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Trial-productive Action of Younger Adolescents (on the Material of Coordination of Educational Subjects of Biology and Literature)

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The work is aimed at identifying the norm of development of test-and-productive action in younger adolescents. The study presents creative and test works analysis of 114 6th-year students taking the course "New Biology" in the frame of the D.B. Elkonin—V.V. Davydov system. The creative task they perform requires study subjects coordination; i.e. transformation of the natural science physiological processes eventivity into the eventivity of a verbal artistic work, framed by the laws of cultural forms, specific for literature. This type of task may be considered as a provocation of a learning trial, and its successful fulfilment as a trial-and-productive author action. We highlighted and described typical variants of performing this work, demonstrating the diversity of ways in which the scientific concept of breathing is integrated into the learning process. As the age development norm, the highest possible achievement, is a successfully realized "double" trial, when artistic success is combined with adequate use of biological concepts. A well-developed and sufficiently disciplined imagination allows a student to accept/set proper task and avoid falling into a semantic hole of underconstructed scientific concept, and to build an adequate artistic image that helps to hold onto shaky ground of conceptual supports.

Keywords: learning trial, productive action, subjects coordination, conceptual development (conceptual changes).

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Пробно-продуктивное действие младших подростков (на материале координации учебных предметов биологии и литературы)

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Работа направлена на выявление нормы развития пробно-продуктивного действия у младших подростков. Представлен анализ творческих и проверочных работ 114 учеников 6-х классов, изучающих курс «Новая биология» в системе Д.Б. Эльконина—В.В. Давыдова. Выполняемое ими творческое задание требует координации учебных предметов, т. е. преобразования естественно-научной событийности физиологических процессов в событийность словесного художественного произведения, подчиненную законам культурных форм, характерным для литературы как вида искусства. Показано, что такое задание может рассматриваться как провокация учебной пробы, а успешное его выполнение — как пробно-продуктивное авторское действие. Выделены и описаны типичные варианты выполнения этой работы, демонстрирующие разнообразие путей становления научного понятия дыхания в процессе обучения. Нормой возрастного развития — т. е. высшими возможными достижениями — в этой сфере можно считать успешно реализованную «двойную» пробу, в которой художественная удача сочетается с адекватностью использования биологических понятий. Развитое и в достаточной мере дисциплинированное воображение позволяет ученику принять/поставить собственную задачу и избежать попадания в смысловую дыру недостроенного научного понятия, выстроить адекватный художественный образ, помогающий ему удержать еще шаткие понятийные опоры.

Ключевые слова: учебная проба, продуктивное действие, координация учебных предметов, развитие понятий (концептуальные изменения).

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Introduction

When studying the issue of action formation in ontogenetic human development, B.D. Elkonin founds the idea that the cycle of productive action is an act of development [12]. The internal coherence of the cycle is the connection of its semantic and operational-technical aspects, about which D.B.Elkonin wrote [15]. Productive action in the artistic sphere is possible as early as in the primary school age in the form of creating author's works (the course of G.N. Kudina and Z.N. Novlyanskaya [4; 11]). The material on which the concepts of genre, plot, composition, and means of artistic expression are tested are the child's life experiences. Discussion of children's essays and their inclusion in the literary magazine of the class is publication, the second stage of productive action. Similar activities are presented in the course of fine arts by Y.A. Poluyanov [5].

It is typical for the subjects of art and aesthetic cycle to have tasks in which author's action is not only possible, but essentially necessary, but such learning trials in the subjects of natural science cycle are still rather exotic, although they are important for mastering scientific concepts. The search for tasks that enable the implementation of learning trials becomes a separate task for the developers of training courses [9]. According to our hypothesis, an important place among them should be occupied by tasks involving the coordination of academic subjects [13]. A concept formed within one subject can become a material for transformation and comprehension in actions that follow the logic of another subject. Publication occurs when independent student work is

presented, discussed and used in the cognitive movement of the class.

In this paper, we will attempt to consider the performance of one of such tasks ("New Biology", 6th form) by young adolescents as a trial-and-productive action, and tentatively outline the norm of age-specific development, understood, according to D.B. Elkonin, as the highest possible achievements in this area [14]. It is probable that the analysis of children's works carried out at the stage of concept formation [8; 17] will also help in studying the transformation of everyday concepts into scientific ones [3; 18; 19].

One of the exercises of the "Animals" module is as follows: "Compose and write down your story of how organic substances and oxygen appeared and met in the internal environment of an amoeba (genre of your choice: lyric, epic, fairy tale, fable, folktale, journalistic report...)" [6]. By the time the task was completed, the pupils had passed half a year's way of developing the scientific concept of respiration as a process of oxidation of organic substances in the internal environment of a living cell with the formation of water and carbon dioxide and the release of energy for other life processes [8; 17].

Fulfilling the task means transforming the natural scientific eventuality of physiological processes into a completely different eventuality. While the eventuality of biology is indifferent to any emotionality, and to any aesthetic and moral evaluability, the eventuality of a verbal artistic work is subordinated to the tasks of aesthetic and ethical influence on people and to the laws of cultural forms typical of literature as an art form. Transformation of this kind requires, firstly, allocation of certain **protagonists** (characters), secondly, creation of a field of their action, in which they would manifest themselves: they would pass through the ordeals of their inner qualities and make a moral choice. This field of action should be constructed as the **plot** of the work, the main reference points of which are the starting point, climax and denouement. In the given variant of the task, organic substances and oxygen are clearly claimed to be the characters. The events in which they will have to act are: 1) the penetration of the characters through the obstacles from the external to the internal environment, 2) their encounter in the internal environment, and 3) its consequences. These events can serve as milestones in the development of the plot, its starting point, climax, and denouement, provided that the pupil fulfilling the task has a practical understanding of the concepts of "character" and "plot". It should be emphasized that the pupil practically understands them, not only knows their literary definition. Thus, both the chosen literary form and the biological concept can be considered as the subject of the trial.

For a biology teacher, this task has the meaning of involving pupils oriented to humanities disciplines in the study of biology, as well as the possibility of assessing the level of mastery of concepts and the possibility of introducing productive action into teaching. For a researcher, children's essays can serve as a material for studying the phenomenon of learning trial and its varieties, as well as of the process of formation of productive action in school teaching and the process of transformation of everyday concepts into scientific ones.

Methods

The research methods are the forming experiment described earlier [8; 17], and comparative analysis of creative and test works of pupils of sixth forms of a Moscow school where "New Biology" is studied (114 works), supplemented by questionnaire survey of pupils to clarify the sphere of children's interests. The study and comparison of a large number of individual variants, the selection of a group of works demonstrating the highest achievements in comparison with the lowest level variants [14] allows us to describe the ways of formation of the scientific biological concept of respiration, to consider children's essays as an age-specific norm of trial-and-productive author's action, and to characterise the task aimed at coordination of educational subjects as one of the possible variants of micro design of learning [19].

Results

This characterisation of the task presented above allows us to highlight a number of indicators of its successful completion. Firstly, it is the choice of the most suitable literary form. These are two epic genres — fairy tale and fantasy story. They allow creating any picture of life, where not only living beings, but also inanimate objects and phenomena, including substances and even their particles, can act.

A common literary device for turning the inanimate into the animate, "substance into being", is the personification known to all children since primary school. Pupils of the 6th form should master this technique as a resource for arbitrary action.

Finally, the pupils have repeatedly encountered the plot basis of epic works in their reading experience and in their school learning[1], and are likely to have an idea of plot as a chain of cause-and-effect relationships, which, in their development, pass through the moments of the starting point, climax, and denouement.

Thus, the criteria for successful completion of the literary component can be considered as follows: 1) the

[1] The works analysed were created by pupils of sixth forms of four newly formed classes. Approximately one third of the pupils of these classes studied in primary school according to the system of D.B.Elkonin and V.V.Davydov, so it is likely that they have first-hand knowledge of the concepts of plot, literary genre, etc. We cannot state this with certainty about the other pupils.

successful choice of genre; 2) the use of personification in the creation of characters without distorting the biological essence; 3) the construction of the plot of a fairy tale or story that is adequate to the natural-scientific sequence of events.

The criteria for success of the biological component are the presence of the key conceptual characteristics: distinction of vegetative functions; distinction of external and internal environment, recognising the mechanisms of biological processes; giving meaning to respiration as a process that provides energy to all the other processes. Since scientific concepts are at the stage of formation, all these points may not be reflected or not clearly terminologically formalised even in a successful work. Nevertheless, the biological meaning of the "encounter" of the oxygen with the organic molecules, as a minimal necessary indicator of understanding, absolutely must be expressed.

Since the task requires coordination of the content of two academic subjects, it is reasonable to identify four groups of essays in which: a) both biological and literary tasks are solved; b) both tasks are not solved (or even not accepted); c) only/mostly biological task is solved; d) only/mostly literary task is solved. Below these groups are characterised.

A. Works in which both tasks were solved (38 pupils participated). This group includes works in which, on the one hand, the peculiarities of the respiration process are described at the highest possible level at this stage of learning and, on the other hand, the artistic task set by the pupil is solved. Naturally, the degree of artistry or clarity of the biological description varies. Here is an example of such work[2]:

"One day, an amoeba wanted to eat and captured an algae with its pseudopods into its digestive vacuole. There it secreted enzymes and they broke the algae down into tiny organic substances. They were sucked by diffusion into the internal environment of the amoeba, and it opened its pseudopods and this vacuole disappeared. Long wandered these organic substances in the internal environment of the amoeba, and then they came across a company of oxygen molecules. By the way, these substances all looked the same, as well as oxygen molecules.

— Hi, we're organics.

And what are you? — the first substances asked,

— Hi, we're oxygen molecules. We got here by diffusion. And you are? — replied the molecules,

— And so did we, what a coincidence!

This group spent the whole day together. They became very good friends, they had fun together, it was really good and interesting.

Why was? Because not everything in life ends well.

When their merry day came to an end, they decided to hug each other goodbye.

But as soon as they touched, they immediately began to dissolve into each other, and rays — energy of heat and movement — appeared from them and small molecules — carbon dioxide and water — sprinkled out. So thanks to their embrace, the process of respiration took place".

The survey allowed us to establish that the pupils who created works of group A differ from the rest in the fact that many of them name literature and/or biology as their favourite subject, i.e. they are more motivated to complete the task, and also almost half of the children in this group are or were involved in art clubs and studios (theater, music, drawing, journalism...), see Fig. 1.

B. Works in which both tasks were not solved (or were not even accepted) (27 pupils participated).

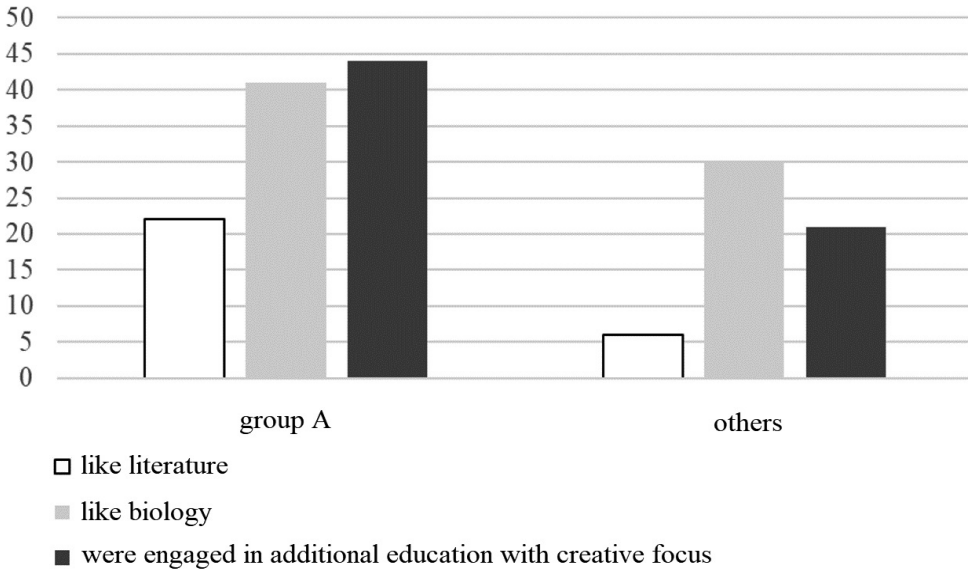

Fig. 1. Peculiarities of the pupils who created works of group A (both problems were solved in the works) in comparison with the others.

[2] The texts of the pupils' works are given without editing.

This is a heterogeneous group, which includes works with significant biological errors, extremely formal works, as well as works in which the stages of the digestion of an amoeba (what happens "before" oxygen meets organic substances) can be described in detail, but the moment of the "encounter" itself is missing. Here is a fragment of this kind of story (the middle is omitted): "I am a small single-celled creature. ... I was split into tiny particles, and they were sucked through a selectively permeable membrane into the internal environment of an amoeba. The parts that the amoeba did not digest were ejected by the contractile vacuole (mistake — authors' note). These residues never travelled to the internal environment of the amoeba" (end of the story).

In this group there are formal works such as: "Once upon a time there were two friends oxygen and organic substances. Each of them wanted to go to Amoeba Land. But they had to get there in different ways. Oxygen decided to go there by water and organic substances by suction. That is how they met again".

Lack of understanding is often replaced by external plot linking (the character went, came, fought).

In order to separate the "literary component", which adds difficulties, from a basic "biological" task and to understand whether pupils can reproduce the definition of the respiration process formulated by the class at the current stage of concept formation, the creative task was supplemented with a simple test task ("Write down what respiration is"). The testing made it possible to detect pupils who a) do not understand the concept of respiration (there are only scattered ideas), b) do not distinguish between respiration and gas exchange/respiration and digestion, c) different characteristics of the process appear as successive, i.e. they do not perceive the release of energy as the biological meaning of respiration. None of the pupils in this group could formulate a definition of respiration, whereas in the other groups only a small number of pupils made various mistakes, among which there were no gross ones (16%, 19% and 25% of pupils, respectively).

C. Works in which only/primarily biological problem is solved (37 pupils participated). This group included works that are, essentially, an extended definition of respiration, sometimes up to 2—3 pages. There is a "light touch" of artistry in them, sometimes in the form of a traditional fairy-tale beginning "once upon a time" or a dialogue form, but it is obvious that the literary task is not set by the pupil: "Once upon a time there were PFC in a small creature. They lived there well and did not feel sad. But one day their little creature was caught by big "tentacles"-legs and their home ended up in a digestive vacuole...". Such works can be considered successful from the point of view of the development of scientific concepts, despite the "underdevelopment" of the artistic component. The selection of terms, reliance on schemes, linking them, turning incomplete thoughts into a developed, biologically intelligible written text play a crucial role in the development of subject thinking [7; 15]. Basically, pupils have created an original author's **popular science** text.

D. Works in which only/primarily a literary task is solved (12 pupils participated).

Here are two fragments of works of this group[3]: "Every year a lucky family and an orphan, chosen by lot, are sacrificed to the most insidious and terrifying creature "Amoeba". One day, the lot was drawn for the PFC family ("proteins, fats, carbohydrates" is the abbreviation adopted in class — authors' note) and the orphan O2 (oxygen). Orphan O2 was immediately inside this insidious and frightening creature, and the PFC family had a chance to escape, but it only seemed so at first glance, because they fell into a trap from which only a few manage to escape..."

"... A collection of paintings, an artist's flat and his materials and belongings are at stake. Anton Pavlovich (an organic substance) and Nikolai Alexandrovich (oxygen) raise the stakes. In the end, Pyotr Andreyevich (a microbe of some kind) won (he offered the largest amount), and Anton and Nikolai accepted defeat and began to co-operate, combining their friendship with it".

Characterising this rather small group of works, it is interesting to note that the pupils when answering the survey questions did not list either biology or literature among their favourite subjects. With the exception of one child, they were not engaged in art-oriented clubs and studios. At the same time, the pupils who solved only the art task completed the test work almost as successfully as pupils from groups A and C, i.e. they were able to verbally reproduce the definition of the respiration process. Except for one, all the children's works were original, there were no signs of copying.

The most interesting from the point of view of studying the formation of the concept are the fragments of works which describe two processes, the process of nutrition and the process of respiration (the "encounter" of oxygen and organic substances). The point is that the process of nutrition is easily visualised, it is an observable process. For example, pupils saw the capture of food by an amoeba, movement of the digestive vacuole, ejection of undigested residues in video fragments, they modelled the process with the help of a plastic bag, depicted it in the form of schematic drawings. It is quite easy to imagine the release of enzymes into the digestive vacuole, the splitting of large organic molecules into small ones and the subsequent absorption, because the action of chopping is similar to human actions,everyone has had a chance to split something into parts, to crush, to crumble something. The eventuality of this process can be easily converted into the narrative eventuality of a fiction text, because it can be easily interpreted as a process of cross-

[3] The texts of the pupils' works are given without corrections.

ing a border, which the character can cross voluntarily or forcibly. And the forced character of the process in a fiction story is more adequate to biological reality.

Contrary to these stages, the "encounter" of small molecules of organic substances with an oxygen molecule is something incomprehensible, which pupils can evaluate only from the initial substances and reaction products, reconstructing the biological meaning of this process (the release of mysterious energy) from the analogy with the combustion process. Therefore, in the majority of works, the moment of the "encounter" is reduced: the stages of nutrition are described in a thorough and colourful way, while the most important thing in the whole story, the "encounter", is given extremely briefly. It is obviously an uncomfortable place and one for which there is no clear visualisation of what is happening. However, it is interesting that in none of the children's works is there a question or other record of the fact that cellular respiration is a process generally unimaginable and therefore not well understood. The results of children's experiments on the study of respiration are recorded in the form of a diagram with arrows and chemical formulae. This diagram serves as a basis for thinking.

In a work of fiction, the imagination must make what is unimaginable and incomprehensible comprehensible and imaginable. In the works of group A and in some of the works of groups C and D, one can find various attempts to fill the conceptual gap using some kind of life analogy. Here are examples (key points are highlighted — author):

"And then a **marvellous miracle** happened, a **marvellous wonder**: proteins, fats and carbohydrates **united** with oxygen and water, carbon dioxide and energy were produced".

"— Oh, **disaster**! We've just learnt that inside the amoeba, there was oxygen waiting for the particles of organic substances. This is the end! The end of particle life!!! But! The beginning of the process of respiration..."

"They started **spinning fast** together, and when they stopped, there was no more O2 or PFC, but there was E of work, E of heat, and also H2O and carbon dioxide".

"This is a live report from Amoeba Stadium where the top two teams Oxygen and Organics met. The first half is underway. An Oxygen player gets round the opponent... **Goal! The ball went into the net so fast it blew a lot of energy out of the net**! Let's stop for a commercial break".

"And the only thing we encountered inside was oxygen, and it turned out it also went straight through the monster. That was all he could tell us. Next he **mutated** into something called carbon dioxide..."

In the above examples, it is possible to find the presentation of "grasped" biological content, images adequate to it, and ideas from the pupil's life experience, coexisting.

Sometimes a child, creating images of characters with the help of personification, gets carried away by consistent anthropomorphism. He likens the substance-character to a human being and forgets about the limits of this likening. Then the imagination takes the child away from the biological content, significantly distorting it. Not only does the image lose its correspondence to the original concept, but also, paradoxically, its artistic persuasiveness, the "truth" of the image itself, gets lost. For example, an image of a happy family is not quite adequate to this content, parents and children in a child's work live together, while oxygen and organic substances are consumed in the process of respiration and cease to exist in their original form: "...Suddenly music started playing, and Oxygen invited me to dance. We danced, I cried with happiness and breathed quickly. But even though I had lost my energy, I was still insanely happy! The end", smiled PFC.

— Mum! Was it really like that? — asked the little H_2O girl excitedly.

— If mum says so, it was, — Oxygen smiled and patted her daughters on the heads..."

In this work, the plot clearly distorts the natural-scientific eventuality. Instead of a radical transformation of the characters, their disappearance as a result of interaction, the story creates a picture of their continued existence in their former state. In another work, the resolution of the love story suggests that the author, on the contrary, keeps the conceptual structure:

"— And now what is going to happen to us? — asked the Organic Molecule.

— We will be recycled in the process of respiration; we will combine and become new substances!

The Organic Molecule was no longer listening. It understood one thing: now they will be together — and it smiled happily..."

Some authors not only adequately transform the event series, but also treat the forced disappearance of their characters as a tragic event. For example:

"...it was too late. PFC was already beyond saving. O_2 was already on the death path... After a while, E[4] of motion, E of heat, CO_2 and H_2O came into the light. No one remembered O_2 and PFC, because they had been "recycled". Since then, this cycle has been perpetual, with milliards of molecules dying every second, and the cycle cannot be prevented".

Discussion

The path of formation of scientific concepts is thorny: researchers often describe it as a path of overcoming persistent misconceptions, significant resistance of children's concepts when trying to "replace" them with scientific, adult concepts [3; 8; 17; 18; 19].

[4] Letter E is the symbol of energy used by the class.

Just as stalactites and stalagmites in a cave represent the frozen history of fluid solutions, the diversity of children's creative solutions allows us to see the history of the formation of concepts as flexible and mobile pillars of thinking and action. The selected groups of works can be seen as a certain cross-section of progress in understanding, moreover, in two intersecting planes: the plane of development of scientific biological concepts about the processes of respiration, nutrition, gas exchange, excretion, on the one hand, and the plane of development of understanding of literary forms and techniques, on the other.

From the point of view of the development of biological concepts, the wide range of variants of task completion demonstrates the stages of transformation of everyday ideas about vegetative functions into scientific concepts: from mixed and incoherent ideas to a clear distinction between respiration and other biological processes, with understanding of the meaning of respiration as a process that provides energy for all others. However, fixing these two poles, we cannot place the many variants of mastering the concept in a gradual scale, since in each work it is possible to see different moments of clear understanding and "gluing", incomprehension. In one work, for instance, a pupil demonstrates clear understanding of the digestive process, but loses understanding of respiration at the moment of describing the "encounter" of oxygen with organic molecules (while in a short test work the pupil easily and completely recites the definition of respiration). In another one, the biological picture of what is happening is broken in the description of gas exchange ("pseudopods withdrew the gas and the amoeba went to sleep"), etc.

The offered task gives pupils an opportunity for productive action [12], as it requires conscious choice of artistic form and creation of a new original text with its subsequent publication — presentation for judgement to a possible reader (teacher, classmates). When creating such text, a student should not lose the essence of biological content, retain the framework of scientific concepts and at the same time follow the requirements of the chosen genre, use the means of artistic expression. Thus, the conceptual coordination of academic subjects gives rise to the possibility of a double test: a test of comprehension of biological processes and a test of mastery of the artistic form of word art. It is worth noting that it is the works in which the artistic component is clearly expressed (groups A and D) that provide the richest food for analysing the emerging concept.

As opposed to educational situations, where children's trial actions arise only in spite of the teacher's intention in a situation of uncertainty [2], tasks on coordination of educational subjects are tasks-frameworks, generating learning trials in agreement with the teacher's project. When solving tasks of this type, the independence of action without a model and algorithm can also be manifested.

When viewed from the side of artistic development, the biological concept in this task acts as a material and a frame that limits, but does not predetermine, the choice and setting of one's own artistic tasks: the pupil independently chooses a specific literary genre, independently creates the images of the characters, and independently constructs the events and development of the plot. The relationship between the mode of action and the material on which it unfolds is contradictory: the material does not "fit" easily into the framework of the chosen genre, the eventuality of biological processes is not easy to transform into the conflictual eventuality of an epic plot. Pupils who have mastered the scientific concept to a greater extent, are able to retain its logic, making such transformation. Those who have mastered the concept of breathing to a lesser extent violate the logic of the concept, and the construction of a fantastic picture of life begins to obey the logic of everyday ideas. Thus, the development of the artistic idea becomes a testing ground for the biological concept — how much it is formed, whether it can be held as a material in the search for characters and the unfolding of the plot. Each particular children's work represents either a rejected test (group B), a failed (partially successful) test (groups C and D) or a fully fulfilled learning test (group A).

According to L.M.Dolgova, trial actions "open the space for students to search for their own (individual) means of understanding situations, to form individual educational experience" [2, p.192]. Agreeing with this point of view, it can be noticed that "material resistance" in this work gives the student an opportunity to feel, not always consciously, the properties of the concept of respiration built in the joint activity of the class before it becomes a means of solving other problems rather than an object of construction in other educational tests.

A.A.Brudny writes: "...the actual world, taken as a whole, always requires completion of two constituent parts for the understanding of it, and therefore the evidential and narrative worlds are additional (in Bohr's sense) to it. In the one, logical following prevails... In the other, events occur and actions are committed, and their coherence is determined by ... a different constitutive force — the semantic one. The experiment shows that the texts of the narrative world have much greater translational potential, they are better remembered and retold than much more compact, consistent and coherent texts of the world of evidence-based judgements" [1, p.19]. It is likely that the construction of an extended narrative text by a pupil gives him/her an opportunity to comprehend the scientific concept which is being constructed, to put it into the contexts of his/her own images, tasks, intentions, to understand and remember its peculiarities. This work will certainly facilitate the final appropriation of the scientific concept in the course of its instrumental use [8; 9].

The construction of an artistic image initially contains the opposition between the scientific and the fictional, defined by the very frame of the task. This pre-

vents the formation of synthetic misconceptions that uncritically combine aspects of previous and new knowledge [18; 20], keeping the frame of critical thinking. Pupil autonomy in this case relies on the work done by the class together, under the guidance of the teacher, therefore, in most cases, this step in mastering a scientific concept does not carry the risks of overestimating the ability of the pupil to assimilate new knowledge only on the basis of independent thinking and previous experience, which many researchers write about [16; 18].

As for the trial-productive artistic action, the completion of such tasks can be considered a new stage in its development in comparison with primary school, since the search for an image solution in such work begins to be limited not only by understanding the features of the artistic form, but also by the biological content.

To complete the trial action, its second tact is necessary: its publication [12]. The very fact of presenting the work for the judgement of the reader (teacher, other pupils) makes the author see it from a different perspective. In addition, the extended discussion of the works created by pupils allows revealing the completeness of mastering the concepts of both disciplines, to reveal the imperfections of the formed concepts. From our point of view, the work on creating own texts by pupils, both fiction (groups A and D) and informational (group B), can also serve as one of the effective ways to increase the completeness of understanding [10] of educational and popular science texts about vital processes in the organism.

Conclusions

1. The task of coordinating the content of biology and literature by young adolescents mastering these academic subjects can be considered as a provocation of a learning trial, and its successful completion as a trial-productive action. The norm of age development in this sphere can be considered a successfully realised “double” trial, in which artistic success is combined with the adequacy of the use of a biological concept.

2. This kind of task gives an opportunity to detect and correct the imperfections of the forming scientific concept, on the one hand, and the concept of literary art form, on the other hand, i.e. it can be used for the purpose of diagnostics of the process of mastering the concepts. Successful completion can be an evidence of understanding of biological processes, as well as the fact that literary concepts are mastered to the level of their use as means of creating a verbal artwork.

3. The opposition and contradiction of the artistic form and biological conceptual content (essay material) counteracts the “gluing” of emerging scientific concepts with the original everyday ideas. A well-developed and sufficiently[5] disciplined artistic imagination allows the pupil to avoid falling into the semantic gap of an incompletely constructed scientific concept, to build an adequate image that helps to retain the still shaky conceptual pillars.

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