

Use of IT for Student-Centered Learning Approach to Education at Modern University

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Abstract

This paper presents the results of a theoretical analysis of student-centered learning aimed at educational outcomes and the realization of the student's personality-oriented potential. In addition, practical approaches to the design of an individual educational trajectory are highlighted and its application for first year students at undergraduate level is exemplified. Student-centered learning approach is one of the key trends in the development of education in today's world. However, modern scientific views on this method are rather contradictory, which makes it necessary to systematize data on the emergence of student-centered learning models in education and analyze the results of the introduction of individual educational trajectories.

Keywords ¹

Individual educational trajectory, the IET, digital technology, electronic information and educational environment, student-centered learning approach, active learning method, design, competencies, educational risks.

1. Introduction

In the context of the digital transformation of education, the search for new approaches to the development of pedagogical theory and teaching practices aimed at differentiating and personalizing learning techniques is gaining importance. The issues of student involvement, quality of education and meeting individual student needs and requirements become particularly important.

An individual learning path is defined as a purposefully designed differentiated educational program that allows the student to choose his or her own learning trajectory and achieve self-identification and self-realization through teachers' help and support.

In addition to the concept of individual educational path, there is the concept of individual educational trajectory (IET). For any area of implementation, the individual educational trajectory has the characteristics of being preset, planned, and measurable. The IET can be implemented in several ways through:

- a content-based approach (variable curricula and educational programs that determine an individual educational path);
- activity-based approach (special pedagogical student activities);

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- process-based approach (organizational work, aimed at the interaction between the student and the administration of the educational institution).

If the aforementioned trajectory and path both have preset directions to guide the student, the professional education track provides students with the freedom to choose their desired career and structure their education accordingly without career counseling. It allows for the ability to make conscious choices and facilitates full student involvement in the process of "self-learning" (in the narrow sense - as self-study) and "self-creation" (in the broad sense - as "self-invention"). In this context, it is proposed to introduce a new concept - "educational project". [5]

The educational project solves more complex tasks and functions of the IET as a system of independent choices, involving independent navigation (and not career counseling).

2. Theoretical background

The main problem of using IET in educational activities is expressed in the following contradiction: IET is a student-centered learning service (hence, a multivariate system), but at the same time it is limited by a set of educational resources available in the electronic information and educational environment of the university. To allow the students to pursue their goals, the IET is built by the student individually, but in order to create an educational service within the electronic information and educational environment of the university, a limited set of content elements of the IET are used, the competence profile of the student, the dynamics of movement along the IET with a mentor, and the dynamics of movement along the IET independently.

In modern education, depending on the techniques and teaching methods used, there are four forms of student-centered learning (personalization of learning):

- 1) the expansion the student's autonomy (used in large introductory courses);
- 2) self-learning (students determine educational tasks, content, didactic tools themselves);
- 3) differentiated teaching (students are divided into groups for further mastering of the educational program);
- 4) adaptive learning (personalization of learning).

Depending on the objectives of the educational organization and the goals of the student, the IET distinguishes two areas:

- personalization of the program, when the teaching process is adapted to a specific student;
- personalization by the students themselves, when the students independently build their own education [7].

The ultimate form of student-centered learning is individualization, which views the student as the end user of education and adapts mass education to the needs of a particular user. For all levels of education, including corporate, "customization" is the modification of the educational program to meet the specific needs of each student [1].

Student-centered learning education is customized for a specific student, depending on his or her personal interests, role in the team or level of training. Specialized educational programs are based on a targeted selection of specific content, examples, and structures to meet the needs and specific goals of a small number of students.

Examples of customizing education include:

- Facilitation
This practice involves group and individual support from tutors, mentors, and internship supervisors for solving educational problems at various levels;
- Boxed solutions
This method is practically devoid of customization. It includes various thematic games, open programs, and online courses (MOOC) and can be used to teach the largest possible number of students.

It is important to note that student-centered learning education programs draw on local capabilities and create unique solutions within the adaptive educational programs that take into account the IET. Such educational solutions take into account the level of subject expertise, range of interests, and educational tempo, personal, behavioral and physiological characteristics of the student.

Comprehensive customization within student-centered learning improves the learning experience through various IET “settings” and adjustable teaching formats tailored to the preferences of a particular student.

Consider several examples of organizing student-centered learning using IET in various foreign universities presented in Table 1.

Table 1

Examples of IET use with student-centered learning programs in various universities around the world

№	University	IET
1	MIT (Massachusetts Institute of Technology) [9]	A student-centered learning approach to learning is an alternative to the industrial model of education. This approach supports students in their developmental process in four areas: cognitive skills (interdisciplinary high-level thinking skills), material knowledge (intensive program in all major disciplines), success skills (individual and group behavior patterns, attitudes and perceptions), goal understanding (self-knowledge, values, informed choice of the development path).
2	SMU (Singapore Management University) [4]	SMU-X Pioneering Pedagogy is based on interdisciplinary content, project-based learning, collaborative real-world problem solving with partners, and active student mentoring from faculty and industry partners. These educational directions are packaged in the IET of students. Platforms used: Echo 360, Active Learning Platform (ALP), eLearn, and WebEx.
3	CODE University of Applied Sciences [2]	The unique curiosity-driven education (CODE) begins with an orientation semester, where all students are introduced to the learning concept, three undergraduate study programs, and the Science, Technology and Society program, which enables students to develop scientific thinking and critical judgment skills, while a series of Interpersonal Skills Workshops helps students work in a team, show leadership and communication skills.
4	University 2035 [8]	The first university in Russia to provide opportunities for professional development by creating individual educational trajectories and tracking digital footprints. The university is a pioneer of a new network principle of education in Russia, in which educational trajectories for each student are selected personally. University 2035's various services provide customized content to enable students to study both offline and online through a digital platform < https://2035.university/ >

In general, most of the universities around the globe consider student-centered learning as a natural and mandatory part of the educational process. Universities strategize and plan their programs based on the independence and awareness of their students. Previous academic restrictions are being replaced with the most open environment. For instance, in Germany even the constitution has provisions on education that are consistent with the concept of IET [16]. Presently, the creation of platforms integrating education with personal development has become the major trend worldwide.

We analyzed a series of case studies on the use of the IET in education and present what we found

to be the advantages and disadvantages of the system in Table 2.

Table 2

Comparative table on the advantages and disadvantages of the use of the IET in education

Advantages of IET use	Disadvantages of IET use
<ul style="list-style-type: none"> - educational planning becomes a dynamic process and is based on objective data; - most of the educational processes are under constant monitoring and can be adjusted if necessary; - the level of complexity of education corresponds to the individual characteristics of the student; - the individual level of preparation, involvement and comprehension of educational material is taken into account; - concrete ways to achieve a positive result are rationalized; - increased student motivation; - it becomes possible to choose a project team; - the share of students expelled due to academic failure decreases. 	<ul style="list-style-type: none"> - mistakes in determining the student needs; - high costs of creating digital adaptive learning systems; - the inability of the education system to reflect the diversity of the students' personal characteristics; - typical trajectories are built on the basis of average inputs, which contradicts the individual approach to the trainee; - the same type of IET format is used to organize the education process in universities with different educational approaches.

Undergraduate, graduate, and postgraduate students self-select courses that make up the core curriculum, their major, minor, and electives. Each course is assigned a number of credits, which are determined by the university and may vary in different countries, universities, and specialties. The number of credits a student receives for the course is determined by several criteria, such as workload, learning outcomes, and hours spent in attendance for the course. The number of hours a student spends attending lectures and seminars, individual tutoring, and exams will factor into the number of credits awarded for the course. Students can earn credits for various types of study activities (modules, courses, internships, project work thesis work, etc.) that are required for the successful completion of their education. Table 3 shows examples of the implementation of the credit system, which is the basis for building the IET of students at foreign universities.

Table 3

Examples of the credit system implementation

University	Country	Type	Comments
MIT [9]	USA	unit	The credit hours (units) for each subject indicate the total amount of time spent in the classroom and laboratory, and the approximate time the average student spends in outside preparation per semester. Each unit is about 14 hours of work per semester or about one hour of work per week for a subject studied for the entire semester. The total score for one subject is obtained by adding all the units. Three MIT units are roughly equal to one "semester hour" or credit. An MIT subject with 12 units translates to four semester hours or credits.
Kentucky State University [10]	USA	credit	At the undergraduate level, it requires a minimum of 120 credit hours per semester, but no more than 144 semester credit hours. To graduate, a student must take at least 42 semester credit hours in upper-level courses.

University of Cambridge [11]	UK	CATS	To meet the Bachelor Degree requirements, a student must complete a 3 step process. First, the student accumulates 120 CATS points at FHEQ level 4, thus, earning a Certificate, then 120 CATS points at FHEQ level 4, equivalent to a Diploma, and finally, 120 CATS points at level 6 FHEQ for the Advanced Diploma. Postgraduate certificates are taught at 7 FHEQ level and have 60 credit points. Postgraduate diploma is accredited with 120 credit points and is taught at level 7 FHEQ. Masters degrees are awarded with 180 CATS points.
Seoul National University [12]	Korea	credit	Undergraduate students must complete a minimum of 130 credits, including 36 credits or more in general education courses, 39 credits or more in their major, and fulfill all the specific requirements of their faculty / college. Students with a dual major, minor, or a combined major course must earn an additional 22 credits from permitted courses.
Freie Universität Berlin [13]	Germany	ECTS	FU-BEST awards ECTS (European Credit Transfer System) credits. ECTS is based on the principle that the workload of a full-time student within one academic year is equivalent to 60 credits, which includes contact hours in the classroom, individual assignments and preparation for classes. The average workload for full-time students in Europe ranges from 1,500 to 1,800 hours per year; one ECTS credit is 25 to 30 hours of work. The Academic Senate of the Free University of Berlin has established that one ECTS credit is equivalent to 30 hours of study.
University of Helsinki [14]	Finland	ECTS	The scope of the degree is measured in (ECTS) credits. The courses provide credits according to the required workload. One credit represents approximately 27 hours of work. The degrees are designed so that students receive around 60 credits within one academic year or 1,600 full-time hours. The first-cycle degree is 180 credits, the second-cycle degree is 120 credits. The maximum scope of the degree is 200 credits and the second-cycle degree is 135 credits.
The University of Melbourne [15]	Australia	credit	Bachelor's degrees have a duration of 3 years and students must accumulate 300 credits. The standard workload for undergraduate students is 50 credits per semester. Most courses yield 12.5 credits. Depending on the program, graduate students may need to accumulate between 100 to 400 credits for completion.

When assessing students, various factors are taken into account: class attendance, test results, homework grades, essays, projects or research papers, results of oral or written examinations, etc. These factors are assigned weights by the instructor depending on the goals and load of the course. As a result, students may be assessed based on some courses on their project work, in others on their exam scores.

3. Results and discussion

The organization of student-centered learning faces certain difficulties. First, it necessitates a collection of a rather large amount of data both at the start of the IET as well as along the trajectory. Among others necessary input data include personal information, diagnostic and competency and professional test results, analysis of the digital footprint, school performance assessment results. Second, if we assume that, taking into account the rapid expansion of methods and channels of training, each student will face a wide variety of choices, then making a choice and the moving along the IET itself will become a problem.

In an environment of rapid change and expanding educational opportunities, educational choices are more likely to become situational, spontaneous and risky.

When building and implementing an IET, the following steps should be followed:

- collect and analyze the data of primary and subsequent diagnostics of students;
- analyze the digital profile of students (applicants);
- build a digital model of the educational process based on the curriculum;
- set the criteria for the IET;
- assign indicators and coefficients to the IET criteria;
- create recommendation scripts (for students / tutors / teachers / employers / scientific advisors / administrative departments of the university, etc.);
- gather students' midterm and final exam results;
- introduce practical exercises in the form of games into the electronic information and educational environment and the IET in order to increase motivation for development and learning;
- develop formats for presentation of learning outcomes based on the IET (reports, student CVs, ratings).

The basic system that will guide the student through the implementation of the IET involves 4 core components. The first component is making a choice and comprehending your activities. The second step is setting personal goals that lead to a specific result. In the third step, you achieve the goals and, finally, reflect on the results and readjust if necessary. A schematic basic diagram is shown in Figure 1.

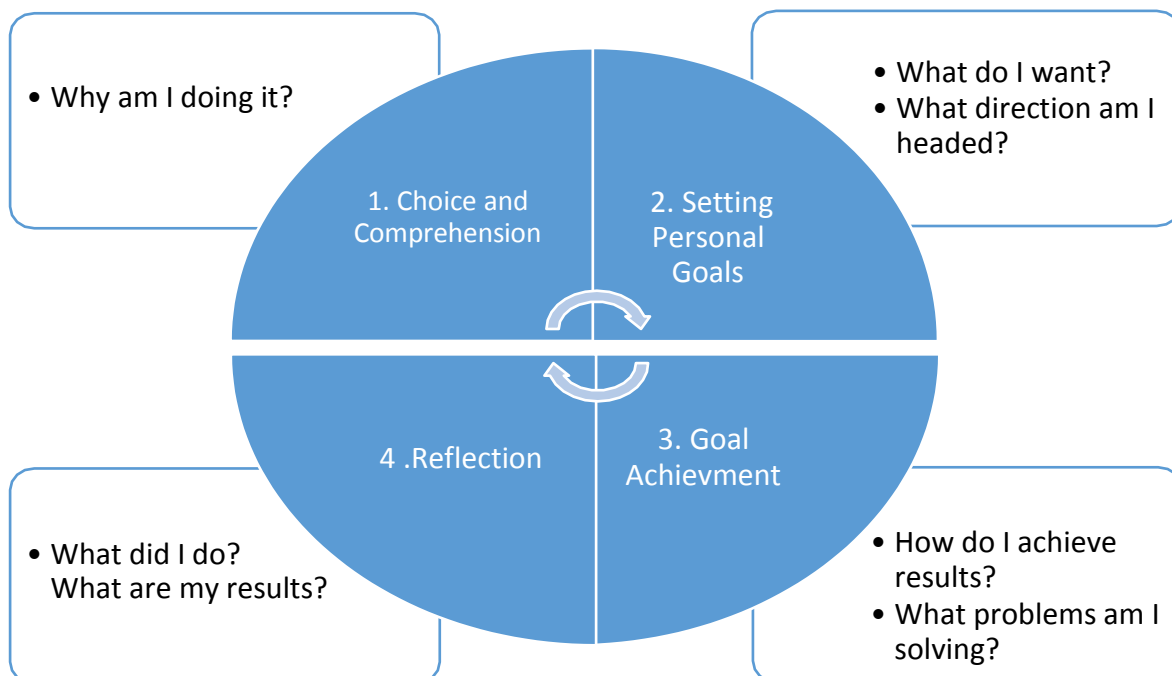


Figure 1: Basic system for decision making

The iterative tasks facing the developers of the IET model are determined by using functional and morphological analysis, which is presented in Figure 2. It is important to understand that to determine the main and secondary functions, it is necessary to use the test questions method and study the static

and dynamic characteristics of the IET by defining its changes, algorithms of action and control.

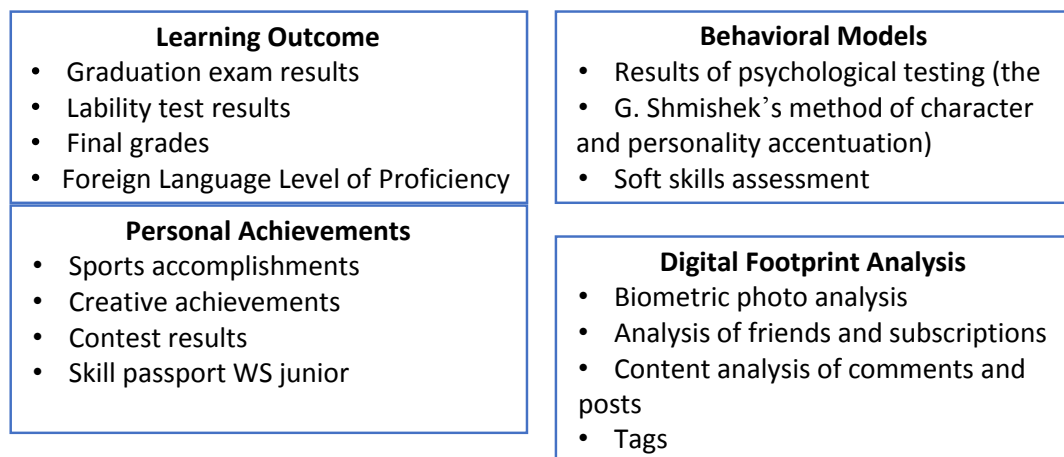


Figure 2: Morphological analysis of the IET

Morphological analysis (F. Zwicky's morphological box) [5] is used in the selection of possible solutions for each element of the IET (the so-called morphological features that characterize the system) to subsequently obtain their combinations on a systematic basis. Application of this method allows to:

- identify and characterize the content elements of the IET system;
- formulate problem areas of the IET that need to be solved;
- construct a multidimensional matrix (morphological box) containing solutions for all identified elements of the IET;
- analyze and evaluate, in terms of goals and functions, the elements of the IET to implement the best solutions (subject to availability of funds). To design the IET, it is important not only to determine the entire range of educational and target results, but also to take into account the results of advancing along the educational trajectory. Constant feedback is needed to assess and timely correct the path of the learner, as shown on the diagram in Figure

3. For this, you can use the MPV analysis (Main parameters of value), which defines all stages of the IET life cycle and educational stakeholders responsible for the implementation of these stages.

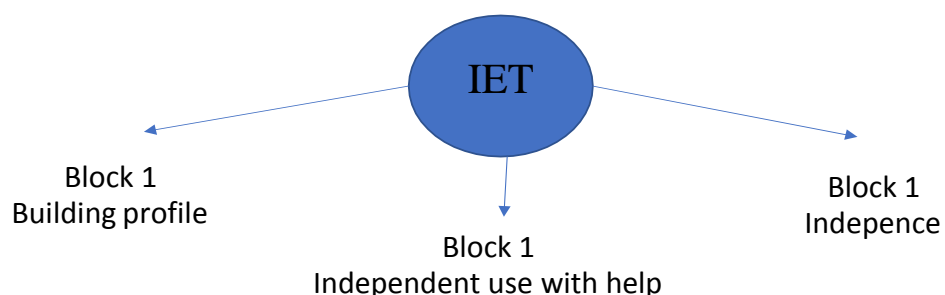


Figure 3: Basic IET blocks identified as the result of the functional and morphological analysis

Based on the results of the MPV-analysis, its subject and content area become the starting point of the IET study. If we take into account the percentage of successful graduates and employed graduates or graduates who have their own business project as the main MPV indicator, then using the S-shaped development curve (R. Foster), we can get the following graph, which is shown in Figure 4.

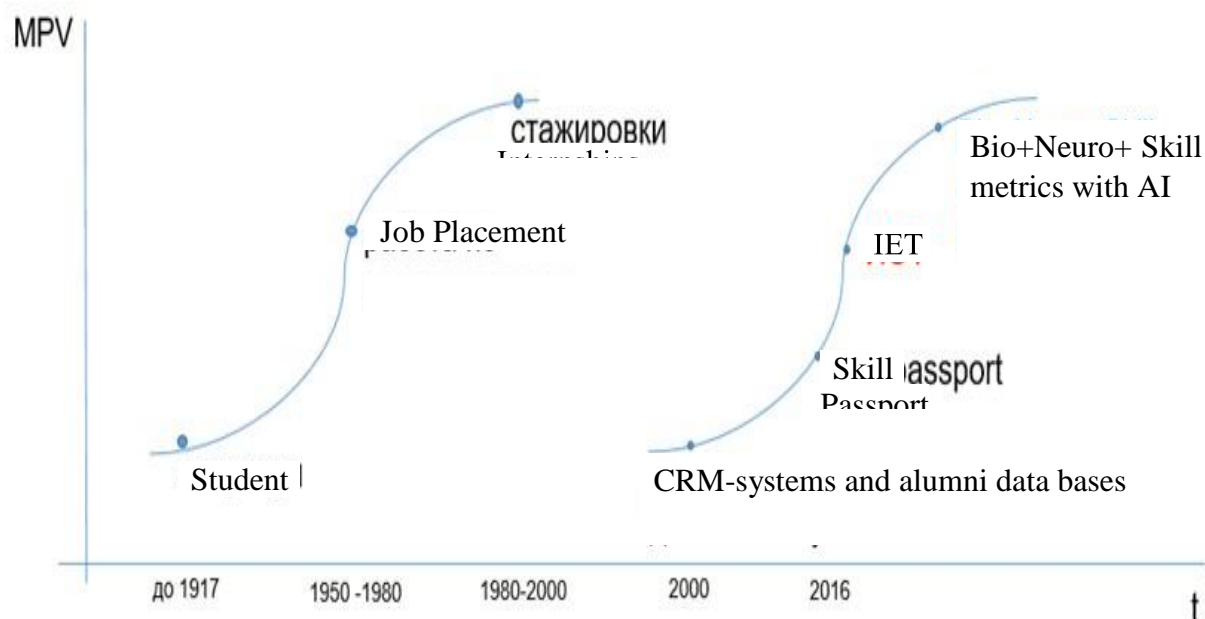


Figure 4: The IET's place on the S-shaped development curve

In this case, the S-shaped curve reflects the relationship between time and changes of the MPV-index. The MPV-indicator goes as far as evolutionary development allows. When the limit is reached, a new paradigm is needed. The stages between two successful paradigms are called technology gaps; those who are the first to form a new paradigm gain an advantage.

The S-shaped curve analysis allows tracing the evolutionary chain of the IET, which is marked with the following elements:

- "Student matrix" is a certificate of admission to the university, which also serves as a student's record book and curriculum, which serves as a basis for the resume when applying for a job in the civil service, in pedagogical and other organizations, and a place where recommendations are written ...
- Job placement is the practice of employing graduates (for example, in the USSR), which is mandatory for a certain period of time for both the graduate and the employer. It ensures the employment of young professionals and provides with social guarantees.
- Internship is a special type of activity to gain work experience or improve professional qualifications, as well as to work in a specialty field during a certain trial period.
- Customer Relationship Management (CRM) is an application software for an educational institution designed to automate strategies for interaction with customers (students), build a unified electronic information and educational environment to support the educational process: keeping students' personal files, information segmentation, workflow automation, etc.
- "Skill-passport" is a document certifying the score a student received on exams, a kind of "digital portrait of a professional". All the exam results are entered into a single information system, which allows graduates to receive skill-passports with test results in electronic form and send them to potential employers.
- IET is a personal (digitized) way of realizing a student's personal potential, reflecting his or her professional competencies, soft skills, social, athletic and creative achievements, as well as the ability for self-learning and self-study.

To make choices, record results, and properly combine subjects into a comprehensive curriculum, there needs to be an adequate IET management system. Most of the foreign models of personalized learning that we know of focus on the use of digital platforms. Among the best known are Summit High School in the United States with a reach of 72,000, and Chinese bdschool.cn, with 170 million students on its platform. The effectiveness of these platforms was confirmed in a 2015 study by RAND, which showed that learning using platform solutions does not compromise academic results and, compared to traditional learning (without IET), improves professional competence and flexible skills [6].

In platform solutions, the following set of services of the electronic information and educational environment is most often used in order for the IET to meet all the tasks of personalized learning:

- diagnostic service (detection of potential)
- service for collecting digital footprint;

- service for building digital profile;
- service for the analysis of alternative educational methods (formats) of training;
- tutor support service;
- service for creating a recommendation system (work with requests);
- online proctor service set-up;
- predictive analytics service.

Thus, with the use of certain methodological tools and a qualified team of educational stakeholders, a step-by-step transition to a personalized education model is possible for any educational organization.

Until a few years ago, the focus in teaching was on the transmission of basic knowledge. Today the transfer of knowledge is carried out in a stream, everything can be read and listened to by oneself. It is much more important for the modern generation to learn new things quickly, conveniently, and in various formats. Therefore, it is important that modern educational solutions are implemented in the electronic information and educational environment. Since professional and modern digital skills are closely related to "soft" and leadership skills, it became necessary to look for new approaches to learning, one of which is the construction and implementation of IET.

IET-based learning should have a consistent method that takes into account the individual learning pace of each student with the same workload to ensure equivalent quality results. In addition, IET-based learning should provide a learning environment in which the student can make choices, make independent decisions, take steps, and achieve results using educational resources. As a result, IET-based learning teaches the student to take responsibility for the process and results of self-development.

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