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## DISCUSSION: THE DEVELOPMENT OF THIS SKILL IN INQUIRY-BASED SCIENCE TEACHING METHODOLOGIES

### KSZTAŁCENIE UMIEJĘTNOŚCI PROWADZENIA DYSKUSJI ZGODNIE Z METODOLOGIĄ NAUCZANIA PRZEZ ODKRYWANIE

**Abstract:** ESTABLISH - European Science and Technology in Action: Building Links with Industry, School and Home is a four year pan-European project funded by the European Union's Seventh Framework Programme (FP7). A specific aims of this project is to reinforce the links between school education and external world, so as to raise the level of scientific knowledge of teachers and their students, and increase students' intrinsic motivation to science and technology. Inquiry-based science education (IBSE) has been selected as the methodology to facilitate this type of teaching and learning. In order to achieve this set aim, it is necessary to prepare the teaching staff to be involved in IBSE. Across Europe teachers and students have begun to adopt the IBSE methodology, facilitated by many projects including ESTABLISH. In Poland, the ESTABLISH teachers training included inter alia, two summer schools during which teachers can deepen the knowledge and understanding of how to apply the IBSE strategy into their own teaching practices. Selected because of their importance in contemporary society life, are the abilities to discuss, to argue and to draw connections. Those skills require the use of specific rules. During the ESTABLISH training, teachers were tasked with creating a list of rules to help them lead a "good discussion" in their classroom. They tried to follow those rules discussing many hot and current topics, for example nuclear energy or use of supplements to lose weight (Chitosan). The advantages and disadvantages of developing this skill (discussion) as part of this teaching method were examined by participants of summer school. At the end of classes teachers shared their experiences of working with proposed method and collectively created a list of discussion topics they thought would be interesting for students that can be implemented in Polish schools. In the presentation, our experiences, remarks and conclusions from working with summer schools' teachers of the ESTABLISH project will be shared.

**Keywords:** teaching methods, discussion, IBSE, teacher training

## Introduction

### 1. Inquiring or lecturing teaching methods?

There are several classifications of teaching methods - ways of working teacher with students which enable mastering knowledge and using it in practice. In Poland, very popular classification is the Okon's one, based on the concept of multilateral process of teaching-learning. In this classification, "learning through discovery" is regarded as a synonym of

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independent investigation to acquire knowledge [1]. These methods include for example a typical problem method, method of cases, situational method and educational games. Such way of teaching is the opposite of traditional way of providing students with knowledge, facts, definitions and concepts.

A question can be raised about the necessity of replacing traditional lecturing methods with the other ones. In response, two main factors should be indicated. First of all, the results of ROSE experiment (The Relevance of Science Education) show that students are not fancy of gaining knowledge from the natural science field. [2]. Negative attitude shifts the main focus from teacher to student, from teaching content to effects. This increase the students' involvement in the process of education, and therefore leads to better results of teaching. Secondly, modern society developing towards the knowledge society needs thinking, independent, variously skilled people, that are capable of cooperation with others and are able to successfully overcome problem situations. Lecturing methods do not encourage students to overcome difficulties and what is more, they do not teach how to do it.

A strategy that promotes research activity of students is the Inquiry Based Science Education (IBSE) [3]. Nowadays this method of teaching is becoming more and more popular in the world [4-6]. It supports the development of students' research attitudes and competences in this field and what is more, it develops their independence [7-9]. One of definition of IBSE says that: "Scientific inquiry is an intentional process of problems diagnosing, carrying out a critical analysis of experiments and searching for alternative solutions, planning the research, testing hypothesis, searching for information, constructing models, discussions with colleagues and formulating coherent arguments" [10]. Already-mentioned discussion is the subject of the presented work.

## Materials and methods

### 2. What skills are required in the contemporary world?

Teaching methods used at various subjects should be selected in such way, that, according to the core curriculum of general education, they will be able to fulfill the teachers aims at comprehensive student's development - enriching knowledge and developing skills associated with particular branches of science, but also practicing the so-called key competences, soft, social, over subject. The study of labour market [11, 12] indicates, that in contemporary world, the key skills development is more important than possessing theoretical knowledge. It is a consequence of the fact, that duties of employees require from them especially communicative skills, teamwork, decision-making and organizational skills, as well as flexibility and creativity.

This tendency has been noticed by the Polish educational authorities and in 1999, in the new core curriculum the following key skills were listed [13]:

- Planning, organizing and assessment of students' own learning, which leads to aware and systematic gaining knowledge.
- Effective communication in various situations, which leads to critical understanding of others and makes students being understood.
- Effective cooperation during teamwork, which gives a possibility of sharing tasks and working in a group.

- Ability to solve problems in a creative way, which gives a possibility to identify and define problems, as well as to find, develop and validate methods to solve them.
- Efficient use of information technology, which leads to the intentional data collection and processing of information by means of computer tools.

The above-mentioned ability to discuss is an essential component of proper functioning of society, which is based on the exchange of views between all stakeholders. Unfortunately, people are easy tempted to take a shortcut and obtain planned results by manipulating others and using eristic dialectic [14]. Therefore, training discussion skills falls within the tasks of school.

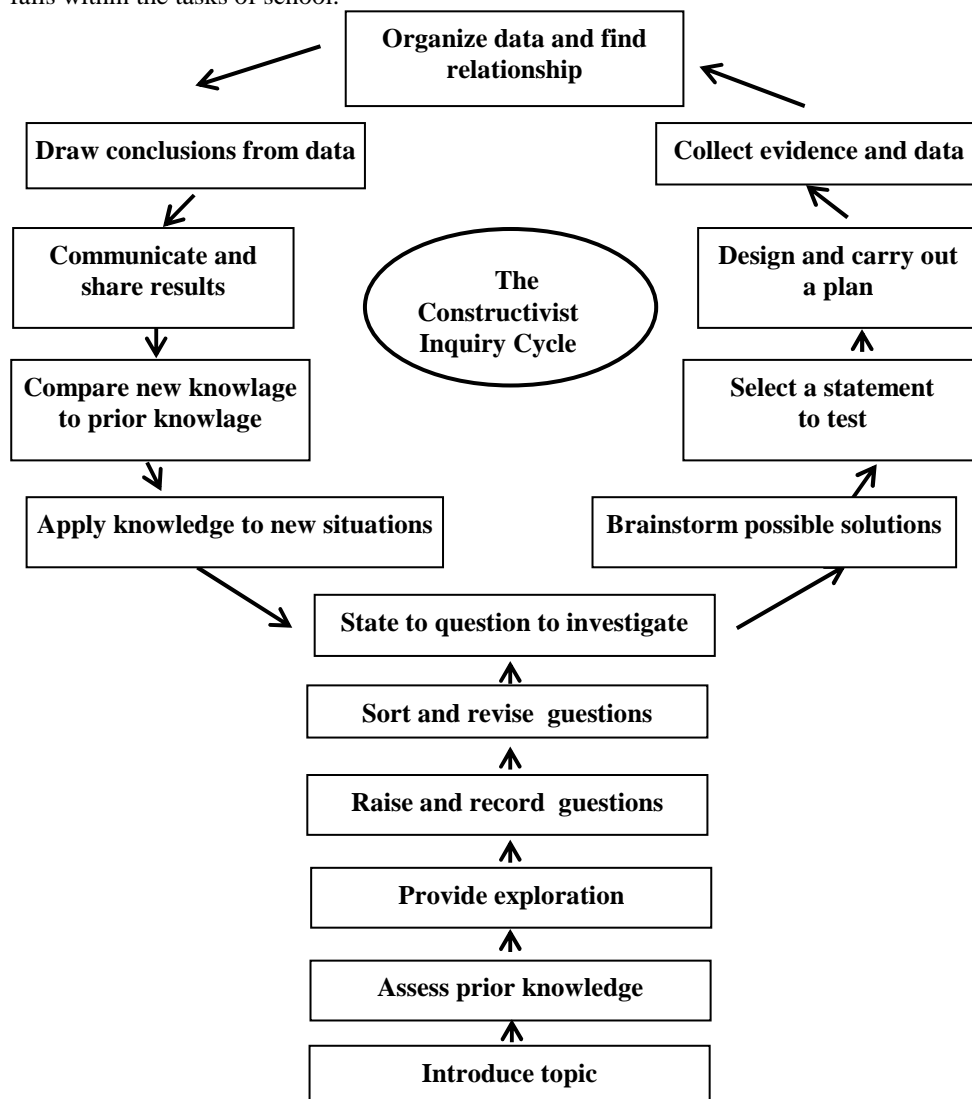


Fig. 1. The Constructivist Inquiry Cycle [16]

The ability to conduct discussion in a proper way and to actively participate in it is also an essential part of functioning of the knowledge-based society (Knowledge society), as discourse is the foundation of the scientific method [15]. Analyzing a constructivist learning cycle [16] it can be noticed, that discussion appears in many of its stages - Figure 1.

### 3. Developing discussion skills within the ESTABLISH project

The aim of the ESTABLISH project (European Science and Technology in Action Building Links with Industry, Schools and Home) is to promote the large-scale use of IBSE strategy (learning through discovery - scientific inquiry) in the teaching of natural science subjects in upper secondary schools (students aged 12-18). Within the Project, there were developed training materials and training of teachers (as well as students preparing for working at school) were launched from the field of introducing IBSE. During the ESTABLISH summer school, its participants were offered to take part in classes concerning development of students' discussion skills.

Two forms of discussion were used, however, there are many other well-known ones, such as: round table discussion, panel discussion, point discussion, decision three or debate, each of which has slightly different course, rules and therefore enables developing different skills. For example, the purpose of debate is to facilitate making decisions concerning controversial topics. It requires taking a particular position: "for" or "against" and giving appropriate arguments. It is also trains the ability to collect and process information, which is in the contemporary world the leading skills [17]. On the other hand, method called "thinking hats", developed by Edward de Bono, [18] combines the ability to discuss, argue, learn opinion on the subject and effective team work together with making group decisions. This method is widely used in business, because it indicates several views from which you can look at the problem [19]. Since no one in this case is emotionally involved with the particular job, the arguments become much more substantive and, at the same time, there is a possibility to "get into the skin" of people with different way of thinking or temperament.

One group of teachers was using the method of „thinking hats” for discussion on the topic „Should a nuclear power plant be built in Poland?” [15] and the other were debating on the topic „Is chitosan effective for weight loss?” [20].

Topic of a nuclear power plant was chosen due to the fact that discussions on this topic have come back in Poland recently, after proposing a possible location of such plant, within public consultations, announced by the Ministry of Economy [21].

The choice of the topic connected with chitosan as a supplement for weight loss was dictated by the increasing rate of parapharmaceuticals' advertisements, especially in the media. At the same time, surveys research carried out in Poland [22] indicated that 40% of respondents did not observe the desired effect of the advertised drug or parapharmaceutical. In addition, the choice of the topic was influenced by the fact, that within the ESTABLISH project the unit dedicated [17] to properties and application of this compound was developed.

Participants of the course were randomly assigned to the appropriate groups [15]:

- During discussion with the use of the method of 'thinking hats', to 4 groups labeled with the proper colours of hats in the summer of 2011:
  - white** - basing on neutral facts;
  - red** - revealing emotions and feelings, both positive and negative ones;

**black** - seeing only black things, indicating shortcomings, risks;

**yellow** - driven by optimism and positive thinking.

The method of „thinking hats” is very often used on training courses for adults. It aims also at broadening horizons, attempts to thinking like a person with different views or temperament.

In the debate in the summer of 2012 - two groups: supporters and opponents of the use of chitosan.

Random selection instead of the free one choice, forces the participants to adapt to the appropriate way of arguing, sometimes inconsistent with their own views and beliefs, and therefore it helps them to develop such type of skill. On the other hand, it impedes the full emotional involvement in the discussion.

In order to facilitate the discussion and make it more matter-of-fact, various articles about chitosan and nuclear power plants were shared with the participants [23-29].

In addition, at the beginning of the debate (before reading the prepared articles), participants were asked to write their own opinion about the weight loss properties of chitosan. 80% of participants claimed that they do not believe in such properties of chitosan. After the debate, the participants were asked the same question again, in order to verify the outcome of the debate. All participants unanimously stated that chitosan is not effective supplement for losing weight.

Since the successful debate is based on four stages, care of their implementation had been taken:

- preparation - rules of the discussion should be set, formulation and presentation of thesis is also needed; what is more, representatives of the two opposing positions should be chosen, drawing those positions,
- debate - in this stage important are: strategy, line, types of arguments and counter-arguments together with evidences,
- end of the debate - indication of winners by the jury;
- summary and evaluation of the debate - discussion of the key points of the debate and determination of the benefits resulting from carrying out such form of discussion.

## Conclusions

One of the goals of both types of discussions was to develop the principles of “good discussion”, which should be applied and respected, and which should also be learnt by students. The most important ones included:

- speaking only on the topic,
- listening to the arguments of other participants,
- using only specific arguments,
- not disturbing others during their speeches,
- respecting different views and opinions *etc.*

An extensive literature regarding the ways of organizing and conducting discussion, the basic element of most activating methods of teaching-learning, which can be used by teachers during preparation of classes is available [24], where also the other elements of discussion were indicated, such as:

- the role of moderator
- determination of the principles of giving the floor
- development of skills of transferring information and receiving feedback

- limitation of the time of single speech
- distinction between facts and opinions in argumentation
- the necessity to summarize discussion

Participants also tried to answer the questions what helps and what disturbs them during the class. They agreed, that it is easier to conduct discussion when:

- the topic is interesting but at the same time controversial
- participants identify themselves with the given arguments
- participants have sufficient knowledge on the topic.

As the participants of the discussion were teachers, they tried to answer the question what causes the greatest difficulty during carrying out such activities in school. It turned out, that major difficulty is to organize discussion in such way that gives every student an opportunity to express his/her opinion.

As the ability to discuss should be practiced during lessons from different subjects, teachers proposed topics connected with the Chemistry Core Curriculum, which, according to them, can interest students to a sufficient degree to provide a fruitful discussion.

At the end of the training, teachers completed an evaluation questionnaire, in which they stressed that practical training of teaching methods, which are going to be applied at schools, is extremely beneficial. They also appreciated the role of the “discussion skills”, however they indicated that in Polish schools, there is not enough time to conduct longer discussions, in a way that every student has an opportunity to express his/her views.

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## KSZTAŁCENIE UMIEJĘTNOŚCI PROWADZENIA DYSKUSJI ZGODNIE Z METODOLOGIĄ NAUCZANIA PRZEZ ODKRYWANIE

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**Abstrakt:** ESTABLISH (European Science and Technology in Action: Building Links with Industry, School and Home) to czteroletni projekt realizowany w ramach 7 Programu Ramowego ze środków Unii Europejskiej (FP7/2007-2013). Głównym celem projektu jest zachęcenie do bardziej powszechnego stosowania strategii edukacyjnej IBSE, czyli nauczania przez odkrywanie/dociekanie naukowe. Z tego powodu w projekcie szczególnie nacisk położono na wzmocnienie więzi łączących edukację szkolną ze światem zewnętrznym, czego rezultatem powinien być wzrost efektywności nauczania oraz wzbudzenie szerszego zainteresowania przedmiotami przyrodniczymi uczniów szkół gimnazjalnych i ponadgimnazjalnych. Kluczową rolę w procesie wdrażania innowacji dydaktycznych odgrywają nauczyciele, dlatego też istotne są szkolenia nauczycieli realizowane w ramach projektu. Opracowane materiały dydaktyczne, zorganizowane szkoły letnie i warsztaty miały przybliżyć nauczycielom zasady prowadzenia zajęć przez odkrywanie/dociekanie naukowe. Metodologia IBSE promuje kształcenie umiejętności kluczowych, ważnych w życiu codziennym, takich jak np.: umiejętność prowadzenia dyskusji czy właściwego argumentowania. Dlatego jednym z zadań realizowanych przez nauczycieli w trakcie szkoleń było rozwinięcie umiejętności prowadzenia dyskusji. Umiejętność ta wymaga jednak stosowania się do odpowiednich reguł, a rolą nauczyciela jest pilnowanie, aby uczniowie reguł tych przestrzegali. W ramach

ćwiczeń zaproponowano uczestnikom szkoleń przeprowadzenie dyskusji na aktualne obecnie tematy, takie jak: „Czy w Polsce należy zbudować elektrownię jądrową” oraz „Czy chitosan jest dobrym środkiem odchudzającym”. Dyskusja poprzedzona była opracowaniem zasad „dobrej dyskusji”. Na zakończenie natomiast nauczyciele dzielili się własnymi doświadczeniami z pracy takimi metodami oraz sporządzili listę tematów do dyskusji, które mogłyby zainteresować uczniów na danym etapie kształcenia. W artykule zawarto doświadczenia, przemyślenia i wnioski wynikające z pracy z nauczycielami w ramach zajęć szkół letnich, dotyczących kształcenia umiejętności kluczowych.

**Słowa kluczowe:** metody nauczania, umiejętność dyskusowania, IBSE, kształcenie nauczycieli