control, he distinguished motor skill as a quantitative factor and motor sensitivity as a qualitative factor. In the sphere of intellect he differentiated visual memory as a factor which collects and maintains data in the mind, then the quantitative factor, as well as creative visual thinking as a qualitatively creative factor. In the sphere of emotional imagination there is a quantitative factor that allows it to relate an image to certain emotions. (Karlavaris, 1991).

Art is not just a show of external images but is also the result of internal operations, the notion of external objects, so it is important to analyze these processes through the stages of child development, especially in art (Lowenfeld & Lambert, 1975).

There are numerous advantages in applying drawing methods during schooling. Firstly, many scientists believe that this is a powerful instrument that reflects the way of thinking, emotions, internal representation and perception of students. Secondly, the introduction of this method provides a more pleasant working environment for students,

and drawings make it possible for students to communicate with each other. Thirdly, in the early stages of schooling, this is a convenient way to overcome fear related to verbal difficulties. Fourthly, the process of drawing as a multidimensional factor, expresses students' views, understanding and attitudes. Drawing confirms objectivity in the projection of individual beliefs. Also, the method of drawing is more objective and easier for the purposes of quantitative analysis than the majority of others (Kubiatko et al., 2012).

The aim of the analysis of students' drawings

In her book "Children's Drawings", Cox (1992) talks about the characteristics of children's drawings and the possibilities of analysis and observation of children's work. She indicates that children, in their artistic expression, dedicate a lot of attention to the symbolism of their drawings, as a way of communication with the outside world.

The application of drawing can be analyzed in two ways. First of all, there is the analysis of objects as characters that should carry a meaning, and then the analysis of what students consider to be relevant to show (Hopperstad, 2008).

One of the challenges in interpreting students' understanding is to explain how the process of applying the acquired knowledge goes. Drawing is useful for students' understanding of different contexts and phenomena (Dempster & Stears, 2014).

During the experimental work with children, in addition to being asked to make a drawing, they were asked to write a short comment, in order to achieve a holistic approach. (MacDonald, 2009). Drawing is an even more relevant tool in assessing students' understanding if it is accompanied by a written commentary (Chin & Teou, 2010).

It is important to mention that there are no ideal criteria for the interpretation of children's artwork; these criteria are diverse and depend on what is seen in their artwork. As regards the analysis, assessment, and evaluation of children's artwork in the educational process, the most important task of teachers and educators is to understand the great diversity of and develop sensitivity to children's art expression. Children's drawings are a mirror of their development and reflect their inner world (Malchiodi, 2012). Through drawings children reconstruct their opinion and express their own ideas (Salmon & Lucas, 2011).

There are numerous studies that analyze the notions that appear in children's drawings, where children want to show their understanding of nature and social phenomena. A wide range of drawings reveal the essential aspects of their conceptual development. Drawings representing plants often also contain atmospheric elements (rain, clouds and the sun) and land. This is associated with conceptual development, i.e. with their understanding that these elements are very important for the life of plants. Based on this we can conclude that children's drawings are very useful as a resource in the evaluation of their conceptual development in childhood, or that they express the connection between the processes of thinking and drawing (Villarroel & Infante, 2014).

Drawing is considered a very successful method in monitoring students' understanding. In this respect, drawings offer a "window" to their conceptual knowledge. A great way to describe an object is to draw it (Göçmençelebi & Tappan, 2010).

Team teaching

Team teaching is described as a didactic model in which two qualified teachers of different subjects work together on the planning, implementation and evaluation of students' activities. There are two major categories of team teaching: category A - two or more teachers teach the same students at the same time in the same classroom, and category B -

teachers work together but do not have to teach the same group of students, nor are these students necessarily taught at the same time.

In this categorization there appears a subtype in category A - cooperative teaching. This means working with smaller groups of students, developing a discussion among the students, and encouraging their cooperation, coordinated by both teachers. In these classes teachers plan together their teaching time and prepare materials. Teachers do not have a monologue in class; they rather develop a dialogue, involving the students in the discussion and polemics (Goetz, 2000). In this research we have applied cooperative education (within category A).

Team teaching means that two or more teachers are involved in the implementation of the teaching process. Since only one teacher can speak at a time, there can be small differences in the time required for each team member. Specific topics and tasks are divided between teachers, according to their particular individual abilities and the contents within the scope of their competence. For this reason, it is best to have teachers who can complement each other with regard to their areas of expertise. If two or more teachers have the same strengths and weaknesses in the subject area, team teaching cannot be effective; it would, therefore, be useful for the teachers to complement each other. Some advocates of teamwork believe that these teachers should be completely equal, none of them being the leader (Wadkins et al., 2004).

Comprehensive studies on the success of cooperative teaching have come to the conclusion that this method of teaching improves cognitive and socio-emotional climate in the classroom (Espey, 2008).

Team teaching increases commitment to students and enables working with small groups of students (Michaelsen & Sweet, 2008).

Team teaching manages to overcome the problem which arises when teachers are limited by programme contents. In this way, holes in the learning process are filled. Students create a clearer picture of some phenomena and processes. When the curriculum is rationally organized, it enables time saving, as teachers of different subjects complement each other. Team teaching boosts students' motivation and awakens further interest in specific areas (Doebler & Smith, 1996).

The significance of integrating the teaching contents of art and biology, and methodological approaches

Exploring the natural and social environment depends significantly on the level of the visualization process and the level of art, because in that area there is an extensive use of the method of presentation and representation. Art education has an impact on the development of students' visual perception, as well as on the development of their ability of observation and their experience of the world surrounding them. Organized observation encourages thinking and boosts the creative impulse. It is known that students' drawings visualize different contents from their conscious mind, activating and reflecting their perception, concepts and thinking, imagination, emotions, socio-emotional attitudes and motor skills. For example, learning about flora and fauna will be one-sided if no aesthetic features are presented (like colours, shapes, etc.) to initiate a powerful impulse to create. When drawing, students express their artistic experience of nature and social relations. Artistic activity encourages students' interest in a specific phenomenon. Students' artwork represents various known, seen or experienced phenomena in nature and social relations. In a word –students acquire a rich life experience. In fact, they show their attitude and feelings towards the world that surrounds them. (Stanisavljević & Filipović, 2015).

Teaching biology includes a wide range of teaching approaches, methods and teaching aids, in accordance with the programme contents, objectives and tasks of teaching (Stanisavljević & Stanisavljević, 2014). There is the possibility of implementing various visual techniques to master the content of biology.

Interdisciplinarity concerning art and biology is achieved by developing creativity in students. The higher level of motivation encourages children's interest in science contents in the field of biology. Applying lessons learned through artistic creativity is encouraged in order to develop skills that deepen the knowledge and make it more fundamental and less abstract (Gurnon et al., 2013).

Examples of team teaching

Clemens and McElroy (2011) conducted a study that included the uses of the didactic model of team teaching, integrating the contents of the English language, history and biology. The English language was used for the interpretation of the roots of technical terms, thus facilitating the students to master historical and biological terms. The interdisciplinary approach involving biology and history turned out to be very useful. The students were explained the connection between the occurrence of certain diseases on the one hand, and economic, agricultural and trade development on the other. It was a good starting point for integrating the two elements. (Clemens & McElroy, 2011).

Helikar et al. (2015) conducted a project in which the authors combined the realization of biological contents and the development of computer skills, and showed how that reflected on the students' knowledge. The interaction between the teacher of biology and the computer science enabled the students to visualize biological phenomena and processes, assisted by computer techniques. Thus, the problem of two-dimensional images of textbooks was overcome; furthermore, the simulation of biological processes showed dynamic systems that functioned over time (Helikar et al., 2015).

Team teaching which included biology and mathematics teachers was aimed at integrating the curriculum and overcoming barriers to the realistic presentation of information, conducting biological research, and enabling students to translate their knowledge of mathematics into practice (Feser et al., 2013).

Methods

The main task of this study was to experimentally determine the efficacy of the didactic models of team teaching, reflected in the interaction of a biology teacher and an art teacher in the implementation of the program content "Marine Life Community", intended for sixth grade students. The survey was conducted in "Dvadeseti oktobar" elementary school in Belgrade. The outcome of the applied experiment was monitored through the analysis of students' drawings on the theme "How do I see Marine Life?". The main question to be considered was: "Can an interdisciplinary approach improve the quality and efficiency of acquiring new knowledge?".

The null hypothesis is that there is no statistically significant difference between the drawings of the experimental and the control group after the introduction of experimental factors (team teaching with the use of additional visual aids in the form of pictures and short educational films) in the experimental group.

The alternative hypothesis is that there is a statistically significant difference, based on the analysis of children's drawings, after the introduction of experimental factors in the experimental group. According to the alternative hypothesis, it is expected that the

observed differences in the quantity and quality of the displayed content between the control and experimental groups, show a greater achievement of the experimental group. The aim of the research was to detect and measure the differences in the results obtained, in order to compare the efficiency of these two models of teaching.

The research included 100 students of the sixth grade of "Dvadeseti oktobar" elementary school, Belgrade. For the purposes of this research we applied the model of the pedagogical experiment with parallel groups [experimental (E) and control (K) groups], according to the given scheme (Appendix 1).

The students were divided into group E and group K (Killermann, 1998). Before the introduction of the experimental factors, the groups were equalized with respect to the number, gender and achievement. The uniformity of the groups regarding the number and gender was confirmed by the Chisquare test (Fisher, 1922).

In group E, the presentation of the programmes contents "Marine Life Community" started with short instructional films showing the way of life and the relationships of organisms under the sea. These were short five-minute films. The students rearranged their benches in such a way that everyone could see the projection screen equally well. This facilitated an interaction among the students, but also between the students and the teachers. The next step was sharing photos of some typical animal and plant species living at the bottom of the sea. The biology teacher explained the life forms, lifestyle and diet of marine organisms, followed by the art teacher's presentation of different shapes and contours of the body, and by a discussion with students about the sea areas and the layout and range of colours that appeared.

As for group K, the same contents were presented in the traditional way. A textbook, containing texts and images, was used. Frontal teaching dominated. The unit was presented only by the biology teacher, without using any additional visual teaching aids or applying an interdisciplinary approach.

In order to avoid any parasitic factors, the students from groups K and E were separated in two different classrooms and divided into two shifts- the morning and the afternoon shift.

Finally, the students of both groups were told to bring crayons to class in a week's time.

After a week, at the next meeting, the following was written on the blackboard: "How do you imagine the marine world?". Each student received an A4 drawing paper and was told to use the crayons to draw. At the same time the students were given the following instructions:

"We would like each of you to draw how you imagine the marine world. This is not a test, so do not look at each other's papers. You can draw as much as you want, but we believe that 15- 20 minutes should be enough. This is a part of a research project, which involves many children of your age. In the end, write a brief comment on the back of the paper on what you displayed in your drawing".

Teachers were prepared to answer the student's questions about what to draw by replying: "It is up to you, you have all the freedom, you cannot go wrong" (Dempster & Stears, 2014).

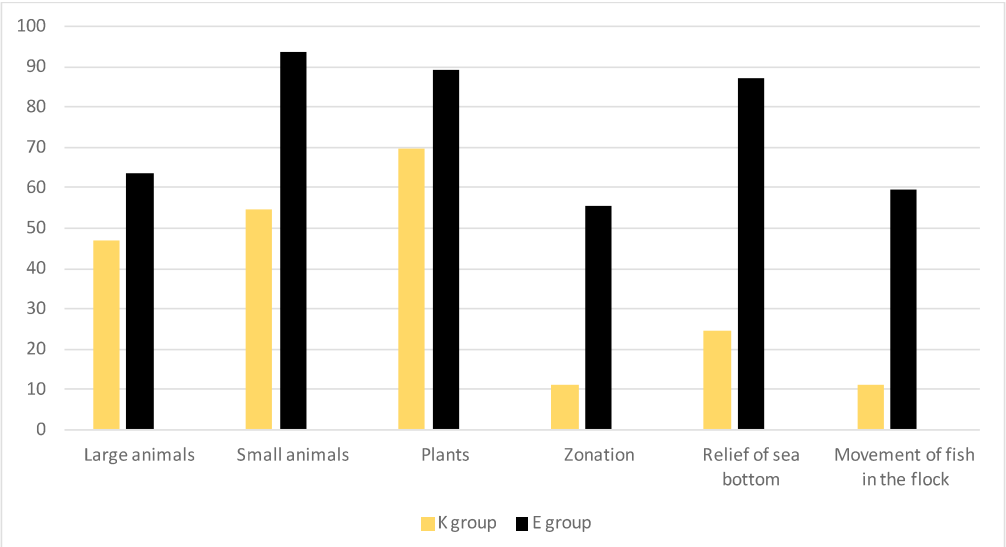
The data and the results were analyzed using standard statistical methods (sum, percent- age distribution, average, standard deviation, coefficient of variation and a Student's t- test (Student, 1908). To obtain data, we used the statistical software package Statistics 6 (StatSoft, 2001).

Results

The results from the representation of different categories of animals are presented in Table 1 and Graph 1.

Table 1. Overview of the relevant categories for the analysis of students' drawings.

Category	Description
Large animals	The student representatives big fishes with cartilage and bone skeleton and large sea mammals.
Small animals	The student displays small marine invertebrates.
Plants	The student displays any of the plant organisms present under the sea.
Zonation	The students respects the propositions concerning the occurrence of certain organisms in different zones.
Relief of sea bottom	The student shows abiogenic and biogenic component of the seabed.
Movement of fish in the flock	The student observes and shows the organization of small fish in the flock.



Graph 1. The frequencies of certain categories of the students' drawings – groups K and E.

Table 2 enables us to monitor if there is a statistical difference concerning the incidence rates of animals in the drawings of the experimental and the control group. The results were obtained with the help of a Student's t-test (Student, 1908).

The results obtained by analyzing students' drawings for the experimental and control

groups, based on the statistical methods of a t-test, were as follows: proceeding from the significant level p = 0.05 and the critical value t =1.96, we concluded that there was a statistically significant difference between groups E and C concerning the number of represented organisms on the drawings (t = 3.54> 1.96)

Table 2. Main statistical indicators of the groups according to the present number of animals (basic statistical indicators of success $\bar{x}$- mean number of displayed animals; S- standard deviation; V-coefficient of variation).

Group	$\bar{x}$	S	V
E	17,87	9,16	51,26
K	7,79	4,96	63,72

Discussion

The results of our research show that the students who participated in team teaching demonstrated better drawings according to the number and variety of marine organisms, related to the topic “How do you imagine the marine world?”. Their drawings were characterized by a better set of colours, greater attention paid to spatial distribution and a greater diversity of organisms. (Appendix 2). Data were analyzed and presented in the framework of six categories described in Table 1. Furthermore, the results obtained by the analysis of the students’ drawings were displayed in Graph 1. As shown in Table 2, based on the application of a Student’s t-test, the difference in the number of animals drawn by the students in the experimental and control groups is statistically significant. The statistical significance proves that the students of the experimental group yielded better results, primarily reflected in the number and variety of marine animals displayed in the drawings. The most frequently drawn animals were fishes; the students most frequently saw them as marine organisms. All the aforementioned results of this research correspond to the results of other studies that considered students’ productivity, higher motivation and a greater degree of activity. The effectiveness of this approach is confirmed by the many works that will be discussed below.

In his study, Teixeira (2000) explored the way in which students developed their knowledge of biology. The author argues that children up to ten years of age have an intuitive knowledge, stemming from intuitive psychology. In later stages of development, there is a socio-cultural context in which children critically examine new facts and acquire more advanced ideas of biological concepts. In the earlier stages of development, personal experience is crucial, and it is only later that the logic of verbal arguments is analyzed. In response to the focus question of the research, which was “What happens to the food you eat?”, children most frequently drew the digestive, respiratory and skeletal systems, rarely showing any other system. The frequent occurrence of the three mentioned systems is the result of children’s experimental knowledge; they come across the stories about these organs in everyday life, and thus are more familiar with their structure and functioning (Teixeira, 2000). In view of the above, it is advisable that the lecture should start with more familiar and continue with less known systems (Dempster & Stears, 2014).

Numerous studies have discussed the way in which outdoor teaching in a botanical garden and ecological classrooms (the green classroom) reflected in students’ drawings

on natural habitats (forests, lakes). The results of this study show that this type of teaching results in a large number of biological species presented on the drawings, primarily small and large animals. In the drawings, students who had not had the opportunity to attend outdoor classes, presented a significantly smaller number of species, mainly large animal species, rarely invertebrates (insects, worms) and other species that are important for maintaining ecological balance (Drissner et al., 2014). However, both girls and boys who had had the opportunity to visit some natural habitats within biology classes, expressed more emotions, reflected in their drawings in terms of the number of the drawn animals and the diversity of the colours used (Reiss et al., 2002, 2007).

Similar results were obtained in another segment of the research, in which the students spent some time in a botanical garden in order to better understand the vegetable world. Scientists have noticed that the knowledge of the plant world is at a much lower level as compared to that of the animal world. One of the reasons for this is the absence of any obvious dynamics of plant organisms, as well as the lack of systematic monitoring and observation of these organisms. When visiting botanical gardens, students are able to notice the described biological phenomena and processes in the natural environment. The results of the research showed the usefulness of visiting botanical gardens and the connection with the programme content concerning the living environment. The analysis of students' drawings showed that children who had had the opportunity to visit a botanical garden presented more plant species. Students showed the adaptation of carnivorous plants, and almost all of them drew the ginkgo because of its characteristic aroma. Among others, two assumptions were confirmed – that aesthetic visual impressions leave a deep mark upon the memory, and that smell leaves the most durable impression. In their comments, the students explained that they had presented other plants in their drawings because they had been delighted by the variety of colours. The initial idea of this research, suggesting that activating more senses in children helps to form more durable memory, was confirmed (Nyberg & Sanders, 2014). What these two scientists point out, is that after attending this type of class, children speak about plants more often and develop the habit of taking care of their plants at home.

Villarroel and Infante (2014) came to very productive conclusions about students' misconceptions of what makes up the living world through the analysis of children's drawings. Given that the focus of the presentation was the world of plants, in addition of drawing the anatomy of plants, many children inevitably depicted atmospheric factors, such as rain and the sun, or land. This suggests that children understood plants as living systems, whose survival is possible only in the presence of water and the sun. Since trees were mostly portrayed as individual and isolated entities, it would be difficult to conclude that the children saw trees as a part of the living world. The analysis of children's drawings is the original method and procedure for considering children's understanding of biological concepts. This serves as a basis for further expansion of knowledge in this field, for combating misconceptions and making knowledge more constructive (Villarroel & Infante, 2014).

Drawing improves conceptual understanding. While drawing, focus must be maintained regardless of whether it is just simple memorizing of data or complex understanding. The credibility of such drawings is supported by a written commentary attached. Drawing helps the student to have a better perception of the essential content that is considered (Göçmençelebi & Tappan, 2010).

Studies have shown that if a scientific text is supported by a drawing or a visual presentation of the essence of the text, students exhibit greater knowledge in their final tests.

It was proved that the students who drew while considering a text acquired greater knowledge than those who considered the same text without drawing. This proved the thesis that students' self-activity, personal engagement and a high degree of motivation, inevitably led to positive results, reflected in the high degree of autonomy, better quality of knowledge and a more systematic knowledge (Schmeck et al., 2014).

Wadkins et al (2004) presented the results of their research, noting the positive aspects of team teaching: (1) students have the opportunity to learn about different styles of teaching, (2) students can deepen their knowledge in certain areas, and (3) teachers can learn useful information from each other in terms of programme contents and teaching styles. The biggest advantage of this model is being able to show students how to work as a team and how to deal with their differences in order to achieve a common goal. In addition, students' knowledge is expanded when the same contents are presented from several different angles. (Wadkins et al., 2004).

Over the past four decades, researchers (Anderson, 1989; Doebler & Smith, 1996) have indicated that team teaching is valuable and should more often be an alternative to traditional teaching, involving only one teacher.

Upon completing the model of team teaching, Clemens and McElroy (2011) presented the results which were very good. The students of the three subjects (English, biology and history) achieved the results that were much better than their previous results in these areas. Particularly noteworthy was the development of scientific literacy, critical thinking and the global awareness of various phenomena in human society. Students were willing to engage in debates and discussions, defending their views on a particular phenomenon or process (Clemens & McElroy, 2011).

Goetz (2000) points out the benefits of team teaching on the basis of literary data, the experience of teachers and students' results. These advantages are reflected in the cooperation of teachers, their joint time planning and detailed consideration of certain areas, thus avoiding any blank segments. Students develop skills and knowledge which cannot be developed when teachers lead their classes individually. Different views on one and the same idea contribute to the durability and quality of students' knowledge, which is possible only through team teaching (Goetz, 2000).

The advantages of combining art and science do not arise from the mentioned cooperation itself, but from the success as a product of that cooperation, which has the potential to inspire new styles of learning. It is necessary to find creative ways for students to evolve and keep a lasting sense of curiosity concerning scientific discoveries. Employing several senses in children contributes to acquiring greater knowledge both in terms of quantity and quality. Art Culture offers extensive knowledge of different techniques which help children in psychomotor development. It also creates the potential to combine biology and art. In this way, students develop skills that are permanent and that become more complex over time (Gurnon et al., 2013).

Cooperative teaching of mathematics, computer science and biology is achieved by erasing the boundaries between teaching and research. The results obtained from the research which was based on teamwork and which included these three subjects, showed that in this way children developed critical thinking, pioneering spirit and the quality of the long-term retention of data. Students developed independence in their work, resulting in their ability to perform computer experiments relating to different biological processes and phenomena that change over time. Students were trained to independently conduct the entire research process. The implementation of such a project and the innovative approach are achieved by systematically expanding children's knowledge (Helikar et al., 2015).

The conclusion of this study, within which the students attended a class simultaneously held by a biology teacher and a mathematics teacher, is that this type of teaching has an impact on students' performance in learning. The students involved in the study stated that after being taught simultaneously by two teachers of different subjects, mathematical methods and formulas became meaningful and easier to learn. The programme contents of biology had helped them understand how biological systems were variable and subject to change, and that there was a need for constant monitoring of developments in nature and for continuously conducting research. Finally, the students comprehended the meaning of an interdisciplinary approach when the two subjects are in question. When asked how they perceived biology, the students who were involved in the conducted study agreed that they no longer saw biology as a set of definitions or a content that could only be learned by heart, but as a meaningful content that you know how to interpret (Feser et al., 2013). Students often have expert knowledge in different areas that is separated, and do not have the ability to integrate and improve this knowledge; it was proved that this deficiency could be overcome through this approach. (Marsteller, 2010).

It turned out that when you presented biology in the form of specific data and examples, rather than as an encyclopaedic science, it enabled children to begin building their knowledge based on some key biological concepts. In this way, teachers promote the scientific approach and interest in science (Duncan et al., 2011). The interpretation of data is essential for any biological researchers. Students who were demonstrated how data should be interpreted, showed the ability of critical thinking and analyzing visual and quantitative information as a tool for building and clarifying specific terms (Barsoum et al., 2013).

Conclusion

On the basis of the obtained results, it can be concluded that modernizing the teaching technology encourages greater students' involvement. When adequately implemented, different types of visual aids, such as photos, as well as audio-visual aids, such as specific educational films, result in the higher motivation of students, and consequently- in the greater efficiency of teaching time. Thus, the introduction of visual and audio-visual teaching aids provides better results concerning the content of students' drawings.

In this study, team teaching is considered as a didactic model, and the results should encourage other teachers to cooperate, and to plan and organize their classes jointly.

According to the analyzed students' drawings, we can notice that, as compared to the control group, the students in the experimental group showed much better spatial orientation. Different forms of marine organisms, their flock organization and diversity, were more prevalent in the drawings of the students whose lectures were organized through teamwork. The drawings of the students of the control group were less creative, had a narrower range of colours and contained a small number of marine organisms, while the distribution of the species was incorrect.

The final conclusion is that if we at the same time motivate students to work and engage them intellectually, that will directly affect their creativity in terms of their ability to represent living beings and the organizations of such beings in a drawing.

In view of the above, we can conclude that students' creativity should be encouraged in the future through drawing within teamwork, not only in the context of biology and art, but also in the context of other subjects.

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Reference

Anderson, R. H. (1989). A second wave of interest in team teaching. *Educational Digest*, 18-21.

Beal, C. R. & Arnold, D. S. (1990). The Effect of Instruction on View Specifity in Young Children's Drawings and Picture Selection. *British Journal of Development Psychology,* 18, 393-400.

Barsoum, M., Sellers, P.J., Campbell, A.M., Heyer, L.J. & Paradise, C.J. (2013). Implementing recommendations for introductory biology by writing a new textbook. *Life Science Education,* 12, 106–116.

Chin, Ch. & Teou, L. T. (2010). Formative assessment: Using concept cartoon, pupils' drawings, and group discussions to tackle children's ideas about biological inheritance. *Educational Research,* 44(3), 110-117.

Clemens, B. J. & McElroy, H. (2011). Team Teaching History, English and Biology: An Integrative Approach. OAH *Magazine of History*, 25(4), 49-50.

Cox, M.V. (1992). *Children's drawings.* Pennsylvania: Penguin Books.

Dempster, E. & Stears, M. (2014). An Analysis of children's drawings of what they think is inside their bodies: a South African regional study. *Journal of Biological Education, 48*(2), 71-79.

Doebler, L. & Smith, C. (1996). Enriching a survey course in educational psychology through a team teaching format. *Education*, 117, 85-88.

Drissner, J. R., Haase, H.M., Wittig, S. & Hille, K. (2014). Short-term environmental education: long-term effectiveness? *Journal of Biological Education*, 48(1), 9-15.

Duncan, D.B., Lubman, A. & Hoskins, S.G. (2011). Introductory biology textbooks under-represent scientific process. *Journal of Biological Education*, 12, 143–151.

Espey, M. (2008). Does Space Matter? Classroom Design and Team-Based Learning. *Review of agricultural Economics,* 30(4), 764-775.

Feser, J., Vasaly, H. & Herrera, J. (2013). On the Edge of Mathematics and Biology Integration: Improving Quantitative Skills in Undergraduate Biology Education. *Life Sciences Education*, 12, 124–128.

Fisher, R. A. (1922). On the interpretation of Chi-square from contingency tables, and the calculation. *Journal of the Royal Statistical Society*, 85, 87-94.

Göçmençelebi, Ş. I. & Tapan, M. S. (2010). Analyzing students' conceptualization through their drawings. *Procedia- Social and Behavioral Sciences*, 2(2), 2681-2684.

Goetz, K. (2000). Perspectives on Team Teaching- A Semester I Independent Inquiry A Peer. *Reviewed Journal*, 1(4), 1-5.

Gurnon, D., Voss-Andreae, J. & Stanley,J. (2013) Integrating Art and Science in Undergraduate Education. *PLoS Biol,* 11(2): e1001491. doi: 10.1371/journal.pbio.100149.1.

Helikar, T., Cutucache, E.C., Dahlquist, M.L., Herek, A.T., Larson, J.J. & Rogers, A.J. (2015). Integrating Interactive Computational Modeling in Biology Curricula. *PLoS Comput Biol,* 11(3): e1004131. doi: 10.1371/journal.pcbi.1004131.

Holliday, E. L., Harrison, L. J. & Sharynne, M. L. (2009). Listening to Children with Communication Impairment Talking through Their Drawing. *Journal of Early Childhood Resarch*, 7(3), 244-263.

Hopperstad, M. H. (2008). Relationships between children's drawing and accompanying peer interaction in teacher-initiated drawing sessions. *International Journal of Early Years Education*, 16(2), 133-150.

Karlavaris, B. (1991). Arts teaching methodology 1 and 2. Rijeka: Hofbauer [orig. in Croatian: Metodika likovnog odgoja].

Katz, C., Barnetz, Z. & Hershkowitz, I. (2014). The effect of drawing on children's experiences of investigations following alleged child abuse. *Child Abuse & Neglect*, 38, 858-867.

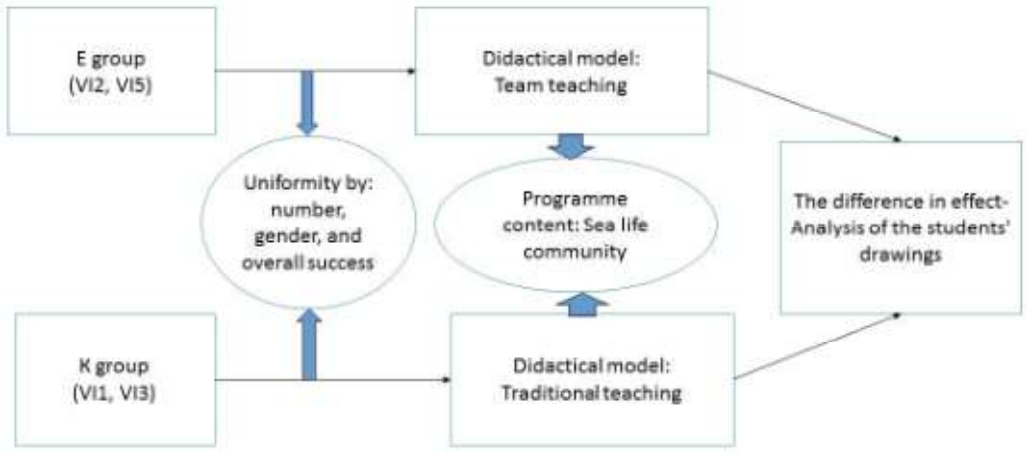
Keogh, B. & Naylor, S. (1998). Teaching and learning in science using concept cartoons. *Primary Science Review*, 51, 14-16.

Keogh, B. & Naylor, S. (1999). Concept cartoons, teaching and learning in science: an evaluation.

International Journal of Science Education, 21(4), 431-446.
Killermann, W. (1998). Research into biology teaching methods. *Journal of Biological Education*, 33(1), 4-9.
Kubiatko, M., Yilmaz, H. & Topal, Z. (2012). Czech Children's Drawing of Nature. *Educational sciences: Theory & Practice*, 3111-3119.
Lowenfeld, V. & Lambert, B. W. (1975). *Creative and mental growth.* New York: Macmillan.
MacDonald, A. (2009). Drawing stories: The power of children's drawings to communicate the lived experience of starting school. *Australasian Journal of Early Childhood*, 34(2), 40-48.
Malchiod, C. A. (2012). *Understanding children's Drawing.* New York: Guilford Press.
Marsteller, P. (2010). Beyond BIO2010: integrating biology and mathematics: collaborations, challenges, and opportunities. *Life Science Education*, 9, 141–142.
Michaelsen, L. K. & Sweet, M. (2008). The Essential Elements of Team-Based Learning. *New Direction for Teaching and learning*, 116, 7-25.
Nyberg, E. & Sanders, D. (2014). Drawing attention to the 'green side of life'. *Journal of Biological Education*, 48(3), 142-153.
Reiss, M. J., Tunnicliffe, S. D., Andersen, A. M., Bartoszeck, A., Carvalho, G. S., Chen, S. Y., Jarman, R., Jónsson, S., Manokore, V., Marchenko, N., Mulemwa, J., Novikova, T., Otuka, J., Teppa, S. & Rooy, W. V. (2002). An international study of young peoples' drawings of what is inside themselves. *Journal of Biological Education*, 36, 58 – 64.
Reiss, M. J., Boulter, C. & Tunnicliffe, S. D. (2007). Seeing the Natural World: A Tension Between Pupils' Diverse Conceptions as Revealed by Their Visual Representation and Monolithic Scence Lesson. *Visual Communication,* 6(1), 99-114.
Salmon, A.K. & Lucas, T. (2011). Exploring Young Children's Conceptions about Thinking. *Journal of Research in Childhood Education*, 25(4), 364-375.
Schmeck, A., Mayer, R. E., Opfermann, M., Pfeiffer, V. & Leutner, D. (2014). Drawing pictures during learning from scientific text: testing the generative drawing effect and the prognostic drawing effect. *Contemporary Educational Psychology*, 39, 275-286.
Stanisavljević, J. & Filipović, S. (2015). Analysis of children's drawings in the function of considering and understanding of biological phenomena and processes [In Serbian], *Art and theory, Review of the faculty of fine arts*, 1(1), 58-63.
Stanisavljević, J. & Stanisavljević, L. (2014). The Application of Concept Maps in Teaching Invertebrate Zoology. In: D. Krüger & M. Ekborg (Eds.). *Powerful Tools for Learning in Biology*, Berlin: Freie Univerzität Berlin, Chapter 13, 197-211.
StatSoft, Inc. (2001). *Statistica for Windows* (version 6) [data analysis software system]. Available online at: www.statsoft.com
Student (Gosset, W. S.) (1908). The probable error of a mean. *Biometrika*, 6, 1-25.
Teixeira, F. M. (2000). What happens to the food we eat? Children's conceptions of the structure and function of the digestive system. *International Journal of Science Education*, *22*(5), 507–520. doi:10.1080/095006900289750
Villarroel, J. D. & Infante, G. (2014). Early understanding of the concept of living things: an examination of young children's drawings of plant life. *Journal of Biological Education*, *48*(3), 119-126.
Wadkins, T., Wozniak, W. & Miller, R. L. (2004). Team Teaching Models. *UNK/CTE compendium of teaching resources and ideas*, 77-87.

Appendices

Appendix 1: Scheme of research methodology.



Appendix 2: Drawing of student from the experimental group.

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