INTEGRATED SCIENCE EDUCATION IN THE CONTEXT OF THE CONSTRUCTIVISM THEORY: SOME IMPORTANT ISSUES

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It is obvious that many scientists nowadays speak about constructivistic approach in education. This topic is becoming very trendy. Is it correct to focus our attention only to the study of this topic? This is a really complicated issue. There are quite a large variety of opinions, as well as controversial. First of all it is obligatory to perceive the idea of integrated science education in the context of constructivism as a theory of learning. Secondly, it is important to understand and name the specificities of integrated science education implemented following the principles of constructivistic teaching/learning. Thirdly, it is necessary to be able to predict the possibilities of integrating the content of different subjects of science related to the specificities of students at different age stage as well as to material and human resources (Lamanauskas, Vilkonienė, 2008). Generally speaking previous studies implied that the development of a constructivist-learning environment could contribute positively to changing student attitudes toward science learning (Oh, Yager, 2004). However, we can not make an one-sided evaluation. Who can deny that the traditional teaching and learning is wrong?

Constructivism may be considered an epistemology (a philosophical framework or theory of learning) (Jean Piaget, 1967, http://en.wikipedia.org/wiki/Constructivism_(learning_theory)#cite_ref-0), which argues humans construct meaning from current knowledge structures. Knowledge should not be divided into different subjects or compartments, but should be discovered as an integrated whole (McMahon 1997; Di Vesta, 1987).

The fact is that constructivism carries a major influence in contemporary science education, although it has been the subject of a heated debate. Remarkably, one of the most important implications of radical constructivism challenges the processes by which individual students actively construct their own knowledge.

Constructivism has always skirted round the actual learning of an established body of knowledge ... students will find that words are used in new and standardised ways: problems which were never even seen as being problems, are solved in a sense which needs to be learned and rehearsed. For a time all pupils may feel that they are on foreign land and no amount of recollection of their own remembered territory with shut eyes will help them to acclimatise. (Solomon, 1994, p. 16). Learning science involves being initiated into the culture of science. If learners are to be given access to the knowledge systems of science, the process of knowledge construction must go beyond personal empirical enquiry. Learners need to be given access not only to physical experiences but also to the concepts and models of conventional science (Driver et al., 1994, p. 6). Most science teachers try their best to explain things clearly, to make

use of metaphors, to use demonstrations and practical work to flesh out abstractions, to utilise projects and discussions for involving students in the subject matter, and so on. They realise that many, if not most, things in science are beyond the experience of students and the capabilities of school laboratories to demonstrate. The cellular, molecular and atomic realms are out of reach of school laboratories, as is most of the astronomical realm. Most of the time even things that are within reach do not work. It is a rare school experiment that is successful. For children, a great deal of science has to be taken on faith. Good teachers do their best in the situation, and try to point out why faith in science is warranted. In that case the approach of integrated teaching/learning is the best choice.

The processes of integration are visible in science, technologies and economy including education. The discussions about integrated education focused on the integration of teaching content are frequently held. The future will show whether it is fashion or necessity. One point is clear – the integration of teaching content is a burning issue of contemporary didactics. The following main objectives make the dignity of integrated teaching evident:

- to conclude and classify knowledge imparted by sciences;
- to reveal the affinity of the key (general science) concepts;
- to reduce the flow of secondary information, to concentrate on teaching how to use the sources of information (for example, encyclopaedia, reference books, dictionaries, audio-video material, etc.);
- to make teaching/learning interesting, attractive, true to life, etc.
- to train pupils to adopt various classified courses in higher forms, etc.

Thus, integration is the development of a new wholeness from the previous different units, components, for example, the content of teaching subjects, the kinds of activities, etc. The characteristic features of the child or teenager should not be forgotten along with the theoretic examination and practic solution of the questions of integrated natural sciences teaching. ***First***, the processes of the child's memory in terms of quality and quantity change (for example, visual-sensorial, emotional memorable, etc.); ***second***, the qualities of pupils' cognitive activities (thinking, observation) are remarkably diverse (a particular group of pupils should manage to perceive integrated material); ***third***, a successful solution of the issues of psychologic adaptation is considered to be an important point (new textbooks, new curricula, requirements, etc.); ***fourth***, contemplation on the basis of concepts prevails at school age, i.e. the world is accepted as the generalization of the main features of objects and phenomena. Incidentally, such thinking form only in childhood (Vygotskij, 1934); ***fifth***, the level of abstraction increases together with the degree of integration.

The younger the child the less s/he knows and manages, and therefore in terms of him/her, the degree of the integration of subjects has to be limited

Certainly, teachers themselves should know more about the styles of teaching/learning and different patterns of work organization (Eric W.K.Tsang, 1997). Pedagogues must communicate, argue and seek effective ways in order to hold teaching material in pupils' memory (Schlesinger, 1996). The author maintains that every integrated curriculum has to include two modules – thematic and functional. The teaching curricula that should reproduce the integration of content as well as of the process become notable. The integrated courses of natural sciences should be coordinated with the systemic ones. The integrated course of teaching has to be undertaken by the complex of training aids/resources for learning such as textbooks, workbooks, didactic material, teacher's book (teaching methodology), visuals, etc. They guarantee increased activities that are directly proportional to the efficiency of teaching/learning.

Table 1. Some factors on integrated natural science education efficiency (Lamanauskas, 2003).

Aspects of the significance of integrated natural science education	Circumstances preventing efficiency of integrated natural science education
• helps to model the entire (holistic) world-view; • forms pupil's individuality; • deepens and develops the kid's world outlook (understanding of nature); • establishes conditions for better mastering, per ceiving and structuring natural sciences knowledge; • establishes conditions to comprehensively perceive relations between reason and result; • establishes conditions to practically apply knowledge; • helps to advance practical abilities and skills; • establishes conditions for the teacher to more colorful convey information; • directly influences the quality of conveying knowledge, evolves the motivation of cognitive interaction with nature etc.	• the unsuitable, perverted view to natural science education; • lack of teachers' initiative and creativity; • teachers' (particularly those of primary school) weak motivation of cognitive interaction with nature; • lack of teachers' experience in the area of integrated natural science education; • sufficiently high expenditure of working hours in order to efficiently formulate strategy of natural science education; • lack of the visual aids of natural science education and the discrepancy of those to the required standards; • unequipped textbooks; the translated textbooks from foreign languages are particularly inefficient (not adapted to Lithuanian schools); • the entire concept of integrated natural science education is missing; • the teachers of elder generation are inert; • natural science education is a supporting part etc.

The constructivist theory of teaching must be based upon the constructivist theory of learning (Selley, 1999). The constructivist framework challenges teachers to create environments in which they and their students are encouraged to think and explore the scientific knowledge (Brooks & Brooks, 2001; Fosnot, 1996).

The elements of constructivist theory in the classroom may be summarized as follows (Richardson, 2003, Brooks& Brooks, 2001):

- attention to the individual and respect for students' background or prior knowledge)
- encouraging and facilitating group dialogue
- planned and often unplanned introduction of formal domain knowledge into the conversation
- provision of opportunities for students to determine, challenge, change or add to existing beliefs and understandings through engagement in tasks
- development of students' metaawareness of their own understandings and learning processes
- use of cognitive terminology such as "classify", "analyze", "predict", and "create"
- evaluating the students in process and give priority to their participation.

Constructivism has done a service to science and mathematics education: by alerting teachers to the function of prior learning and extant concepts in the process of learning new material, by stressing the importance of understanding as a goal of science instruction, by fostering pupil engagement in lessons, and other such progressive matters. Constructivism has also done a service by making educators aware of the human dimension of science: its fallibility, its connection to culture and interests, the place of convention in scientific theory, the historicity of concepts, the complex procedures of theory appraisal, and much else.

The integrated course of natural sciences should form the base amount of natural science knowledge (in a broad sense), i.e. "a formal component", as every teacher tries to identify the priorities of his/her teaching subject and the criteria of the efficiency of peculiar teaching

methods and forms. The preparation of the integrated course of natural sciences is a concurrent part of teaching, optional, extracurricular, etc. courses. The educational curricula have to reflect the integration of the content of the teaching/learning process. The integrated and systemic courses of natural sciences should be combined. A real correlation and its reflection in the child's psycho physiologic abilities, skills, aptitudes and interests during the educational process at different age range is acclaimed to be a very important indicator of the content of natural sciences integration. The integration of the educational process has to be coordinated with didactic differentiation that is determined by unequal pupils' knowledge, different interests and teaching motivation, unlike intellectual motivation, self-control skills, etc. Self-sufficiency, the principles of freedom of choice and responsibility, psychologic learners' adaptation should be stressed when preparing the integrated courses of teaching/learning. More attention should be paid to schoolchildren's personal perfection, the development of differentiated teaching and evaluation, the accumulation, classification, assessment and usage of information and to the development of other skills, the alteration of group and individual work in the educational process. The integrated teaching course has to be guaranteed by the means of teaching/learning such as textbooks, workbooks, didactic material, visual aids, etc. as well as by the teacher's proficiency to work at qualitatively new level in a new century. A crucial point is a practic check of the set patterns of the content of integral natural science education that could be applied for a particular socio-cultural environment.

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