# PREPARING STUDENTS TO FORM CUSTOMIZED EDUCATION PROGRAMS FOR THEIR FUTURE

**Acker D.,** Dr., Professor of Agricultural Education, College of Agriculture and Life Sciences, Associate Dean for Global Engagement, Director,
**Center for Sustainable**
*Rural Livelihoods Raymond and Mary Baker Chair in Global Agriculture*
*Iowa State University, Ames, Iowa, USA*
*E-mail:* dacker@iastate.edu
**Kalna-Dubinyuk T.,** Dr., Professor in Economics, Department of Public Administration, Management of Innovation & Extension
*National University of Life and Environmental Sciences of Ukraine*
*E-mail:* tatiankd@yahoo.com

***Abstract.*** *Current trends including globalization, digitalization, informatization, computerization, etc., dictate new requirements for the forms, content and delivery methods of education. Education in the form of acquiring knowledge is replaced by the form of acquisition of competences. The actual principle of the quality and level of education is the competence approach, and in the field of providing educational services - the student-centered approach. The purpose of this work is to share the discussion regarding the trajectory of student's education with the necessary competencies for future professional activity, taking into account the student-centered approach to the educational process systems thinking required to solve complex problems, and dynamic optimization methods. The formation of the student's educational trajectory is based on the development of methodological, ontological and logical foundations of knowledge construction. Ontologies play a decisive role in the description model of the formation of such trajectories when a system of ontological descriptions of various training programs is created, which simultaneously becomes a means of methodology for the formation of new trajectories of knowledge. The use of the proposed principles of formation of the student's educational trajectories allows to make this process, on the one hand, more personalized, and on the other hand, transdisciplinary - which ensures the unification of students into study groups by courses, departments and faculties. The practical implementation of the step-by-step principles of building and installing educational programs takes place in the format of "Prism of Knowledge" based on the "Web-Software Complex – Editor of Learning Trajectory Scenarios". It provides the user with a toolkit with dynamic optimization methods for building various scenarios of the optimal learning trajectory taking into account innovations and future professional activities. Therefore, the given system of formation of knowledge trajectories allows building both personal knowledge bases and unification of groups of students, which in the future will contribute to the development of student-oriented education.*

***Keywords:*** *education trajectory, competencies, student-oriented education, prism of knowledge, ontology, e-network, personal knowledge base.*

**Introduction.** The rapid development of society in the era of information technologies leads to necessary changes in the educational component as well. Today, it is becoming more and more obvious that modern higher education is moving away from the informative paradigm of education, focused on the transfer of knowledge, the formation of skills and abilities, and is moving to a competency-based one, based on the formation of the

ability to master the future profession. Student-centered learning involves the active learning activity of the student while acquiring the necessary competencies and increasing responsibility for one's own learning, aimed at achieving a certain result. For this, it is necessary to analyze the work program and work plans with the separation of theoretical basic disciplines, which are a necessary component for obtaining fundamental knowledge of the future specialist. On the other hand, in order to obtain the necessary competencies of a future specialist, it is extremely important to determine the elective disciplines that are determined by the specialty. Therefore, the student has the opportunity to choose one or another of the disciplines according to his own wishes and future profile. The specified approach is the basis for forming the individual educational trajectory of the student.

The analysis of international experience in the field of competence-based and student-centered principles of education shows that the student-centered approach to education is the best model of modern education for achieving the competency level of education seekers. In order to respond in a timely manner to the modern needs of industry and education, it is necessary to implement scientifically based methods for creating an individual educational trajectory of a student. The paper proposes the use of dynamic optimization methods for forming the student's education trajectory with his necessary competencies for future professional activity based on the "Prism of Knowledge" with the "Web-Program Complex - Editor of Learning Trajectory Scenarios".

As a result, we get the implementation of the step-by-step principles of building various scenarios for the optimization of training programs, taking into account innovations and future professional activity based on "Web-Software Complex - Editor of Learning Trajectory Scenarios". Its functionality provides the user with a toolbox with dynamic optimization methods for creating both personalized educational programs and transdisciplinary ones - which ensure the unification of students in study groups by courses, departments and faculties.

The formation of learning trajectories is visualized in the "Prism of Knowledge". Activating the screen of such a "Prism of Knowledge" shows not only structured blocks of educational programs by periods of study, but also a window with complete information about the educational program from its beginning to the end with a set of accompanying materials: electronic textbooks, training courses, presentations, etc. All this provides a flexible mechanism for preparing students for the formation of an individual curriculum for their future.

**Analysis of recent researches and publications.** The foundations of modern world trends in the field of education were laid at the beginning of the 20th century, when the concept of student-centered education was first used by Frank Hayward in 1905. This concept received its further development in the works of both European and American scientists [1, 2, 3]. This is the case in the works of John Dewey (middle of the 20th century), who promoted a practical approach in education, when knowledge of the essence of things and the principles of nature is possible only through the practical assimilation of the skills of making things and their application. In the 80s of the XX century. the formation of the modern model of student-centeredness in education was influenced by the American psychologist Carl Rogers. Bin proposed a human-centered approach in education - the formation of a free self-active personality capable of realizing all its possibilities. Another American, Malcolm Knowles, gave the main role to self-education. The necessary incentive for self-education should be the right motivation. But this form of self-directed education is possible only for adults, for whom instead of teachers facilitators are needed,

who could help in the process of starting the natural inclination to self-development of the personality. Also important was the cognitive theory of learning, which was developed by the Geneva school of psychology - Jean Piaget and his followers. The key factor of education for this system is reflection, in the process of which connections are formed between abstract theoretical knowledge and practical skills of interaction with real objects.

Today, the principle of competence in educational technologies is the most important. The best results are provided by the implementation of a student-centered model. The essence of the latter is a partnership between teachers and students in the process of acquiring practical skills and competencies. The goal of education is to form the foundations of critical thinking and self-learning and self-improvement skills to achieve greater universality of education. The modern model of student-centered education involves a transition from a passive to an active form of education; formation of critical and analytical ways of thinking in students; reflective approach to the teaching process from both teachers and students; distribution of responsibility for learning results between the teacher and the student; increasing student autonomy in the learning process. This approach is the basis of the Bologna process of reforming the education system of European countries. Ukraine joined this process in 2005 and since then has been steadily advancing through the implementation of its basic principles in the national education system.

The analysis of global trends in the field of education with their theoretical and methodological approaches indicates the relevance of the issue of choosing a student's learning trajectory and the need for further research on the use of modern IT for its implementation.

**Purpose.** The purpose of this work is to share a discussion about the trajectory of a student's education with the

necessary competencies for future professional activity, taking into account:

- the student-centered approach to system thinking in education

the process necessary to solve complex tasks;

- methods of dynamic optimization;

- information and software tool "Web-Software Complex - Editor of Learning Trajectory Scenarios", as a basic web-platform for building various scenarios of the optimal learning trajectory, taking into account innovations and future professional activity;

- visualization of the personal knowledge base in education in the form of a virtual "Prism of Knowledge".

**Methods.** The methodological basis of the study is the dialectical method of learning modern education, the method of theoretical generalization, analysis and synthesis of the system of organization of knowledge bases in education, the ontological method of designing knowledge bases built on the platform of graph theory, methods of dynamic optimization.

**Results.** A set of necessary competencies is mandatory for the formation of a high-quality, competitive graduate. A competent approach in education will allow mastering basic skills and competencies and form the personality of a qualified worker. This approach is characterized by student-centered learning. This concept includes, according to modern scientists, not only the achievement of educational goals important for the student in educational activities, but also self-development and various types of extracurricular activities, which allow the student to reveal in himself those abilities that will be important to him in the future and to his liking [1].

Individual educational activity transforms a student from a passive "receiver" of educational services into a subject of their definition and ordering. At the same time, the teacher realizes the function of a leader and consultant of students regarding the selection of

information, its sources, the organization of adequate educational situations, the elimination of identified gaps in order to master the necessary competencies, systematization and improvement of knowledge.

For this, it is necessary to analyze the work program and work plans with the separation of theoretical basic disciplines, which are a necessary component for obtaining fundamental knowledge of the future specialist. On the other hand, in order to obtain the necessary competencies of the future specialist, it is extremely important to determine the elective disciplines that are determined by the future specialty. The specified approach is the basis for creating an individual educational trajectory of the student.

Therefore, the student has the opportunity to choose one or another of the disciplines according to his own desire and future profile. At the same time, students should learn "anytime, anywhere," meaning that student learning can take place outside of traditional classrooms, such as through online course programs, or at non-traditional times, such as at night and on weekends. This fully applies to teachers, whose work may involve flexible working hours and remote work.

To create a student's educational trajectory, it is proposed to use the "Prism of Knowledge" [4]. "Prism of Knowledge" is a virtual electronic form of visualization of a student's educational trajectory in the form of a set of screens combined into a prism. "Prism of Knowledge" is presented in Fig. 1.

Each screen contains a set of hyperactive pictures that link to structured curriculum blocks by learning periods. If you activate the picture, a window will be loaded on the monitor screen with complete information about the training program from its beginning with a set of accompanying materials: electronic textbooks, training courses, presentations, etc.



**Fig. 1. "Prism of Knowledge"**

The practical implementation of the step-by-step principles of building and installing educational programs in the "Prism of Knowledge" is based on the "Web-Software Complex - Editor of Learning Trajectory Scenarios" [5]. A detailed description of working with the

"Learning Trajectory Scenarios " is presented in the "Instructions" at its address: **work.inhost.com.ua**. "Web-Software Complex - Editor of Learning Trajectory Scenarios" is presented in Fig. 2.



**Fig. 2. "Web-Software Complex – Editor of Learning Trajectory Scenarios"**

It has a wide format of use, from the creation of personalized educational programs to transdisciplinary ones - which ensure the unification of students in study groups by courses, departments and faculties.

The principles of formalization of the e-scenario of the knowledge base "Web-Software Complex - Editor of Learning Trajectory Scenarios" in a practical aspect are based on its operational graph-structure, in which the vertices of the graph and their connections are displayed in the form of nested folders (folders) that determine the name terms and concepts in accordance with the given learning trajectory. At the same time, each folder contains its own information data block.

The information structure of data blocks consists of a set of data blocks with the following characteristics:

- name of the data block;

- content of the data block entered from the keyboard;

- hyperlinks to external sources of information that have Microsoft Office formats (video, audio, pictures, tables, etc.), as well as to websites and web resources, including other scripts contained in the knowledge base.

The general operational graph-structure of the e-scenario of the learning trajectory knowledge base is presented in Fig. 3.

To build various scenarios of the optimal learning trajectory, taking into account innovations and the future professional activity of specialists, the functionality of the "Web-Software Complex - Editor of Learning Trajectory Scenarios" provides the user with a toolkit with dynamic optimization methods [7]. The methods of dynamic modeling, which have the name - methods of sequential analysis of options, most fully meet the modern requirements of education. The practice of their application shows that they allow to quickly make scientifically based decisions taking into account perspective, risk and uncertainty when it is

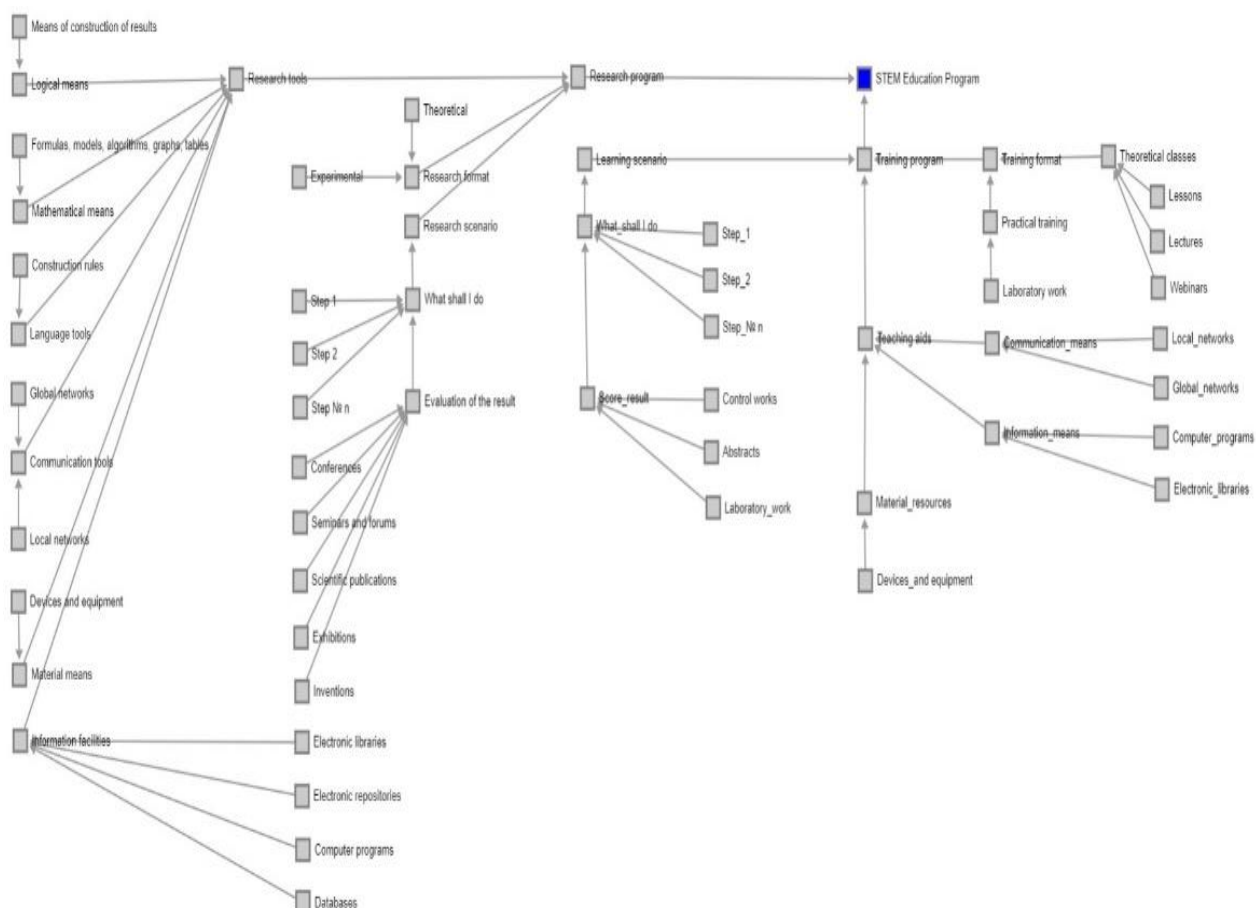necessary to act from what is now and in the future, clarifying previous decisions in order to be competitive.



**Fig. 3. The general operational graph-structure of the e-scenario of the learning trajectory knowledge base**

To build various scenarios of the optimal learning trajectory, taking into account innovations and the future professional activity of specialists, the functionality of the "Web-Software Complex - Editor of Learning Trajectory Scenarios" provides the user with a toolkit with dynamic optimization methods [7]. The methods of dynamic modeling, which have the name – methods of sequential analysis of options, most fully meet the modern requirements of education. The practice of their application shows that they allow to quickly make scientifically based decisions taking into account perspective, risk and uncertainty when it is necessary to act from what is now and in the future, clarifying previous decisions in order to be competitive.

The continuous change in the situation on the clothing market requires educators to make scientifically based decisions to determine or clarify the optimal trajectory of a specialist's training. In order to build such a trajectory, the states of the educational process are first determined, the parameters of which will be disciplines - mandatory, chosen by the student. To determine the number of states, it is necessary to determine the variations of each of the parameters.

The solution to such a multi-step problem consists in sequentially sorting through all possible variants of states by the years of the student's education, taking into account the main limitations of the educational process, when non-competitive solutions are rejected at each step according to the rules for selecting variants [8]. This is how the best trajectory of a specialist's training is found.

This is the practical implementation of the step-by-step principles of building and installing training programs based on the "Web-Software Complex - Editor of Learning Trajectory Scenarios".

**Discussion.** One of the promising directions for further improvement of the presented principles of education trajectory formation is the development of methodological, ontological and logical bases for designing educational programs. Ontologies play a decisive role in the model of the description of the formation of such trajectories, which involves solving the actual problems of increasing the effectiveness of educational work. Also, one of the promising tasks of the development of the provided IT is the creation of a system of ontological descriptions of various training programs, which simultaneously becomes a means of methodology for the formation of new educational trajectories. The use of the proposed approaches to the formation of a personal educational trajectory allows to make this process, on the one hand, more personalized, and on the other hand, more mobile and unlimited in the format of electronic distribution of educational trajectories. That is, the provided education trajectory formation system allows building both personal and collective educational trajectories. This is achieved due to the fact that a specialist in the field of education has the opportunity to use his own experience, building personal e-scenarios of the formation of education, and, if necessary, connect to them other e-scenarios of education of specialist colleagues, or embed his educational trajectories in their e-scenarios of education , or transfer them personally to your colleagues, thereby spreading your educational trajectories in the professional sphere and creating educational teams.

Thus, high-quality training of specialists is impossible without a thorough analysis of needs regarding the direction of their future professional activity. This can be achieved by individual selection of the training trajectory [8], its optimization based on the "Prism of Knowledge" with the "Web-Software Complex - Editor of Learning Trajectory Scenarios".

**References**

1. The Routledge International Handbook of Student-Centered Learning and

Teaching in Higher Education. Edited by Sabine Hoidn, Manja Klemenčič. Published July 29, 2020 by Routledge, 694 p.

2. Sosnytska N.L., Glikman V.S. A student-centered approach to

professional education in the conditions of sustainable development of society. Scientific Bulletin of the Flight Academy. Ser. Pedagogical sciences. 2017. Issue 1. P. 377-381.

3. Deineka V.V. Student-centrism: Traditions and modernity. Student-centered educational process as a guarantee of ensuring the quality of higher medical education: materials of III educational method. conf. Kharkiv: KhNMU, 2020. Issue 10. C. 47-49.

4. Kalnoy S. P., Kalna-Dubinyuk T. P. "Prism of knowledge" as virtual form of organization of e-network personal knowledge base on the example of medicine. Problems of innovation and investment development. 27/2021. P. 85-96.

5. Kalnoy S.P. E-scenario of learning as a means of organizing educational and operational interaction of participants in the scientific and educational process", Scientific notes of the Small Academy of

Sciences of Ukraine. [Coll. of science Proceedings ...] K.: 2018. - Issue 11. pp. 43-49.

6. Kalnoy S.P. Ontological mode of the E-scenario of scientific research as a means of organizing the operational research knowledge base. /S.P. Kalnoy// Problems of innovation and investment development (Economics and Management Series). Scientific and practical journal 20/2019. pp. 90-101.

7. Tetyana Kalna-Dubinyuk, Kateryna Ladychenko, Lyudmila Syerova, Mariia Kuchma, Svitlana G.Litovka-Demenina . Dynamic Modeling in Making Scientifically Grounded Business Decisions. Studies of Applied Economics Special Issue: Development of a Market Economy in the context of the Global Financial Crisis. Vol. 39 No. 9.

8. Mikhalevich, V.S. Sequential optimization algorithms and their application. Cybernetics, 1965, No. 2, pp. 85-88.

9. Nonnecke, G., and D. Acker. Global Resource Systems: A Curriculum to Train the Next Generation of Global Leaders. NACTA Journal. December 2019, Vol 63(1a), pgs. 85-92.

## ПІДГОТОВКА СТУДЕНТІВ ДО ФОРМУВАННЯ ІНДИВІДУАЛЬНОГО НАВЧАННЯ ПРОГРАМИ ДЛЯ ЇХ МАЙБУТНЬОГО
### Акер Д., Кальна-Дубінюк Т.

***Анотація.*** *Сучасні тенденції, зокрема глобалізація, цифровізація, інформатизація, комп'ютеризація тощо, диктують нові вимоги до форм, змісту та методів надання освіти. Навчання у формі здобуття знань замінюється формою здобуття компетенцій. Актуальним принципом якості та рівня освіти є компетентнісний підхід, а у сфері надання освітніх послуг – студентоцентричний підхід. Метою даної роботи є поділитися дискусією щодо траєкторії навчання студента необхідними компетенціями для майбутньої професійної діяльності з урахуванням студентоцентричного підходу до системного мислення навчального процесу, необхідного для вирішення складних завдань. і методи динамічної оптимізації. Формування освітньої траєкторії студента базується на освоєнні методологічних, онтологічних і логічних основ побудови знань. Онтології відіграють вирішальну роль в описовій моделі формування таких траєкторій, коли створюється система онтологічних описів різноманітних навчальних програм, яка одночасно стає засобом методології для формування нових траєкторій пізнання. Використання запропонованих принципів формування освітніх траєкторій студента дозволяє зробити цей процес, з одного боку, більш персоналізованим, а з іншого – трансдисциплінарним – що забезпечує об'єднання студентів у навчальні групи за курсами, кафедрами та факультетами. Практична реалізація покрокових принципів побудови та інсталяції освітніх програм відбувається у форматі «Призми знань» на базі «Програмного комплексу Web – редактор сценаріїв траєкторій навчання». Він надає користувачеві інструментарій із методами динамічної оптимізації для побудови різноманітних сценаріїв оптимальної траєкторії навчання з урахуванням інновацій та майбутньої професійної діяльності. Отже, наведена система формування траєкторій знань дозволяє будувати як особистісні бази знань, так і об'єднання груп студентів, що в майбутньому сприятиме розвитку студентоорієнтованої освіти.*

***Ключові слова:*** *траєкторія освіти, компетентності, студентоорієнтована освіта, призма знань, онтологія, електронна мережа, особистісна база знань.*