

*Future possible research* will be devoted to define and describe the principles of effective implementation of STEM education in Ukraine and give practical examples for their using in the classroom or laboratory.

#### References:

1. Brown, R., Brown, J., Reardon, K., & Merrill, C. (2011). Understanding Stem. Current Perceptions. *Technology & Engineering Teacher*, 70(6), 5-9.
2. Bybee, R.W. (2010). Advancing STEM Education: A 2020 Vision, *Technology and Engineering Teacher*, 70 (1), 30-35.
3. Ejiwale, J. (2013). Barriers to successful implementation of STEM education. *Journal of Education and Learning*. Vol. 7 (2), pp. 63-74
4. Fairweather, J. (2008). Linking Evidence and Promising Practices in Science, Technology, Engineering, and Mathematics (STEM) Undergraduate Education. Access mode: [http://www7.nationalacademies.org/bose/Fairweather\\_CommissionedPaper.pdf](http://www7.nationalacademies.org/bose/Fairweather_CommissionedPaper.pdf).
5. Gonzalez, H.B. & Kuenzi, J.J. (2012). Science, Technology, Engineering, and Mathematics (STEM) Education: A Primer. CRS Report for Congress. Congressional Research Service.
6. Kanematsu, H., Barry, D.M. (2016). STEM and ICT Education in Intelligent Environments. *Intelligent Systems Reference Library*. - New York., Springer. DOI 10.1007/978-3-319-19234-5.
7. Law of Ukraine. (2002). Pro innovatsiinu diialnist. Zakon Ukrainy No. 40-IV vid 04.07.2002 r. [The Document "About the Innovation Activities". The Law of Ukraine, 40-IV, dated 04 July 2002]., Access mode: <http://zakon5.rada.gov.ua/laws/show/40-15>.
8. Mataric, M.J., Koenig, N. & Feil-Seifer, D. (2007). Materials for Enabling Hands-On Robotics and STEM Education. Refereed Workshop AAAI Spring Symposium on Robots and Robot Venues [E-Reader Version]., Access mode: <http://rll.cse.unr.edu/media/documents/2016/Mataric-2007-536.pdf>.
9. MON Ukraine. (2000). Pro zatverdzhennia Polozhennia pro poriadok zdiisnennia innovatsiinoi osvithnoi diialnosti. Nakaz MON Ukrainy No. 522 vid 07.11.2000 r. [The Document "About the Approval of the Procedure of realization of innovative educational activities". The Decree of the of Minister of Education and Science of Ukraine, 522, dated 07 November 2000]., Access mode: <http://zakon2.rada.gov.ua/laws/show/z0946-00>.
10. MON Ukraine. (2016). Pro stvorennia robochoi hrupy z pytan vprovadzhennia STEM-osvity v Ukraini. Nakaz MON Ukrainy №188 vid 29.02.2016 r. [The Document "About the creation of a working group on implementation of STEM-education in Ukraine". The Decree of the Minister of Education and Science of Ukraine, 188, dated 29 February 2016]. Retrieved December 29, 2016., Access mode: <http://old.mon.gov.ua/ua/about-ministry/normative/5219->.
11. Sanders, M. (2009). STEM, STEM Education, STEMmania. *The Technology Teacher*, December/January 2009, 20-26.
12. Sharko, V.D. (2016). Naprjamy modernizacii systemy shkilnoji osvity v umovakh perekhodu na STEM-navchannja [The directions of modernization of the school education in the transition to STEM-education]., Access mode: <http://internet-confer.16mb.com/>.
13. The Institute of modernization of educational content (2016). Osnovni zavdannia viddilu STEM-osvity Instytutu modernizatsii zmistu osvity [The main tasks of the Department of Education STEM-Institute modernization of educational content]., Access mode: <http://www.imzo.gov.ua/stem-osvita/>.
14. Tsupros, N., Kohler, R., and Hallinen, J. (2009). STEM education: A project to identify the missing components, *Intermediate Unit 1 and Carnegie Mellon, Pennsylvania*.
15. Williams, P.J. (2011). STEM Education: Proceed with caution. *Design and Technology Education*, 16 (1), 26-35.



U.D.C. 37.016:54:373

## ELECTIVE COURSES AS CONTENT BLOCK OF PROFILE TEACHING OF SCHOOL EDUCATION

G. Iuzbasheva, Philosophy Dr.

Communal higher educational establishment «Kherson academy of continuing education», Ukraine

Conference participant

*Differential approach for teaching of schoolchildren at general educational teaching establishments of Ukraine is integral part of organization of qualitative school education. School teachers use different sets of instruments to solve this problem. Elective courses can be regarded as content block of profile teaching of school education. Their contents depend on the profile, which the pupil chooses, while studying at profile school. The contents of elective courses is examining on the example of such school subject as chemistry. The article is dedicated to this problem.*

**Keywords:** school education, differential teaching, elective courses, chemical and biological profiles.

Key question of nowadays is orientation of system of teaching to the development of individuality, able to carry out self-dependent teaching activity, self-development and creative solving of intellectual and practical problems. In the conditions of reforming of school education differential teaching is a crucial element of pedagogical changes [1]. Observing philosophy of this question, we realize that the centre of pedagogical process is a person with his (her) individual needs and his (her) own internal world as the highest value of society's life. The significant place belongs to differential teaching while solving these tasks. Profile character can be regarded as a special mean of differential teaching. Profile teaching is realized by the way of learning of system of teaching courses – basic, profile, special and elective ones (courses to be chosen) [2].

Elective courses (courses to be chosen) are aimed to satisfy different interests of pupils, such kind of courses is in the frame of school component of curriculum. There are different elective courses at different schools using the same profile of teaching. Their set according to the themes must be supplementary to guarantee choice for pupils, and forms of organization of teaching must have active character. The main peculiarity of elective courses is in necessity of choice of some concrete courses (5 – 6 and more) by a pupil himself (herself) and in their compulsory attendance after choice that puts the pupil in the situation of self-dependent professional self-determination, creation of individual life style.

In the result of researches it was established the fact that elective courses fulfilled the following functions: 1) learning of key

problems of nowadays in the chosen field of knowledge; 2) learning of the main profile subjects on high profile level thanks to satiation of profile course with additional contents that deepened and widened knowledge of the main subjects; thus elective courses fulfilled the role of superstructure, adding the contents of profile course; this additional course became a profound one and school class accordingly we named the class with profound learning of concrete subject; 3) direction of attention toward active aspect of contents, perfection of habits of cognitive, practical, research activity, support of cognitive interests including those ones that didn't go out the borders of profile; 4) guaranteeing of internal profile specialization thanks to wide use of interdisciplinary ties, that made possible to start courses with different directions; for example, at the school classes of natural history profile it was possible to start courses with implementation of knowledge using different subjects for example «Materials of space techniques» (physics and chemistry), «Bioorganic polymers» (chemistry and biology), «Natural minerals in techniques» (geography, physics, chemistry) and so on; 5) help to schoolchildren in concretization of choice of fields of cognitive activity in the frames of one scientific discipline, support thanks to elective courses of profile subjects on high level; 6) acquaintance with bases of future professional activity at pre-professional stage thanks to oriented courses (for example «The bases of medicine», «The bases of geology» and so on) that played the role of test on «professional suitability». Passing of this professional test facilitated the development of interests and professional aspirations, favored preliminary acquaintance with the bases of professions, realizing of individual's opportunities. And at last critical assessment of right choice of individual's future helped his (her) self-realization, formation of profession or refusal of it. If the test on professional suitability was failed (for example the man preparing to enter some medical educational establishment loses consciousness from the view of blood) in such case this person needs «to find himself» in another profile [5].

Elective courses are one of the most significant means for constructions of individual educational trajectories (programs) for pupils because they are close by their biggest measure to choice of elements of content of education by every schoolchild depending on his (her) skills, interests, life plans. This mean plays the important role in the structure of profile education of senior stage of school.

It is used elective courses of two types in school practice: subject-oriented; those give possibility for the pupils to realize their own cognitive interests in the chosen educational field and to form skills and means of activity for practical important tasks (teaching practice, project technology, research activity); interdisciplinary; those support motivation of pupils, favor internal profile specialization.

The content of programs of subject-oriented elective courses contains a profound learning of separate themes of basic general educational programs and guarantees higher (profound) level of learning of chemistry.

In school practice subject-oriented elective courses are divided into the following groups:

- elective courses of higher level are directed to deepening of teaching subject. Such kind of elective courses permits to study separate teaching subject not at the profile but at the profound level. In such a case all units of course are deepening evenly;
- elective courses where pupils study separate units of the main course that are compulsory (or not compulsory) in the curriculum of mentioned subject;
- applied elective courses, the aim of those is to acquaint with significant ways and methods of usage of knowledge in practice, development of interests of pupils to contemporary techniques and manufacturing;
- elective courses of learning of methods of cognition of nature;
- elective courses of history of a subject which is compulsory (or not compulsory) in the curriculum (history of physics, biology, chemistry, geographical discoveries, history of astronomy, techniques, religion and so on);
- elective courses of learning of methods of solving chemical tasks, composition and solving tasks on the base of experiment.

The main tasks of elective courses are:

- favorable conditions for self-determination of pupils in the choice of their further professional activity;
- creation of positive motivation of study at the chosen profile;
- making acquaintance of pupils with the main kinds of activities of the chosen profile;
- stirring-up of cognitive activity of pupils;
- rise of informational and communicative competencies of pupils.

The content of elective courses grounds on the following principles: developing principle (elective courses are aimed to develop cognitive self-dependence, research skills and habits that ensure for school leaver an opportunity to work, to improve professional skills during all his (her) life; taking into consideration age peculiarities of schoolchildren (the content of elective courses must be available and interesting for children, these courses must connect the logic of development of an individuality as a priority one and the logic of expanding of a curriculum); taking into consideration regional peculiarities that permits to make the process of study more interesting for pupils; professional direction (realization of this principle makes the process of choice of future profession by pupils and their parents easier).

The most important element of differential teaching was stirring-up of cognitive activity of pupils through creation of possibilities for self-realization and self-esteeming.

Themes of elective courses were prepared taking into consideration the desire of pupils but not of teachers. The contents of courses were aimed to concrete pupil who has chosen special course for himself. Material of integrated programs is wider than traditional teaching subjects. Programs acquaint with complex problems and tasks; they need synthesis of knowledge of different subjects.

While the process of selection it was examined the following positions: what laws, theories, ideas, principles, notions, skills, habits, kinds of pupil's activity were offered for assimilation, how curriculum would favor to profile internal specialization of teaching and forming of profile skills and habits; for what concrete professions, fields of activity it was needed chosen content, what pupils had to know and can before learning of elective course.

According to the structure each program is consisted of two blocks: theoretical and practical ones (practical lessons, laboratory researches, domestic practical researches) [4].

The choice of courses is chosen by pupils voluntarily. Researching this question we took into consideration the following demands: variation character, short-termed – 9 hours or 17 hours that gave an opportunity for a schoolchild to change in the case of need some courses during teaching year, and also completeness, integrated contents.

After the results of quiz, job interview, pupils choose topics of elective courses that teachers offer them at the end of teaching at previous class. The contents of courses don't duplicate the contents of subjects, it contains not only information which widens knowledge of teaching subjects but acquaints pupils with means of activity necessary for successful mastering of program material of different profile of teaching. Before choice of course teacher should foresee effectiveness of teaching of pupils.

Peculiarity of elective courses is in necessity of choice made by a pupil himself between some concrete courses (in the 8<sup>th</sup> and in the 9<sup>th</sup> classes 2-3 courses to be chosen; in the 10<sup>th</sup> and in the 11<sup>th</sup> classes 3-4 and more), that puts the schoolchild in the situation of self-dependent professional self-esteeming, individual professional rise.

The contents of courses to be chosen acquaint pupils with the world of contemporary professions; expand the knowledge of school subjects of pupils; give the possibility to evaluate their own abilities concerning means of activity.

Teacher can try to work in a creative way to realize these programs, taking into consideration the quantity of hours for learning of elective course, interests and skills of pupils, needs of the region, and possibilities of teaching and material base of school. The analysis of the research showed that we could use the curriculum of elective courses also for carrying out facultative lessons and on the contrary – programs of facultative lessons we could use for learning of elective courses.

For example, the curriculum «Chemical professions that are needed to a society» can be used at school (in the 9<sup>th</sup> class at the stage of pre-profile preparation) as facultative course and at senior profile school (the 10<sup>th</sup> or the 11<sup>th</sup> class) as elective course. As separate elective courses or facultative lessons in different classes of learning it is possible to study separate units of course «Chemistry in tasks». As far as distribution of hours in the curriculums is approximate, the teacher can plan from 9/12 till 17/34 hours for learning of these units. According to Regulations about elective courses for pre-profile preparation and profile teaching of pupils, quantity of hours, foreseen for study of course to be chosen, can change depending on the theme and the specialization: 17 – 51 hours on profile level, 8 – 17 hours – on pre-profile level.

According to the components each program of elective courses consists of explanatory note, description of structure of the curriculum, contents of teaching material and demands to the level of general educational preparation of pupils, teaching and long-term plan of subjects, annotation of practical and laboratorial works, literature, methodical recommendations, appendixes. Ten programs include four – subject-oriented and six – interdisciplinary ones.

Let's examine the example of the contents of subject-oriented program of elective course for the pupils of the 10<sup>th</sup> class using the topic «Guide to chemistry». The program of elective course is for short-term time – 17 hours. The course is directed to all-around development of individuality of a schoolchild; it is oriented on the scientific grounding of preserving of environment and health of a man as one of the most important categories in the system of values of a society [3].

The aim of the course is in forming of integrated knowledge about history of nature, skills of the pupils (biology, physics, and bases of health). Grounding of importance of introduction of health way of life is through modeling of consequences of toxic action of things on the organism of a man.

The contents of teaching material and demands to the level of general educational preparation of pupils:

The contents of teaching material	The demands to the level of general educational preparation of pupils
<p><i>Introduction (1 hour).</i> The aim and the tasks of elective course. Demands to safety of life activity during the lessons. The sources of information: references, scientific and popular literature, electronic journals of internet and so on.</p>	<p>A schoolboy (a schoolgirl):</p> <ul style="list-style-type: none"> <li>• <i>can</i> use different sources of information;</li> <li>• <i>follows</i> the rules of safety during work in the room of chemistry.</li> </ul>
<p><i>Chemistry and food (2 hours).</i> Proteins, lipids, carbohydrates, vitamins in the food. Everyday need in food ingredients. Nutritional supplements. «Food label». Nitrites in the products. Demonstration. Determination of vitamins in drugstores.</p>	<p>A schoolboy (a schoolgirl):</p> <ul style="list-style-type: none"> <li>• <i>can</i> juxtapose the codes of nutritional supplements E using the table; choose vitamin complex in the food, drugstore and calculate everyday ration of food.</li> </ul>
<p><i>Carbohydrates (3 hours).</i> The representatives of carbohydrates: glucose, fructose, sucrose, maltose, lactose, starch and cellulose. Changes of carbohydrates in living organisms. Chemical essence of biochemical exchanges of carbohydrates: photosynthesis, breath, fermentation. <u>Practical work 1.</u> Colorful reactions of carbohydrates: Determination of carbohydrates in food (milk, bananas, honey, grapes, apples).</p>	<p>A schoolboy (a schoolgirl):</p> <ul style="list-style-type: none"> <li>• <i>expresses opinion</i> about biological meaning of carbohydrates;</li> <li>• <i>analyzes</i> the main component of food;</li> <li>• <i>determines</i> carbohydrates with the help of research way;</li> <li>• <i>follows</i> the rules of safety during work in the room of chemistry.</li> </ul>
<p><i>Proteins (4 hours).</i> The component of proteins, levels of organization of protein molecule. Works of F. Sanger concerning determination of structure of insulin. The representatives of proteins. Exchange of proteins in the human's organism. The meaning of synthetic proteins. <u>Practical works 2 – 4.</u> 2. Denaturizing of proteins under influence of phenol, formalin, acids. Coagulation of gelatin by spirits. 3. Manufacturing of models of protein molecules. 4. Determination of proteins in food (milk, meat broth, water extract of flour).</p>	<p>A schoolboy (a schoolgirl):</p> <ul style="list-style-type: none"> <li>• <i>characterizes</i> the levels of organization of proteins, biological role of proteins;</li> <li>• <i>evaluates</i> the meaning of synthetic proteins;</li> <li>• <i>evaluates</i> the achievements of biotechnology;</li> <li>• <i>analyzes</i> the main component of food;</li> <li>• <i>determines</i> proteins by the research way;</li> <li>• <i>follows</i> the rules of safety during work in the room of chemistry.</li> </ul>
<p><i>Ferments (3 hours).</i> The main forms of ferments. Mechanisms of actions of ferments. Usage of ferments in medicine and in economical activity of a man. <u>Practical works 5 – 6.</u> 5. Influence of temperature on activity of ferments. Breaking up of hydrogen of peroxide by ferments of potatoes. 6. Inhibitory action of chloride-ions on dehydrogenate complex of potatoes.</p>	<p>A schoolboy (a schoolgirl):</p> <ul style="list-style-type: none"> <li>• <i>knows</i> the mechanism of actions of ferments.</li> <li>• <i>grounds</i> their usage in medicine and in the life of a man.</li> <li>• <i>follows</i> the rules of safety during work in the room of chemistry.</li> </ul>

<p><i>Household chemistry (2 hours).</i>          Soap and synthetic detergent means. Influence of different factors on tooth enamel. Chemicals for dyeing of hair. Varnishes for nails. Toothpastes, rinse aids.  <u>Practical work 7.</u>          Expertise of cleanser «Comet».</p>	<p>A schoolboy (a schoolgirl):</p> <ul style="list-style-type: none"> <li>• <i>has</i> understanding about hydrophobic and hydrophilic parts of surface active chemical, optical bleaches;</li> <li>• <i>knows</i> components of varnishes, toothpastes.</li> </ul>
<p><i>Medical means (2 hours).</i>          Antibiotics: benefit and harm of to the organism of a man. Classification and spectrum of actions of antibiotics. Researches of medical means.  <u>Practical work 8.</u>          8. Determination of qualitative component of a mean «Feroplex».          Final lesson (1 hour).</p>	<p>A schoolboy (a schoolgirl):</p> <ul style="list-style-type: none"> <li>• <i>describes</i> ways of research of medical means;</li> <li>• <i>knows</i> the main destination of antibiotics;</li> <li>• <i>follows</i> the rules of safety during work in the room of chemistry.</li> </ul>

It can be seen from the table that elective course «Guide to chemistry» consists of 17 hours. The content of program is divided into two blocks: 7 hours of theoretical material, 8 hours – practical lessons, introduction, and final lesson. Coordination of blocks of theoretical and practical material is 8:8. Theoretical material unites three components: chemical (proteins, lipids, carbohydrates, vitamins in food, biochemical exchanges and so on), biological (everyday need in food components, exchange of proteins in the organism of a man, processes of photosynthesis, breath), bases of health (food, nutrition supplements, influence of different factors on tooth enamel, antibiotics: benefit and harm of to the organism of a man, usage of ferments in medicine and in economical activity of a man).

Practical part of the program (47%) gives the opportunity to realize the interest of pupils to carry out health way of life, modeling of effects of toxic action of products on the organism. The pupils are offered the complex of practical knowledge. Forming of practical skills favors emergence of new qualities of pupils concerning health way of life. Such practical lessons as dyeing of hair, varnishes for nails, toothpastes, rinse aids form among schoolboys/schoolgirls careful attitude toward their own health, follow the rules of hygiene, teach to be careful to choice of synthetic cleansers, varnishes for nails, toothpastes, rinse aids.

Pupils in the 10<sup>th</sup> class choose the form of final lesson according to the level of their preparation: conference «Attention – food», round table «Problems of everyday life», presentation of «Are antibiotics useful? », debates «Defend himself/herself», proof of usefulness or harm (expert's assessment) of a cleanser «Comet» and so on. After the results of choice of carrying out of all the pupils we can group in micro-groups for defending of scientific and research works (reports). Preparation of pupils to the participation at the final lesson demands from the teacher of chemistry high level of professional preparation and definite competence concerning the questions of organization of such kind of lesson.

The quality of elective courses has the following results: realizing the influence of food, household chemicals, and medical means on the life and on the health of a man, their place in ecological processes; forming of habits of research activity; forming of habits of collective work; self-determination concerning further profile of teaching.

In the result of learning of elective course pupils must know: methods of determination of carbohydrates in food, methods of sedimentation of proteins while heating by acids, salts, and colorful reactions of proteins; properties of amylase of a plum, chemical influence of activators and inhibitors on the activity of an amylase.

Pupil of the 10<sup>th</sup> class choose elective course «Guide to chemistry» according to their chemical and biological profile which forms new thinking; the main components of mentioned profile must be:

- understanding of danger of any kind of influence on the health of a man;
- conviction of necessity of learning of theoretical material for overcoming of prognostic difficulties in preserving of own health;
- realizing of the fact that chemistry as natural science has relations concerning emergence of numerous ecological problems as well as working out of effective methods of its successful solution;
- understanding of the fact that organism of a man as well as organism of each living being is a system, its functioning obey definite patterns (chemical, biological, bases of health, physical ones);
- perception of beauty and harmony in nature;
- understanding of the fact that first of all each person must educate in himself (herself) such qualities as kindness, honesty, decency, aspiration to serve to general human ideals, understanding of value of man's life and health.

The program of elective course plays a significant role in the realization of specialized teaching, in the choice of a future profession of a pupil. Elective courses in profile school together with profile subjects are becoming base for understanding of programs of higher educational establishments and scientific literature.

The researches proved that elective courses positively influenced on motivation during the choice of life way, they have great potential for profile self-determination of a schoolchild; future in profile teaching belong to them. Mentioned arguments specified the necessity of working out not only elective courses but text-books for guaranteeing of profile teaching for general educational teaching establishments of Ukraine.

#### References:

1. Bourins'ka N.M. Ouchitelevy – pro profil'ne navchannya ouchniv ou starshiy shkoly [To the Teacher - about profile education of students in the high school]., N.M. Bourins'ka., *Biologiya i himiya* [Biology and chemistry]. – 2010., No. 4., pp. 10–11.
2. Bybyk N.M. Profil'na shkola: problemy naukovy-metodychnogo souprovodzhennya [Profession-oriented school: problems of scientific and methodological support]., N.M. Bybyk, M.I. Bourda., *biologiya i himiya v shkoly* [Biology and Chemistry in School]. – 2004., No. 6., pp. 2–4.
3. Yuzbasheva G.S. Navchal'nyy programy elektivnykh kursiv ta fakoul'tatyviv. Himiya. Variatyvna skladova Typovykh navchal'nykh planiv. 5–11 klasy [Educational programs of elective courses and facultatives. Chemistry. Optional component of Typical Curricula. 5-11 grades]., G.S. Yuzbasheva, T.A. Oliynyk: navchal'no-metodychniy posybynyk [study guide]. – Herson., Ailant, 2012. – 108 p.
4. Yuzbasheva G.S. Organizatsiya navchal'nogo protsesou [Organization of the educational process]., G.S. Yuzbasheva, M.M. Glazounov: metodychniy posybynyk [textbook of methodics]. – H., Vydavnychna grupa «Osnova», 2014 – Biblioteka zhurnalov «Himiya» [Journals Library «Chemistry»]., Issue 4 (136).– 128 p.
5. Yuzbasheva G. Differential teaching in school science education: conceptual principles *Chemistry: Bulgarian Journal of Science Education* ISSN 0861-9255 SJR (2011) = .192. – 2013., Vol. 22, No. 6. – November-December., pp. 824 – 831.