



## Theoretical Foundations of The Creation of a Curriculum in Higher Project IT in Education

Valery V. Glushchenko\*

Department of SMART Technologies, Moscow Polytechnic University, Russia

\*Correspondence: E-mail: [valery.v.glushchenko@gmail.com](mailto:valery.v.glushchenko@gmail.com)

### ABSTRACT

The subject of the work is the formation of theoretical foundations for the creation of curricula in higher project IT education; the object of the work is the curriculum in higher IT education; the purpose of the work is to increase the curriculum in higher project IT education; to achieve this goal, the article solves the following tasks: Descriptions of the essence and structure of the curriculum, the formation of methodological provisions of the theory of curriculum, descriptions, and discussions of the mechanism of curriculum formation in higher project IT education.

© 2023 Universitas Pendidikan Indonesia

### ARTICLE INFO

**Article History:**

*Submitted/Received 04 May 2023*

*First revised 26 Jun 2023*

*Accepted 14 Aug 2023*

*First available online 15 Aug 2023*

*Publication date 01 Sep 2023*

**Keyword:**

*Appearance,  
Curriculum,  
Differentiation,  
Education,  
Its project,  
Structure,  
Theory.*

## 1. INTRODUCTION

The relevance of the work is related to the need to improve the effectiveness of curricula and educational IT projects. The hypothesis of the article is the assumption that the formation of differentiated curricula can be a tool for improving the quality of higher project education.

The work aims to form a scientific theory of client-oriented curricula as a tool for improving the quality of project higher IT education.

To achieve the set goal of the work, the following tasks are solved:

- (i) discusses and clarifies the concept, essence, and structure of the curriculum;
- (ii) the general theory of curriculum is being formed;
- (iii) a mechanism for the formation of client-oriented curricula in IT education is being formed;
- (iv) the features and risks of the process of creating curricula in higher project IT education are discussed.

The object of the work is the curriculum in higher project IT education. The subject of the work is the general theory and methodology of creating client-oriented curricula in higher project IT education.

The study of scientific publications on the topic of the work shows the following. The formation and use of curricula in pedagogy have a long history (Pichugina, 2022). It is possible to form curricula in various segments of higher education, including the field of management (Strekalova *et al.*, 2016). Scientists study the following areas of curriculum methodology: principles of formation and architecture of curricula for individual IT disciplines (in particular, for the academic discipline "Cybersecurity") (Sukhomlin *et al.*, 2020); features of curriculum creation and the innovative potential of curriculum proposals (Finin, 2019). Curricula are considered the methodological basis of intellectual education. Scientific and pedagogical workers (NPR) believe that hidden curricula can be used in the formation of professional qualities of specialists, in particular economists (Mishina, 2019).

At the same time, the development of innovative activity forms a request for the development of a project form of higher IT education. The issues of differentiation in higher education were relevant in the US higher education system in the 1970s and 1990s. The analysis showed that differentiation methods are used in pedagogical practice in Russia (Kirschner *et al.*, 2002). The problem of forming algorithms for creating curricula is relevant in higher IT education at the beginning of the 21st century (Kisel *et al.*, 2019).

To prevent crises in education, the development of curricula should be aimed at adaptation of the higher education system and individual universities to the conditions of a new technological way; development of the project form of higher IT education (Glushchenko, 2022).

Customer-oriented training programs can become a way to improve the quality of higher project IT education (Glushchenko, 2021). The theory of the curriculum can be created in the likeness of the general theory of scientific activity.

The analysis of publications on the topic of this article showed the following:

- (i) educational programs have a long history of development in higher school pedagogy;
- (ii) curricula are considered an important tool for ensuring the quality of higher education, including in the field of project-based IT education;
- (iii) university staff is actively developing specific topical issues of creating and using curricula and much more.

At the same time, at the beginning of the 21st century, there is no general theory of the curriculum. This may reduce the effectiveness of the processes of creating and using training programs in the field of higher IT education at the beginning of the 21st century. Thus, the

task of creating a general theory of curricula in higher education, in particular, in the interests of creating client-oriented curricula in project-based IT education, is relevant.

## 2. METHOD

The object of the work is the curriculum in higher project IT education. The subject of the work is the general theory and methodology of creating client-oriented curricula in higher project IT education (Kirschner *et al.*, 2002 ; Birdman *et al.*, 2022)

## 3. RESULTS AND DISCUSSION

Because the term "curriculum" is quite rarely used in the Russian system of higher education, it is necessary to dwell on this concept in more detail. It can be predicted that with the development of the project form of IT education, the concept of curriculum will become a pedagogical category. As you know, key concepts are considered scientific categories. This further confirms the relevance of this article.

The definition of "curriculum" is most often used as a synonym for the term "course of study" or "course of the study program". In this interpretation, the concept of "curriculum" (as a training course program) includes a methodology and a concept that is used in the field of higher IT education, which can mean: the paradigm of education; a set of issues related to the pedagogical process; methodological regulation of educational processes; recommendations aimed at improving learning outcomes; a system for managing the processes of project IT-education.

With this view, the concept of "curriculum" in this article will be interpreted as a concept that represents: first, an education program (explicit curriculum); an extension of the concept of "educational program" (hidden curriculum). The possibility of such an interpretation of the concept of "curriculum" is determined by the existence of explicit and hidden curriculum (Mishina, 2019).

Based on this matter, this paper proceeds from the fact that structurally the curriculum includes two parts: the first part is an explicit curriculum, which is identical to the concept of an educational program; the second part covers the hidden (implicit) curriculum, which includes the following elements: teaching methodology (didactics); organizational culture of the training program; student motivation system; appearance (key characteristics and structural elements) of the student ecosystem at the university, etc.

Historical analysis allows us to say that the previous "peak" of interest in differentiation in higher education in the USA occurred in the period of the 1970s-1990s. This corresponds to the beginning of the previous 9th technical order. One of the characteristic features of higher education in the conditions of a new technological way of life is the development of pedagogy and practice of project IT education. Project IT education is understood as a form of higher education, in which educational projects are included in the curricula, which are considered as an independent structural element (the volume of project educational activities is at least 20% of the academic load) of the educational process at an IT university.

Increased attention to project-based IT education is associated with the activation of innovative activities, which is becoming almost permanent in the new technical order. Innovative developments are implemented mainly in the form of innovative projects. The transition of enterprises to the project model of the organization's activity is expected (Glushchenko, 2022). The essence of customer orientation of universities is described in At the same time, researchers have not previously been able to find out the causes and factors of such differentiation in higher education. The theory of technological orders allows us to

conclude that the period of activation of differentiation in higher education coincides with the period of transition of the US higher school to functioning in the conditions of the 9th (previous concerning the present time) of the technological structure, which was called "microprocessors" (from 1970 to 2010). At the same time, it is possible to put forward a private hypothesis that the spasmodic growth of new technologies was then the source and reason for the need for differentiation in US higher education. It should also be borne in mind that customization is considered one of the key trends of the previous technical order. The need for customization is formed as a consequence of the inability to obtain a high-quality educational product in the absence of customization of education.

The theory of technological structures creates additional opportunities for establishing the causes and factors of differentiation in higher IT education. To do this, you can use the methods of such theories: theory of systems; theory of technological structures; general theory of pedagogy (educationology); theory of didactics (teaching); methodological provisions of differentiation in higher IT education, etc.

At the same time, it should be borne in mind that in 2023 the situation in the Russian IT sector of the economy is aggravated by the following: international sanctions against the IT sector of the national economy lead to the need for independent development of IT products; the main scientific and pedagogical personnel are focused on working as "qualified consumers" of foreign IT products.

These are new introductory, working conditions and a relatively new task for the domestic economy and the entire system of higher IT education.

The study of the situation in higher IT education shows that due to the formation of a new technological order shortly, a transition to client-oriented differentiation in such (and other) types of IT education will be required. This is due to the steady growth in the number of professions, and therefore it is necessary to create a differentiation mechanism in higher project IT education.

For education in the period of the 10th technological order, trends will be characteristic:

- (i) unification (Bologna Process);
- (ii) differentiation (customization and customer orientation);
- (iii) development of intellectual education and much more.

At the same time, differentiation can take two forms: individualization of the work of IT universities; client-oriented IT universities.

Customization of the work of IT universities is understood as adapting their work to the current needs of key players in this sector of the economy.

The client-oriented nature of IT universities is understood as their ability to train personnel capable of forming and implementing plans (programs) and strategic development of enterprises supporting the university.

In the period up to 2023 and beyond, all IT developments in the real sector of the economy should be carried out at all levels of the technological pyramid of the IT sector under consideration. As you know, this kind of "technological IT pyramid" includes the following hierarchical levels: conceptual (1st); technology development (2nd); design of production facilities (3rd); implementation of production processes (4th); level of maintenance and training of personnel (5th).

The client-oriented nature of the curricula of higher project IT education may consist in the fact that to train specialists at each of these levels of the technological pyramid, the explicit curricula of such educational programs should include (in the variable part) academic disciplines reflecting the specifics of work at these levels, namely:

- (i) the educational program at the 1st level of the technological pyramid should include such

disciplines as philosophy and methodology of science, theory of technological structures, theory of systems and system analysis, methods of synthesis of effective ideas of innovative projects, in particular, the theory of solving inventive tasks and other disciplines used in exploratory scientific research;

- (ii) in the structure of the explicit curriculum of specialists working at the 2nd level of the technical pyramid, it is necessary to include academic disciplines aimed at the synthesis of effective technologies: the general theory of technologies, methods of search and regulatory scientific research, theory of complex technological systems, theory of IT technology efficiency, programming and others;
- (iii) the educational program at the 3rd level of the technological pyramid should include such theories as engineering design, lean manufacturing theory, programming, technical service theory, and others.

Similarly, academic disciplines can be selected that reflect the specifics of training specialists for their subsequent work at the 4th and 5th levels of the technological pyramid.

In addition, client-oriented curricula should differ in their own: topics and types of educational projects; organizational culture of the subject and project parts of training; student motivation system; the appearance of the student ecosystem (Glushchenko, 2023), and others.

At the same time, various criteria should be used to assess the quality of client-oriented higher project IT education.

The analysis shows that the functions of client-oriented curricula in higher project IT education can be called:

- (i) the integrative function of the curriculum in which such a curriculum systematically combines all the elements that contribute to improving the quality of higher education;
- (ii) adaptation function, within which the curriculum ensures the adaptation of the educational process to the needs of the economy and society;
- (iii) differentiation of educational programs following the needs of the economy and society, stakeholders;
- (iv) improving the quality of higher education by coordinating the factors and elements of the educational process;
- (v) coordination of the interests of stakeholders in the educational process;
- (vi) reflections in the educational process of the international and sectoral division and specialization of labor and more.

The roles of client-oriented curricula can be called:

- (i) increasing the level of satisfaction of stakeholders in the educational process (employers, students, teachers, etc.);
- (ii) accelerating scientific and technological progress (STP);
- (iii) improving the quality of goods and services in the real economy.

Let us consider the methodological provisions of the general theory of curriculum within the framework of the complete theory of science- Scientology.

The general theory of the curriculum will be called the science of creating scientific knowledge in the field of design and practical use of the curriculum in higher project IT education. Such a theory covers a complex of scientific problems, philosophy, ideology, politics, motives, methods, methods, tools, and technologies for the innovative creation of curricula (as objects), mechanisms for creating curricula, and studying the life cycle of curricula up to the moment of their withdrawal from the educational process.

From an epistemological point of view, the general theory of curriculum can be considered as a methodology for research, analysis, and management of methods for solving scientific and practical problems facing modern higher-project IT education.

Let's define the scientific method, object, subject, functions, and roles of the general theory of curriculum. The scientific method in the general theory of curricula will be called a system of principles and techniques by which objective knowledge of pedagogical processes and socio-economic results of educational activities is achieved within the framework of such curricula, taking into account their updating (modernization).

Functions (from the word "perform") The general theory of the curriculum is that within the framework of this scientific discipline can be performed in the higher education system, specific IT universities, as well as in the political, social, economic, technological, environmental subsystems of the state, global society, and economy.

The economic and social role (significance) of the general curriculum theory is determined by the effectiveness of the implementation of its functions, which this scientific discipline implements concerning meeting the educational needs of the economy and society.

The key functions of the general theory of curricula can be considered the following functions: methodological function, cognitive and instrumental function, legislative function, optimization, prognostic, preventive, psychological function, the function of socialization of knowledge, the function of minimizing man-made, environmental, and social risks, the system-forming function of this theory.

The methodological function of the general theory of curriculum consists in the development of conceptual apparatus, theoretical foundations of scientific research and methodology for the study of phenomena and processes, the formulation of laws and categories of this scientific discipline, the development of tools for the management of scientific research, innovative project in the field of curriculum formation and management of their life cycle to maximize the effectiveness of educational activities, minimize damage from risks generated by creation and use of such curricula.

The cognitive function of the general theory of curricula includes the processes of accumulation, description, study of facts of reality in the field of science, innovation, and technology at various levels (global, national, sectoral, regional, etc.), analysis of specific phenomena and processes within the process of scientific research in this area.

The instrumental (regulatory) function of the general theory of curricula is of a practical nature, as it consists of several points: evaluation of curricula by stakeholders; synthesis of methods and tools for managing scientific research of curricula; formation of recommendations to university administrations on the modernization of curricula and others.

The legislative function of the general theory of curricula is embodied in the process of substantiating the need and developing legal norms that contribute to the development of the theory and practice of the use of curricula in higher education at all stages (creation, use, modernization, withdrawal from the educational process) of their life cycle.

The optimization function of the general curriculum theory is to synthesize or select the best from a certain point of view, for example, minimum costs, achieving safe and environmental conditions, and the consequences of creating and using educational curricula.

The prognostic function of the general theory of curricula covers the assessment of the state of project IT education programs, and its impact on the economy and society in the future in terms of the need and possibility of developing certain types of client-oriented curricula in IT education.

The preventive function of the general theory of the curriculum can be reflected in the implementation of proactive and preventive measures based on the results of the forecast of



the development of the theory and practice of the curriculum, to prevent crises of such education and negative consequences for the economy and society.

The psychological function of the general theory of curricula is to explain to the subjects of the educational process the need for financial and other costs for the continuous development of the theory and practice of creating and implementing curricula within the framework of the management of the development of the higher education system, the management system of scientific and technological development. the progress of the economy and society.

The function of socialization of knowledge in the field of the general theory of curricula is to disseminate knowledge about the role and importance of curricula in the development of higher project IT education, analysis of the impact of curricula on the development of modern science, technology, technology for the modern state and society as a whole. society, the need for effective measures to disseminate knowledge about the curriculum among a wide range of scientific and pedagogical staff of IT universities, the population. Performing the function of socializing the general theory of curricula is of great importance for ensuring the sustainability of development and progressive legal support for the development of the higher education system, economy, and society.

The system-forming function of the general theory of curricula is to accumulate knowledge aimed at ensuring the creation of adequate curricula, including the functions of planning, organizing, motivating, and controlling the results of life cycle processes (creation, use, modernization, withdrawal from the educational process, etc.) curricula.

The role of the general theory of curricula can be recognized: firstly, optimization of the development processes of higher project IT education; secondly, reduction of risks during research and implementation of innovative projects in the field of creating such curricula; thirdly, increasing the competitiveness of universities and financial results in education and economics.

The laws of the general theory of the curriculum can be called stable cause-and-effect relationships between the methods of scientific research, the creation and implementation of curricula and their content, and methods of implementation.

The following laws of the general theory of the curriculum can be described:

- (i) The development of the general theory of curricula is associated with specialization and division of labor, a constant increase in the number of professions.
- (ii) The increasing complexity of the curriculum reflects the increasing complexity of life practice and the complexity of science, economics, education, and public life.
- (iii) There is an acceleration in the rate of aging of knowledge and moral aging of educational programs in the field of information technology based on this knowledge.
- (iv) The management system for the creation and implementation of training programs is becoming more and more distributed;
- (v) The increase in the diversity of training programs is associated with an increase in the complexity of work, division, and specialization of the workforce.
- (vi) Coordination between IT universities is carried out based on curricula created and implemented by the university.
- (vii) Differentiation in pedagogy is a tool and method for creating client-oriented curricula.
- (viii) The life cycle of the curriculum includes the stages of pre-project research; creation of the curriculum; use of the curriculum in the educational process; modernization of the curriculum; removal of outdated curriculum from the educational process.

The mechanism for creating client-oriented curricula (programs) of higher IT education will be called a set of methods and tools for the formation of explicit and hidden curricula in higher

IT education.

At the same time, the situation is such that a significant number of university researchers and teaching staff do not see a fundamental difference between projects within the framework of the subject method of teaching (subject pedagogy and didactics) and the project method of teaching (project pedagogy and didactics).

The study and comparative analysis of the subject and project pedagogy of teaching (didactics) show the following:

- (i) when implementing a course project on a certain subject, the student (student) works alone, with the vertical (top-down) guidance of a scientific and pedagogical worker (SPW-teacher), and when performing a project as part of a small project group, several students work together on one project (the competence of working as part of a small project group is realized) when at the same time, the guidance from the SPW (teacher) has both vertical and horizontal components;
- (ii) when performing a course project on a subject, a student works on a project on a topic defined by the department, and when performing an educational project as part of a small project group, the project topic is put forward by this group itself and discussed with the SPW;
- (iii) in a course project, the student applies the student's competencies in a certain subject, and in a collective educational project, a small group implements a set of necessary competencies, which is interdisciplinary;
- (iv) when performing a course project, all elements of this project are performed by one student, while performing a collective educational project, tasks are decomposed and distributed among the participants of the project group;
- (v) when performing a course project, the student's knowledge in one subject is confirmed, and when performing a collective educational project, the goal is to commercialize knowledge while using knowledge from many disciplines (economics, marketing, etc.) and others in a comprehensive manner.

All this allows us to talk about the qualitative difference between the methodology and pedagogy of higher subject and higher project IT education.

Due to the variety of higher IT education programs, it is necessary to substantiate the mechanism of differentiation of higher IT education curricula. The development of the theory of technological patterns allows us to practically apply the prognostic function of this theory (technological patterns) to substantiate the factors and principles of differentiation of curricula in higher project IT education in a new technological way.

This is because the continuous growth in the number of professions (an increase of about 500 professions per year) can be considered a source of the need for differentiation in the interests of providing client-oriented training programs for higher project IT education. Therefore, it can be assumed that differentiation should be based on the product approach (educational products) and the customer orientation of universities (Glushchenko, 2021).

Such a mechanism for creating client-oriented curricula of the higher project educational process in the field of information technology is proposed:

- (i) formation of the theory of technological structures in the interest of identifying the factors of a new technological order affecting the system of higher project IT education;
- (ii) further development of the scientific and methodological platform and methodological provisions of the general theory of higher project IT education;
- (iii) description of the elements and elaboration of the entire mechanism of adaptation of higher project IT education to the conditions of the new technical school;



- (iv) description of the functions and roles of the higher IT education project as a structural element of the mechanism of adaptation of the IT sphere of the economy and society to functioning in the conditions of a new technical order;
- (v) structuring, description, and study of factors of differentiation of higher project IT education within the framework of the new technical order;
- (vi) study of the structure and elements of the curriculum of higher project IT education;
- (vii) generalization of the methodology for the formation of a clear curriculum of client-oriented higher project IT education;
- (viii) formation of a methodology for creating a hidden (implicit) curriculum of higher project IT education;
- (ix) research and description of risks at all stages of the life cycle of the curriculum of higher project IT education;
- (x) coordination of the curriculum with all interested parties in the educational process;
- (xi) monitoring and evaluation of the level of effectiveness of the curriculum;
- (xii) correction of the appearance and characteristics of the elements of the curriculum (modernization of the curriculum) based on the results of monitoring its effectiveness;
- (xiii) withdrawal from the educational process of educational programs that do not demonstrate sufficient effectiveness, and much more.

In general, we can say that the use of the concept of "educational program" gives: firstly, it gives a formalized and narrower idea of the educational process compared to the analysis of the program in the format of curricula; secondly, the use of the concept of "educational program" does not allow to reflect implicit knowledge about this program.

At the same time, the practical use of the term "curriculum" in the interpretation described in this article makes it possible to integrate formal (explicit curriculum) and informal (hidden curriculum) components in the preparation and implementation of educational programs. The use of the term "curriculum" gives a broader idea of the content and pedagogy of higher project IT education, which can contribute to improving the quality of such education.

When creating and using curricula, it is important to analyze the risks associated with the creation and implementation of such client-oriented training programs in the field of higher IT education.

Such risks can be divided into internal and external.

- (i) The external risks of creating client-oriented training programs in higher project IT education include: uncertainty of long-term trends in global scientific and technological progress; misunderstanding of the development strategy of the basic enterprises of the industry; lack of a policy for the formation of client-oriented training programs in an IT university. university and much more.
- (ii) The internal risks of creating and implementing IT curricula include the unpreparedness of the administrative and scientific-pedagogical staff of universities for the widespread creation and implementation of educational programs; misunderstanding of the importance of curricula in the process of improving the quality of higher education in the new technological order; insufficient competence of individual representatives of the scientific-pedagogical staff of universities; organizational culture of the university and much more.

#### 4. CONCLUSION

The article formulates the functions, and roles of curricula, as well as the general theory of curricula in higher education during the 10th technical school. This paper: describes the application of curriculum theory in the development of client-oriented curricula in higher

project IT education: describes the life cycle and mechanism of creating such curricula; discusses the risks associated with the creation and implementation of curricula. As a recommendation for the development of the topic of the article, it is recommended to develop a methodology and study the theory and practice of creating client-oriented curricula in higher IT education.

## 5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

## 6. REFERENCES

- Birdman, J., Wiek, A., and Lang, D. J. (2022). Developing key competencies in sustainability through project-based learning in graduate sustainability programs. *International Journal of Sustainability in Higher Education*, 23(5), 1139-1157.
- Finin G. I. (2019). The specifics of curriculum development in modern education and the innovative potential of curriculum proposal : Bulletin of the National University "Law Academy of Ukraine of the name of Yaroslav the Wise". *Series: Philosophy, Philosophy of Law, Political Science, Sociology*, 40(10), 86-95.
- Glushchenko V. V. (2022). The concept of project activity of organizations in the period of the 9th technological order. *Scientific Heritage*, 4(83), 24-34.
- Glushchenko V. V. (2023). Managing the process of creating a university student ecosystem. *Indonesian Journal of Interdisciplinary Studies*, 3(2), 191-202.
- Kisel, O. V., Dubskikh, A. I., Lomakina, Y. A., Butova, A. V., and Potrikeeveva, E. S. (2019). Differentiated approach as a factor on development of students' professional communicative competence. *Amazonia Investiga*, 8(19), 287-297.
- Kirschner, P., Carr, C., Van Merriënboer, J., and Sloep, P. (2002). How expert designers design. *Performance Improvement Quarterly*, 15(4), 86-104.
- Mishina S. V. (2019). Formation of professionally significant qualities of future economists through a hidden curriculum. *Scientific Notes of the Orel State University*, 85(4), 253-257.
- Pichugina V. K. (2022). Hercules as a bad student: features of the curriculum for the ancient Greek hero. *Domestic and Foreign Pedagogy*, 1(2), 148-167.
- Strekalova G. R., and Kravchenko E. V. (2016). Formation of a curriculum for the education of bachelors of management. *Sustainable Development Management*, 4(5), 101-104.
- Sukhomlin V. A., Belyakova O. S., Klimina A. S., Polyanskaya M. S., Zubareva E. V., and Yakushin A. V. (2020). Architecture and principles of curriculum development for the discipline "Cybersecurity". *Modern Information Technologies and IT Education*, 16(4) 927-939.