



Sample didactic model of forming competence in the subject, in the education of chemistry and environment protection

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ABSTRACT

The article offers a sample didactic model for the formation of a complex competence on the subject in the education of chemistry and environment protection, on the basis of the stage-by-stage formation of a system of competencies necessary for the education in the subject. An analysis is made of the main structural components of the model: purpose, content, and organization of the pedagogical experiment.

Keywords: model, competence in the subject, key competences

INTRODUCTION

One of the main tasks that Bulgarian school is facing is the attainment of a new, up-to-date quality of education. That involves the formation in students not only of a system of knowledge, skills and habits, but also an attempt for independent activity and personal responsibility, i.e. specific educational competencies.

The resolution of that task requires the increasingly more comprehensive usage of the competences approach in the education process. "That approach corresponds to the general concept adopted in most developed countries, regarding education results in the form of competences, discussed as an indicator of human potential." [3] The essential idea of the competences approach consists in the assumption that the main result of education does not comprise the individual items of knowledge, skills and habits; it comprises the capability and readiness of students for effective and productive activity in diverse socially significant situations. In its turn, the introduction of the notion of educational competences into the normative base of education enables the resolution of yet another crucial problem that schools are facing, viz., the problem of assessment of students' educational achievements.

Studying the psychological and methodological references, we did not discover a united attitude on the definition of the notions of "competence" and "competency". [1,2,4-6] Out of the definitions we have studied, we abide by the ones that define competencies as a "necessary result of the educational activity of students which comprises not only knowledge and skills, but also the adopted methods of actions, personal qualities necessary for productive activity", and competence as an integral feature of personality, a system of competencies structured in a specific manner and integrating knowledge, skills, and also attitudes of the individual towards himself/herself" [8].

In the three-stage hierarchy of competencies proposed by A.V. Hutorsky, key competencies occupy the first place. They are followed by general subject competencies which refer to a specific range of school subjects and educational areas. The author allots the third place to subject competencies (specific with respect to the first two types of competencies, formed in the framework of school subjects) [7].

The fulfillment of the competence approach in the course of the education in *chemistry and environment protection* has the purpose of forming a system of competencies corresponding to that educational area. Furthermore, possibilities exist for the formation and development of both subject and beyond subject (key) competences.

According to the references studied, subject competences are formed via the contents of the school subject, and key competences are formed via the technologies of education and the fulfillment of interdisciplinary relationships. [7] In the Bulgarian references we have studied, we did not find a description of a model of formation of subject competence. [1,2,3,4,5,8] There is also a lack of descriptions of the possible ways of its formation in methodology books and in practical guidance books for teachers. In Russian language references, examples are offered for the formation of specific key competencies, but there again we did not discover a generalized, invariant model of formation of subject competence in the education in *chemistry and environment protection*. [7,9,10,11,12]

That determined the goal of the pedagogical experiment part of which we have presented in the present publication, viz.: development of a methodology for the formation of subject competence in the education in *chemistry and environment protection*.

EXPERIMENTAL SECTION

The stages of the methodology are fulfilled in the following sequence: Acquaintance with the theoretical bases of the competence approach (an apparatus of notions, didactic technologies for its fulfillment) → Studying the good pedagogical experience for the formation of key competencies in education → Diagnostics of students' motivation and attitude at the start of the experiment → Setting the goal → Development of a didactic model for the formation of subject competence in the education in *chemistry and environment protection* → Selection of the methods, forms and means for the fulfillment of the goal set → Approval of the developed model in the course of education → Concluding diagnostics.

In the present article we have presented the results of the stage related to the establishment of the didactic model. In its development, we have proceeded from the understanding that the formation of subject competences cannot be fulfilled solely via the educational content. For the purpose, the complex formation is necessary of a number of other competencies: scientific chemical, education cognitive, health and ecological, information, communicative, research, experimental, control and assessment competencies.

RESULTS AND DISCUSSION

The developed didactic model reflects the goal, content and organization of the pedagogical experiment as a result of which knowledge and skills in chemistry are mastered, and students' individual capabilities and personal qualities are developed. The structure of the model is presented in Figure 1.

The goal that we have set for ourselves is the formation in students of a complex subject competence in *chemistry and environment protection*, on the basis of stage-by-stage formation of a system of competencies necessary for the education in the subject.

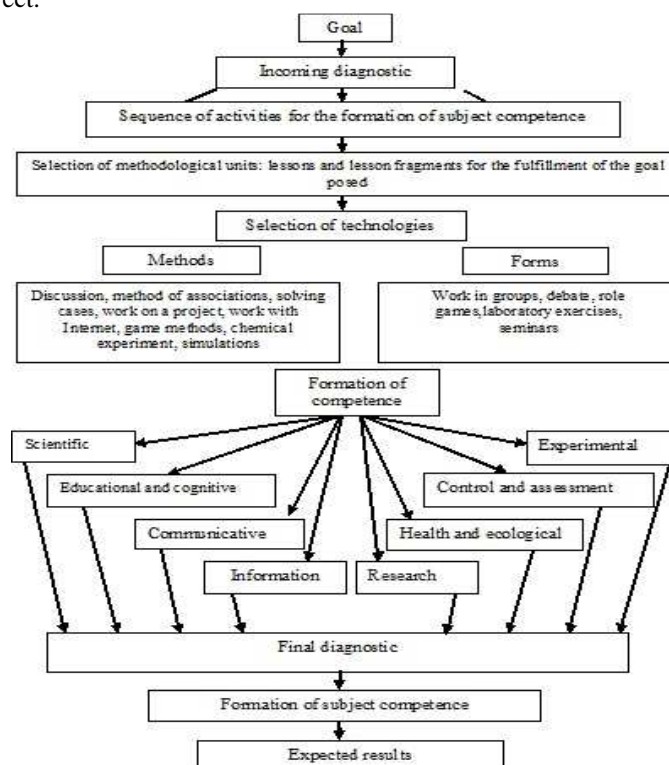


Figure 1. Sample model of the formation of subject competence in chemistry and environment protection

The incoming diagnostics establishes the level of key competencies formed which are part of the system of subject competence, and students' motivation and attitude to the forthcoming work.

In the framework of the competence approach, the predominant significance is allotted not so much to the expansion of the volume of knowledge and skills acquired, but predominantly to the acquisition of experience in their application in specific practical situations. The formation of personal qualities which enable students to be successful in their development is of no lesser importance. The spontaneous acquisition of these qualities by students in the course of lessons, and even in extracurricular activity, is impossible. For the purpose, it is necessary to systematically use the capabilities of modern pedagogical technologies (research, design, information and communication etc. technologies) which comprise active and interactive methods and forms of education. They create favorable conditions for the development of skills for collaboration, communication, tolerance and self-assessment, they stimulate creativity and initiative, and in that manner assist for the formation of important key competencies.

Subject competences are formed within the frames of a specific subject. But that formation does not happen only once, in an isolated manner; it happens via the stage-by-stage formation of an overall system of competencies characteristics for the specific subject area. In its turn, each of these competencies also includes its complex of other competencies related to the thought, research, creative processes in students' cognitive activity. For the purposes of the work presented here, we have dwelled on the capabilities for forming the competencies included in the model proposed. In our opinion, they have the highest importance in the formation of a complex subject competence in *chemistry and environment protection*.

Scientific chemical competency comprises chemical literacy: knowledge of substances and their properties, skills for safe work with substances, skills for adequate use of chemical knowledge for the solution of everyday life and practical problems. It is formed both via educational content and via chemical experiments. To attain it, we employed a specially developed methodological system in the course of the work. It includes lesson plans with usage of innovative technologies and didactic materials: worksheets, information cards, contextual problems. In addition, students search and enrich the educational content with suitable interesting information, they model objects and processes being studied (e.g. circumrotation of substances), they plan and conduct chemical experiments, carrying out part of them in home conditions.

Educational and cognitive competencies are related to students' readiness for independent cognitive activity. They are characterized by built skills for establishing causal/effect relationships and formulating conclusions, for independent acquisition of new knowledge and skills, and fulfillment of their personality potential. Included in these competencies are the setting of goals, planning, analysis, reflection, self-assessment. Within the frames of these competencies, the requirements for functional literacy are determined [7].

For the formation of these competencies in the course of the work, we use the solving of non-standard logical problems; entertaining problems such as puzzles, crosswords; cases related to the application of what has been learned into practice. The problem research approach has proved especially effective for their development. To fulfill it, in some of the lessons we conduct educational mini research cycles which enable students, as a result of observations, analysis, formulation of hypotheses and their verification, to formulate conclusions and attain new knowledge on their own.

Health and ecological competencies formed in the course of education in *chemistry and environment protection* include a student's capability to find his/her way in the surrounding world, assess the preciousness of nature, of his/her own health and the health of the people around, and also skills for decision taking, risk assessment and management. For the formation of health and ecological competencies in the course of education, we use interdisciplinary lessons and role playing related to global ecological or socially significant problems, debates, work on projects. A "Bulgarian People Are Ill" project was developed. Within the project framework, research was conducted on the most frequent diseases and nutrition regimes suitable for each disease, relating each regime to the calorie content of foods. In the website launched as part of the project, a calculator is included which provides data on the basis of age, sex, weight, physical loading.

Information competencies are related to the skill of being able to independently search, analyze, organize, transform and use the necessary information. Their formation is closely related to the training of students in using information sources in the right manner. For the purpose, we use the following types of educational tasks: preparation and writing of reports; preparation of a list of sites containing information on a given topic; collection of electronic materials for illustration of specific topics within the educational content; preparation of presentations, animations and simulations, preparation of brochures. Students study independently additional sources of information: books,

dictionaries, encyclopedias, digests, Internet materials. When the end products of the work are prepared according to preliminary specified criteria, students form skills such as creativity, skills for planning, generalizing, aesthetic taste, the skill for assessment and self-assessment.

Communicative competencies involve the good command of the language official for the country, as well as command of other European languages, knowledge and use of communication skills, the skill of participating in team work, the skill of presenting information. To form them, we use dialog methods: discussion, debate, brain attack, case solving, work on a project. These methods are accomplished by working in a group where the activities are aimed at coordinating different opinions, to obtain the final goal. During discussions, in an environment of free communication, students interact with one another, exchange information, solve the problems set together, model situations, overcome conflicts, and when necessary resort to compromise.

Research competencies require the availability of knowledge acquired in a specific scientific field and formed research skills. For the formation, in the course of the pedagogical experiment we use educational research problems related to independent searching and finding lacking information, and work on a project, with the themes being: Catalysts of natural processes, Circumrotation of nitrogen in nature.

The experimental competencies formed in *chemistry and environment protection* include skills for planning and implementation of a chemical experiment, knowledge and observation of the rules for safety, presentation and analysis of the results obtained, expression of the chemical reactions that have occurred by chemical equations. One of the possibilities we use to attain these competencies is the work with worksheets. They mandatorily include problems which require independent creative solutions by students. Another possibility is implemented during laboratory tests. Students, divided into groups, take video clips of the tests being performed. The video clips are watched by the other groups which have to assess whether the safety rules have been observed, how precisely and accurately the tests have been conducted. In that manner, the skills formed are a responsible attitude towards experimental work, skills for planning and safe conduct of chemical experiments, as well as the skill of assessment and self-assessment.

Control and assessment competencies are related to the students' assessment of their own theoretical and practical preparation, with the skill of self-control and using of different manners of control of classmates' activity. To form these competencies, the students were given the task to prepare criteria for the assessment of a presentation and of a lesson. After discussing the suggestions made, criteria were determined on the basis of which students assess their own achievements and the achievements of their classmates.

Owing to the limited volume of the publication, we do not include a description of the specific methodological variants of forming the respective competencies. These variants shall be the subject of another article.

CONCLUSION

The pedagogical experiment has not been concluded yet. The finale result expected from its conduct is the formation of a complex subject competence in *chemistry and environment protection*.

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REFERENCES

- [1] VI Angelova, ZM Malcheva, LL Genkova. Metodika na obuchenieto po chimiya. Universitetsko izd., Sofia, **1999**,
- [2] M Andreev. Protshesut na obuchenieto. Didaktika. Universitetsko izd., Sofia, **1996**, 420
- [3] LL Genkova, *Za kompetentnosten podkhod kum kachestvoto na obrazovaniето i obuchenieto po chimiya, Chimiya*, **2007**, (16), 489-507
- [4] PD Petrov, MA Atanasova. Obrazoatelni tehnologii i strategii za uchene, Veda Slovena, Sofia, **2001**, 300
- [5] PI Radev. Pedagogika. , Hermes, Plovdiv, **2007**, 368
- [6] D Raven. Kompetentnost v sovremennom obshtestve. Vyyavlenie, razvitie i realizatshiya (angl.1984), Moskva, **2002**, 253-273
- [7] AV Khutorskoy. Kompetentnostnyy podkhod v obuchenii. Nauchno-metodicheskoe posobie, Eydos, Moskva, **2013**, 73
- [8] NS Tshankov, LL Genkova. Kompetentnostniyat podkhod v obrazovaniето, Universitetsko izd. Neofit Rilski, Blagoevgrad, **2009**, 32-35

[9] EV Zelenskaya Kompetentnostnyy podkhod v obrazivanii

<http://elenazelenskaj.ucoz.ru/news/2008-08-24-2>

[10] IA Zimnyaya, *Klyuchevye kompetentshii – novaya paradigma rezultata sovremennogo obrazovaniya*, Internet zhurnal „Eydos”, 2006. <http://www.eidos.ru/journal/2006/0505.htm>.

[11] AV Khutorskoy, *Klyuchevye kompetentshii kak komponent lichnostno-orientirovanny paradigmy obrazovaniya*, Narodnoe obrazovanie, 2003 (2) , 58-64.

[12] AV Khutorskoy, *Tekhnologiya proektirovaniya klyuchevykh I predmetnykh kompetentshiy*,

<http://www.eidos.ru/journal/2005/1212.htm>