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**INDIVIDUAL EDUCATIONAL TRAJECTORY  
IN MODERN UKRAINIAN HIGHER EDUCATION  
AS A TOOL FOR ADAPTABILITY TO ITS ENVIRONMENT**

**Abstract.** The adaptability of modern education depends on a number of technical and organizational factors, including the provision of the educational process with computer technology, the ability of all participants in the educational process to use cloud technologies, the readiness of the administration of higher education institutions (HEI) to create conditions for studying students according to individual educational trajectories. Adaptability allows HEI to compete on the market of educational services, to maintain the level of education in the unfavorable conditions of a prolonged pandemic and war, to change the content of disciplines in accordance with the rapid development of science and technology. Our research demonstrated the possibilities of predicting the success of individual educational trajectories using the trend method, which works on the basis of the widely used Microsoft Excel office program. The individual educational trajectories of students (separately from each other) studying music and forming valeological competence while studying the valeological discipline "Health Pedagogy" were analyzed. Trend forecasting, based on the use of qualitative indicators of competencies, showed fairly accurate results (with an error of approximately 10%), which allows us to recommend the forecasting method for use by higher education institutions, regardless of the student's study profile. We have also identified four conditions for ensuring the adaptability of higher education: a large number of optional disciplines, the possibility of changing the forms of education, the pace of learning (depending on the abilities and health of students), crediting the results of studies in similar disciplines in other institutions of higher education and in non-formal education. The method proposed by us for predicting the success of training according to an individual educational trajectory can be considered adaptive, because it allows evaluating the results of training in different specialties.

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**Keywords:** *forecasting, trend method, cloud education technologies, personalized learning.*

**Introduction.** Adaptability of modern education is its important characteristic, which is connected with the possibility to change the content and forms of teaching at the demand of the time and to compete in the market of educational services. The Latin term "adaptation" has been used in science since the 18<sup>th</sup> century at the initiative of H. Aubert. It was first widely used in evolutionary theory to describe the ability of a living organism to adapt to changing external conditions. The term is often used in medical-biological scientific sources to describe the ability to compensate for the action of pathogens without causing disease. Compensatory and adaptive reactions are considered within the limits of normal physiology, "disruptions of compensation" – within the limits of pathology [1]. Adaptive processes are also the subject of research in management, psychology, sociology, physiology, cybernetics, economics, pedagogy, etc.

In fact, adaptability is the ability to flexibly change while maintaining one's purpose. That is, in adaptability, there are limits to the variability of content and form. Each branch of knowledge has its limitations. For example, modern pedagogical education does not allow violating the principles of confidentiality and evidence-based medicine [2; 3]. Adaptability is effective when it uses the principles of feedback and measurability of the results of the activity to which it is applied. Therefore, in education, adaptability is often considered together with the qualitative assessment of the formation of competences [4; 5]. The principle of adaptability in Ukrainian education was fully realized during the forced transition to distance and mixed forms of education since the beginning of the COVID-19 pandemic and the full-scale war with Russia. An important task of adaptation was to preserve the quality of education. In the short-term perspective, determining the impact of changing forms of education is carried out by determining the formation of graduates' competencies [6]. Indicators of academic success are less informative [7], as are indicators of graduate employment.

The adaptability of education should also fulfill the function of individualization of learning, which is associated with the construction of an individual educational trajectory of learning for each individual student, or at least for inclusive and gifted students. An individual educational trajectory is of particular importance for students of art specialties. But the analysis of the results of pedagogical research on the topic of building individual educational trajectories reveals a significant lack of practical recommendations, assessment methods and forecasting of individual learning outcomes.

**Analysis of literary sources.** Modern education increasingly emphasizes a personal approach to the professional training of specialists. This led to an increase in the number of scientific studies in which the authors discuss the essence and features of creating personal educational trajectories. A significant number of scientific works in this field of research over the past 15 years are associated with the use of computer (cloud) technologies [8–10]. One of the tasks of educational activity is to significantly reduce the time needed to develop governing pedagogical influences through the use of predictive models [11–13]. The forecasting process makes it easy to have data about each student in the cloud (distance education sites) that does not need to be entered additionally to perform forecast calculations. Separate educational platforms have begun the development of forecasting tools, although the widely used Microsoft Excel office program (USA) is already equipped with the simplest set of tools [14; 15].

The use of prediction is more traditional for modeling the educational processes of groups of students than for personalized learning. However, at the individual level, it is able to show the possible scenarios of individual development of competences and determine whether it is necessary to give up the benefits of training according to a collective program altogether [16]. The decision to switch from general group to personalized training must be made by the student together with his mentor, and the administration of the higher education institution (HEI) must allow training on an individual educational trajectory and change the curriculum.

Thus, the **purpose** of our research is to determine practical steps for building individual educational trajectories of students of higher education institutions, methods of its prediction and evaluation of the results of personalized training.

**Presenting main material.** An adaptive educational environment should be flexible: contain a large number of elective disciplines, offer choices regarding the forms of learning. The best practices of adaptive learning take into account the needs and characteristics of each student, provide tutor (assistant) support. In our opinion, the development of adaptive education will be facilitated by the obligation of all HEI to consider the documented results of non-formal education of students (diplomas, certificates), certificates of the results of studies in other HEI of Ukraine and other countries, and to count ECTS credits without re-studying the relevant disciplines, if the student requests it. This form of crediting results corresponds to the principle of academic mobility of the Bologna process, supported by Ukraine [17].

The second important step of studying with an individual trajectory is the student's right not to take the exam, if the student has, in his opinion, obtained a sufficient number of ECTS points (more than the minimum) during the course of study. This reduces the level of stress during study and promotes health-saving. Each teacher should have the appropriate right to give a final grade for training without taking an exam (credit).

The third important option of studying according to an individual educational trajectory is the opportunity to study at one's own pace, which is important for students who: 1) have health disabilities and are able to study only inclusively; 2) initial knowledge, skills and abilities; 3) gifted students [6; 18].

An example of the 1<sup>st</sup> category are students who cannot walk independently and move around with the help of crutches or a wheelchair. An example of the 2<sup>nd</sup> category are students who: a) demonstrate a lack of knowledge of anatomy, physiology, hygiene and emergency premedical care, which should have been obtained within the school curriculum in the disciplines “Human Biology” and “Fundamentals of Life Safety”,

and which are necessary for training in the discipline "Health Pedagogy" [19; 20]; b) do not have a basic musical education at the time of admission to musical HEI [21]. An example of the 3<sup>rd</sup> category of students are gifted students in certain areas of education (in exact sciences, in certain exact sciences, in humanities, in certain humanitarian sciences, in sports, in art, in certain types of arts). Gifted students (they start at the same level of knowledge, skills and abilities as other, ordinary students, but achieve academic success faster than others) should not be confused with students who have special professional training at the time of starting the study of certain relevant disciplines. (For example, students with a medical education more easily master the discipline "Health Pedagogy"). But the technology of changing the requirements for the minimum and minimum levels of competence formation, described in [6], can be applied to both those and other students.

As already mentioned, to ensure the opportunity to study according to an individual educational trajectory, there is a sufficient number of optional disciplines [22]. The development of the system of optional disciplines should be based on a competency-based approach: the student should form a list of competencies at the minimum to maximum level according to the educational level (bachelor's, master's) and the category to which he belongs (inclusive, ordinary or gifted). Some competences are formed at the expense of special disciplines almost entirely. For example, valeological competence is due to the disciplines "Health Pedagogy" or "Fundamentals of Medical Knowledge and Health-Saving". Some competences can be formed throughout the course of study due to the study of many disciplines. For example, the integral competence of each specialty in accordance with the state higher education standard. In this case, the replacement of one discipline by another is simplified, especially if HEI has a real-time competence formation control system available to teachers and students, as well as if the joint formation of competencies is agreed between the HEI's departments [5].

To visualize a personal educational trajectory, we suggest using maps that perform instrumental and symbolic functions. The instrumental function allows you to adapt the environment to the interests and needs of the individual. Iconic function is a personally significant psychological tool that helps a person perceive himself and his actions in a new scale and context. The map acts as a generalizing tool for the individual, because through it he can consider his place in action in a broad context [12, p. 24]. To forecast an individual educational trajectory, it is possible to use the *trend method*, the line of which can be linear or non-linear (parabolic, hyperbolic, etc.). We will demonstrate the possibilities of forecasting and visualization of an individual educational trajectory using the examples of musical and valeological education.

When predicting an individual educational trajectory in music education, we used the following concepts to determine the level of general musical training: 1) musical-theoretical training; 2) possession of technical skills; 3) level of independence. Forecasting is performed in two steps: 1) diagnostic (with control sections); 2) prognostic. Consecutive sections with an interval of 2 weeks are provided by a teacher or a mentor under the guidance of a teacher, which is demonstrated by the example of student S. (*Table 1*). The assessment is carried out using a qualitative method [4]. The overall score is calculated as the arithmetic mean of the corresponding indicators.

Thus, the general level of professional (musical) competence of student S. increased from 3.36 points out of 10 possible (slice 1) to 5.24 (slice 3), which indicates noticeable progress in mastering elementary music theory, awareness of modern musical culture, mastery of skills sound creation, right and left keyboards, accordion bellows, analyzing musical text, reading text from a sheet. We noted a gradual noticeable increase in indicators that depend on the student's abilities and level of motivation. The obtained results were used by us to further predict the individual educational trajectory and professional development of the future music teacher without primary music education.

Table 1. The mechanism of predicting the educational trajectory of future music teachers.

Criterion	Indicator	Slice I	Slice II	Slice III
Music-theoretical training	General awareness of modern musical culture	7.00	8.00	9.00
	Knowledge of elementary music theory	4.00	6.00	7.00
	<b>Overall assessment</b>	<b>5.50</b>	<b>7.00</b>	<b>8.00</b>
Possession of technical skills	Possession of sound production skills	4.00	7.00	7.00
	Possession of right and left keyboards	4.00	7.00	8.00
	The level of mastery of the bellows	4.00	6.00	7.00
	Skills of independent analysis of works	3.00	5.00	5.00
	Skills of practical work on a musical piece	3.00	5.00	5.00
	<b>Overall assessment</b>	<b>3.60</b>	<b>6.00</b>	<b>6.40</b>
Level of independence	Determination of tonality of the work and size	1.00	1.00	1.00
	Definition of appliqué and bellows	1.00	1.00	1.00
	Analysis of musical text	1.00	2.00	2.00
	Reading musical text from a sheet	1.00	1.00	2.00
	Work on dynamic shades, interpretation of work	1.00	1.00	1.00
	Ability to independently study musical works	1.00	1.00	1.00
	<b>Overall assessment</b>	<b>1.00</b>	<b>1.17</b>	<b>1.33</b>
	<b>Final assessment</b>	<b>3.36</b>	<b>4.72</b>	<b>5.24</b>

Forecasting of further development was carried out using Microsoft Excel on the basis of time series, or the sequence of changes in indicators over time. The forecast consists in spreading (extrapolating) the data for the next time period based on the data for the past time period. As already mentioned, the observation step is 2 weeks. The total duration of the forecast is 4 months, divided into 8 equal intervals of 2 weeks each. The first 3 periods are test periods, the next 5 are extrapolation periods. The trend line (Fig. 1) is chosen as a logarithmic approximation, which well describes the value that first rapidly increases or decreases, and then gradually stabilizes.

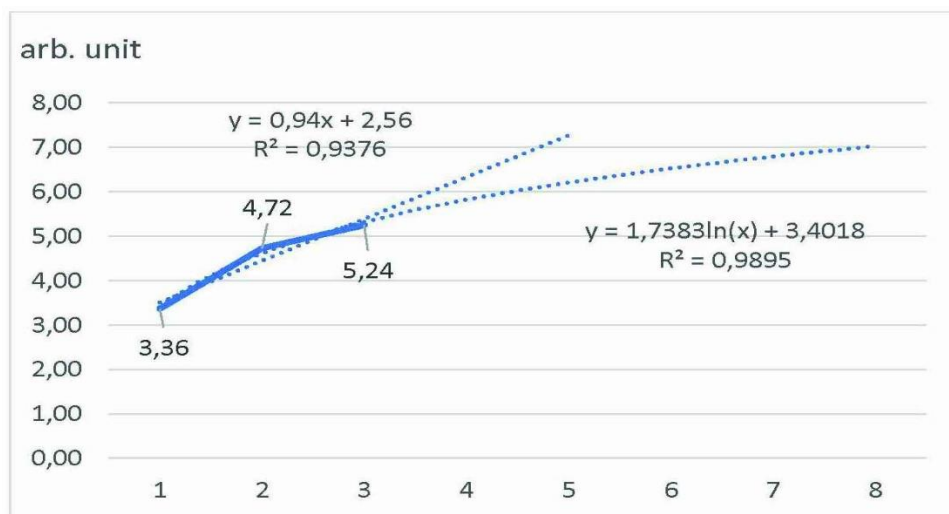
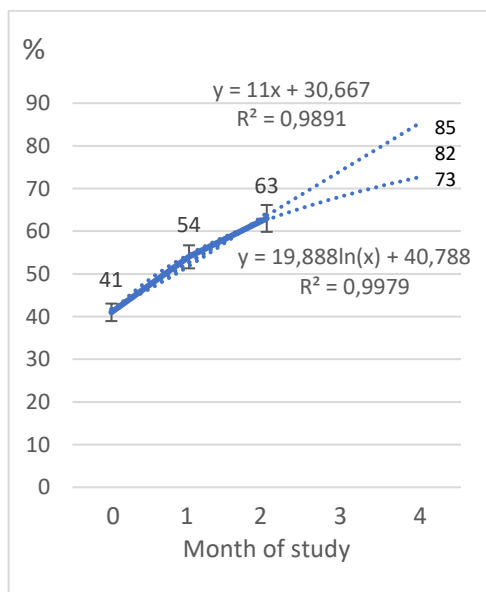


Fig. 1. Predicted individual educational trajectory of student S.

The second example of predicting an individual educational trajectory is presented for student N. (Table 2, Fig. 2), who studied the discipline "Health Pedagogy" at the Ukrainian Engineering and Pedagogical Academy in the 1st semester of the 2022/2023 academic year. To assess the formation of valeological competence and its 4 components (CC: cognitive, k; activity, a; motivational-value, mv; personal, p) 4 sections were performed: 1<sup>st</sup> – at the beginning of training, 2<sup>nd</sup> – after 1 month from the start of studies, the 3<sup>rd</sup> – 2 months after the start of studies, the 4<sup>th</sup> – 4 months after the start of studies. The first three slices performed a diagnostic function, which allowed us to make a forecast, the 4<sup>th</sup> slice allowed us to check the individual forecast. The evaluation of the results was carried out according to the qualitative factor-criterion model of the formation of competence, created according to the methodology of H. Yelnykova [6]. The results were also compared with the model of maximally formed valeological competence [5].



**Table 2. The formation of valeological competence of student N. during the study of the valeological discipline "Health Pedagogy", which contains a forecast and comparison with the model of competence formation at the maximum level (%).**

CC	Slice 1	Slice 2	Slice 3	Forecast (line/log)	Slice 4	Maximum
k	11	14	17	23/-	21	25
a	9	9	12	14/9	19	25
mv	7	13	15	24/7	22	25
p	14	18	19	24/22	20	25
Total	41	54	63	85/73	82	100

← **Fig. 2. Predicted individual educational trajectory of student N.**

According to most of the calculated indicators, the result of the 4<sup>th</sup> slice was closer to the linear trend line than to the logarithmic trend line. Therefore, it can be concluded that the formation of valeological competence of student N. took place



according to the pattern of linear progression, which corresponds to an intensive and persistent learning style [23]. Thus, the method chosen by us for predicting the individual educational trajectory allows us to predict quite accurately (within 10% error) the academic success and opportunities for professional growth of future graduates during their studies.

### **Conclusions**

1. The possibility of building an individual educational trajectory of a student of a higher education institution exists only in higher education institutions that work in an adaptive mode.

2. The individual educational trajectory is subject to forecasting by widely available cloud tools. Forecasting can use the data of qualitative assessment of the formation of competencies and their components. A greater amount of data obtained at the diagnostic stage of building an individual educational trajectory will make the forecast of its success more accurate. The minimum number of measurements (sections) of the diagnostic stage is three.

3. Advanced cloud technologies create favorable conditions for the individualization of the learning process.

**Prospects for further research** consist in the improvement of the trend method to increase the accuracy of the forecast of the effectiveness of student learning according to individual educational trajectories.

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## **ІНДИВІДУАЛЬНА ОСВІТНЯ ТРАЄКТОРІЯ В СУЧАСНІЙ УКРАЇНСЬКІЙ ВИЩІЙ ОСВІТІ ЯК ІНСТРУМЕНТ АДАПТИВНОСТІ ЇЇ СЕРЕДОВИЩА**

**Анотація.** Адаптивність сучасної освіти залежить від низки технічних та організаційних факторів, серед яких забезпеченість навчального процесу комп'ютерною технікою, вміння всіх учасників освітнього процесу користуватися хмарними технологіями, готовність адміністрації закладів вищої освіти (ЗВО) створювати умови для навчання студентів за індивідуальними освітніми траєкторіями. Адаптивність дозволяє ЗВО конкурувати на ринку освітніх послуг, підтримувати рівень навчання у несприятливих умовах тривалою пандемії та війни, змінювати зміст дисциплін відповідно швидкому розвитку науки та технологій. У нашому дослідженні продемонстровані можливості прогнозування успішності індивідуальних освітніх траєкторій за допомогою методу трендів, працюючому на базу широко вживаної офісної програми Microsoft Excel. Проаналізовані індивідуальні освітні траєкторії студентів (окремо одна від іншої), які навчаються за музичним фахом та формують валеологічну компетентність під час вивчення валеологічної дисципліни «Педагогіка здоров'я». Прогнозування методом трендів, що базується на використанні кваліметричних показників компетентностей, показало доволі точні результати (з похибкою приблизно 10%), що дозволяє нам рекомендувати метод прогнозування для використання закладами вищої освіти незалежно від профілю навчання студентів. Також ми виділили чотири умови для забезпечення адаптивності вищої освіти: велика кількість дисциплін за

вибором, можливість змінювати форми навчання, темп навчання (залежно від здібностей та здоров'я студентів) зараховування результатів навчання за аналогічними дисциплінами в інших закладах вищої освіти та при неформальній освіті. Запропонований нами метод прогнозування успішності навчання за індивідуальною освітньою траєкторією можна вважати адаптивним, тому що він дозволяє оцінювати результати навчання за різними спеціальностями.

**Ключові слова:** прогнозування, метод трендів, хмарні технології освіти, персоналізоване навчання.

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