



## **DIGITAL TRANSFORMATION OF ADAPTATION PROCESSES AMONG FOREIGN STUDENTS OBTAINING MEDICAL EDUCATION IN THE KYRGYZ REPUBLIC**

*Transformação digital dos processos de adaptação entre estudantes estrangeiros que obtêm educação médica na República do Quirguistão*

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### **ABSTRACT**

The key goal of the research is to improve the integration of foreign students into the educational environment by developing an expert system that systematizes and unifies adaptation processes at the national and organizational levels. To implement such a system, the authors conduct a structural analysis of the educational process and develop its formal models reflecting changes in process states depending on external influences and the logical links between them. The study identifies key processes and objects interacting in the ecosystem of the educational institution, which allows for the development of a client-server architecture for an intelligent system. This system is designed to support international students throughout their educational journey, assisting them in decision-making processes and interaction with educational resources. The authors conclude that the proposed digital transformation model supports foreign students' adaptation and aligns with Kyrgyzstan's national strategy's broader educational and professional goals. The model offers a scalable and modular approach, providing continuous improvement of educational programs and the overall management of international students' adaptation processes. **Keywords:** Educational services, Educational program, Education quality, Business process modeling, Functional modeling.

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## TRANSFORMAÇÃO DIGITAL DOS PROCESSOS DE ADAPTAÇÃO ENTRE ESTUDANTES ESTRANGEIROS QUE OBTÊM EDUCAÇÃO MÉDICA NA REPÚBLICA DO QUIRGUISTÃO

*Digital transformation of adaptation processes among foreign students obtaining medical education in the Kyrgyz Republic*

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### RESUMO

O principal objetivo da pesquisa é melhorar a integração de estudantes estrangeiros no ambiente educacional por meio do desenvolvimento de um sistema especialista que sistematize e unifique os processos de adaptação nos níveis nacional e organizacional. Para implementar tal sistema, os autores conduzem uma análise estrutural do processo educacional e desenvolvem seus modelos formais refletindo mudanças nos estados do processo dependendo de influências externas e dos links lógicos entre eles. O estudo identifica os principais processos e objetos que interagem no ecossistema da instituição educacional, o que permite o desenvolvimento de uma arquitetura cliente-servidor para um sistema inteligente. Este sistema é projetado para dar suporte a estudantes internacionais ao longo de sua jornada educacional, auxiliando-os nos processos de tomada de decisão e interação com recursos educacionais. Os autores concluem que o modelo de transformação digital proposto dá suporte à adaptação de estudantes estrangeiros e se alinha com os objetivos educacionais e profissionais mais amplos da estratégia nacional do Quirguistão. O modelo oferece uma abordagem escalável e modular, proporcionando melhoria contínua dos programas educacionais e do gerenciamento geral dos processos de adaptação de estudantes internacionais.

**Palavras-chave:** Serviços educacionais, Programa educacional, Qualidade da educação, Modelagem de processos de negócios, Modelagem funcional.

## INTRODUCTION

Education export is one of the priority directions in the program of transformation of higher education in Kyrgyzstan. Kyrgyz universities train students from CIS countries and far abroad (India, China, Pakistan). The attractiveness of Kyrgyz education lies in its relatively low cost, simplified admission procedures, the opportunity to study in several languages (Kyrgyz, Russian, and English), as well as international educational projects. Programs for the adaptation of foreign students in Kyrgyz society are developed at the state level. In addition, local adaptation programs can be created in the ecosystem of a specific educational organization.

Educational services export is an educational activity associated with the training of foreign students in person or via information and communication technologies (Codd, 2023; Logachev, Zhukova, 2020). Depending on the country that provides export educational services, the sources of income may differ and include: income from educational processes within the state or in foreign branches of domestic educational organizations; income from research grants, contracts, or other collaborations; contributions from alumni; charitable donations; income from foreign independent educational organizations; and licensing of intellectual property abroad (Kuzmenkov, Levashenko, 2018).

The national educational system of the Republic of Kyrgyzstan is being transformed to reflect global educational processes. Various educational projects are being implemented in the Republic (e.g., the TEMPUS Project "Development and improvement of the University Administration on International Affairs" (UNIVIA), Erasmus+ EUCA-INVEST "Investing in Entrepreneurial Universities in Caucasus and Central Asia", Erasmus+ LMPT "Development of Bachelor and Master Programs in Sustainable Tourism in Open Education in China, Vietnam and Kyrgyzstan"), a common educational space for CIS countries is being formed, and bilateral cooperation with developed countries and industrial partners is developing (e.g., from Russia, China, Kazakhstan, Turkey, Romania, Germany) (Tursunaliyeva, Ubukeeva, 2020).

According to the Deputy Head of the Ministry of Education, the national universities of Kyrgyzstan will host 58.6 thousand foreign students in 2024 (Bilim AKIpress, 2024). The most popular direction for such students is medicine (healthcare). In the 2022-2023 academic year, the share of international students who chose medicine-related educational programs was 40% (IOM UN Migration, 2023).

To ensure foreign students' integration into the sociocultural environment of the Kyrgyz Republic and the intellectual environment of the educational institution, their security, fundamental rights and freedoms, psycho-emotional resilience, and the development of a favorable social position and social role, provisions for the "Adaptation for International Students" program are developed annually at the state level. Such programs can be created based on an educational organization to comply with the National Development Strategy of the Kyrgyz Republic for 2018-2040 and other development programs envisaging cooperation between the university and partners (for example, the UN's development program in the Kyrgyz Republic "Promoting Kyrgyzstan's Youth Cohesion and Interaction Towards Uzbekistan" under the UN Peacebuilding Fund).

The implementation of programs ensuring the effective integration of international students into the university ecosystem necessitates the digital transformation of the educational process. This translates into the need to create a software product capable of interacting with the foreign student to provide support for their decision-making in the organization of training, setting up communication with teachers, students, and other university specialists, assistance in the selection of reference literature, educational resources, etc. Thus, our research aims to ensure the digital transformation of the educational process according to the listed requirements.

The subject under study is the educational process, while the object is the learning process of a foreign student.

The theoretical significance of the study lies in the structurization of the educational process and the establishment of factors influencing changes in the quality of education of foreign students and the availability of educational services to them. The result of this research is a process model that allows predicting changes in learning outcomes in connection with changes in the university ecosystem conditions, assessing its condition in the context of implementation and operation of software products and the realization of different projects.

The practical significance of the study consists in the creation of a tool that provides constant support for a foreign student during their adaptation in a new place and the possibility of forming a system of recommendations to create the best individual educational and professional trajectories. In addition, the developed instrument enables

public and state control over the quality of the content of educational services and the opportunity to create and implement new educational concepts.

## 1 METHODOLOGY

The creation of any software product corresponds to certain stages of the life cycle, at each of which research, design, and development methods are established and comprehensively implemented.

The method of structural analysis was employed to determine the functional capabilities and categories of users. With its help, the research subject was represented as a set of interrelated objects changing their state under the influence of internal and external processes. Stepwise refinement and synthesis were used to determine the quantitative and qualitative characteristics of processes and objects. In the analyzed literature sources, this approach to formalizing the problem domain is actively used and allows obtaining a description of it suitable for digital transformation (Buede, Miller, 2024; Logachev et al., 2020; Tilley, Rosenblatt, 2017).

The results obtained were visualized using the Unified Modeling Language (UML) and functional modeling (IDEF0) methodologies. The analysis of literature sources related to software product design shows that these methodologies allow representing the behavior of objects and processes graphically considering certain factors (Logachev et al., 2022; Manenti et al., 2019; Sabharwal et al., 2019). A UML diagram of precedents demonstrates the system's response to external impacts depending on the category of users exerting it. IDEF0 diagrams show the logical subordination of objects and processes without regard to time.

The described methodologies have a unified modeling language that uses graphic notations that precisely define the image and its corresponding interpretation.

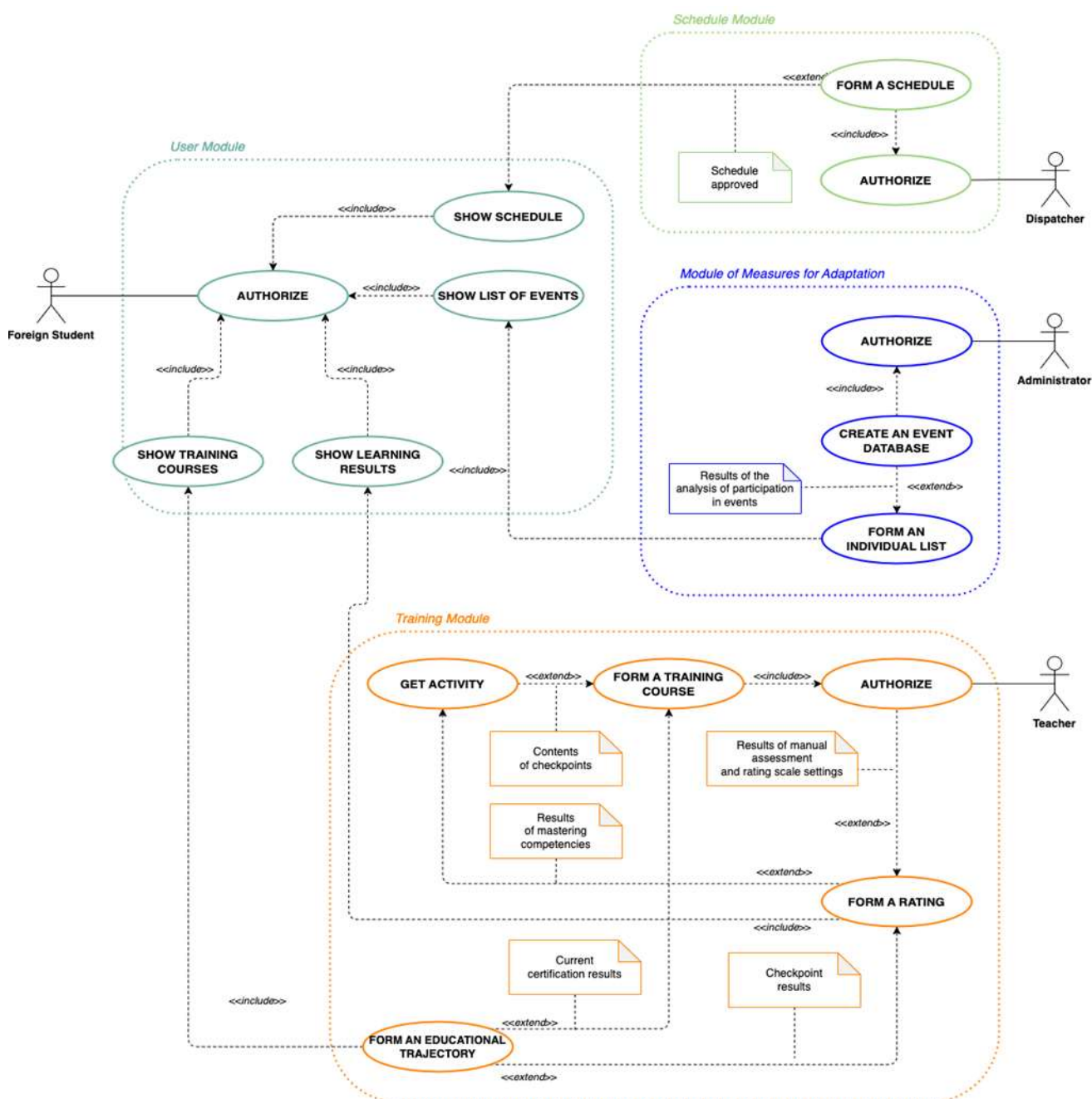
## 2 RESULTS

As a result of applying the described research methods, the key processes and objects in a foreign student's interaction with the resources of the educational organization's ecosystem were identified. This enabled us to carry out the digital transformation of relevant processes and to define the architecture of a software solution to provide continuous support for such a student in the educational process.

A client-server architecture has been established for the intelligent system to distribute functionality between user and server hardware. With this organization, all computational processes are performed on the server side, thereby ensuring the systematization of all computational processes and the resources required for their implementation. The functionality remaining on the client side is associated with obtaining data on user activity; transforming this data into a form suitable for transmission to the server; generating user queries; and transforming the data received from the server into a form understandable to the user.

The programming implementation of software product functions is a modular structure. It allows the functions to be grouped by the nature of work performed and makes it possible to modify individual parts of the program code without affecting other modules. In addition, this structure ensures the subsequent scalability of the system by adding new modules. Figure 1 shows the precedent diagram demonstrating the interaction of the main categories of users with the functionality of the designed software product.

Figure 1 - Diagram of precedents of software product operation for the adaptation of international students



Source of data: implemented by authors

The key category of the system resources users is the "Foreign Student". Access to resources is available only after authorization. The "User Module" consolidates the results of the operation of the "Training Module", the "Schedule Module", and the "Module of Measures for Adaptation".

There are two types of relationships arising between precedents: inclusion (the "include" stereotype) and extension (the "extend" stereotype).

The "include" stereotype ensures that all actions included in the two related precedents are performed together. Let us present a description of a few such stereotypes:

1. The "Teacher" upon authorization is able to create a training course (set the competencies to be mastered, specify didactic units, create resources for students' independent work, etc.).
2. The "Administrator" can use the module resources to create lists of events held by the educational organization or other organizations that have access to the module. At the first stage, a list of all the activities available for the "Foreign Student" to attend is available. The students can mark the events they enjoyed or visited,

save the categories of interest, etc. Later on, based on the user's activity, a list of recommended events is generated with the help of the intelligent system.

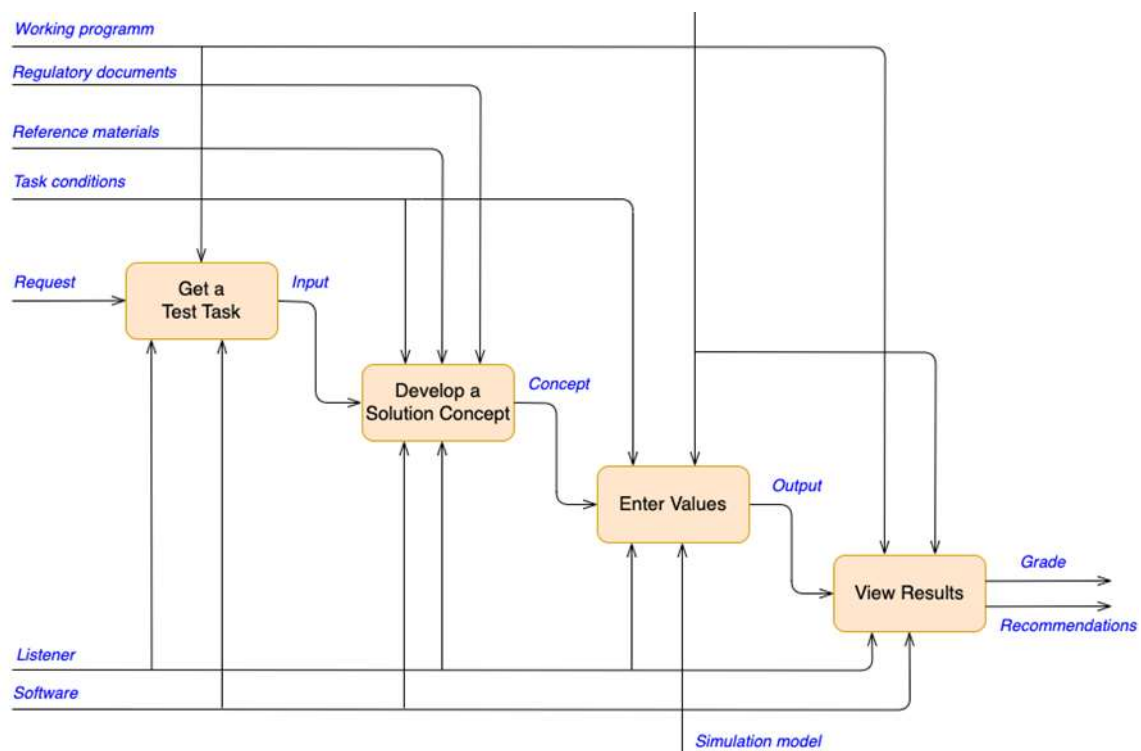
3. Once they are authorized, the "Foreign Student" has the opportunity to review the list of recommendations for studying educational material, get acquainted with the content of educational courses (look through reference materials, complete tests, etc.), obtain the list of grades and recommendations on additional material to be studied as part of their learning trajectory, which is formed automatically to raise the level of professional competencies, and read the list of adaptation activities.

4. Once the "Dispatcher" is authorized, they can create a schedule of training sessions, which will be visible to users with the "International Student" role.

The "extend" stereotype ensures that the totality of the action of one precedent is executed only when certain conditions are met in the course of another precedent. For instance, the educational trajectory for a student is formed only after receiving the results of mastering control points, meaning that their course assignments must be graded.

The developed model is consistent with the concept of educational programs related to medicine (healthcare), specifically the use of practice-oriented resources for the development of professional competencies (e.g., simulation models, digital simulators, multimedia resources). In order to use these tools, at first, international students need additional reference materials or accompaniment. The use of the functionality of the designed software product allows the student to request additional help at any stage of learning with practice-oriented resources. The content of such assistance is formed with the help of the intellectual capabilities of the digital system. Figure 2 shows a fragment of a functional diagram formalizing this process.

**Figure 2 - Fragment of the functional diagram for the use of practice-oriented resources in mastering educational programs in medicine**



Source of data: implemented by authors

The developed model reflects the means involved and the managerial influences accompanying the performance of each task by the student. Managerial impacts serve as the means to ensure the correct use of software and other tools to achieve the planned result (or the efficient use of funds to perform the work).



### 3 DISCUSSION

The findings lead us to conclude that the employed methodologies for investigating the problem domain and designing the software product are used correctly and valid results are obtained. At the heart of the software product design methodology is the structure, logical organization, and operating principles of the object, created based on existing processes and presented according to a formal design language (Buede, Miller, 2024; Tilley, Rosenblatt, 2017). As a result of the work carried out, graphical models of processes were created to reflect the required aspects of the research subject and presented according to the generally accepted graphic notations of the stated methodologies.

The analysis of studies dealing with software design and development shows that at the design stage, the researchers decomposed the research objects to establish links between the objects to organize the processes efficiently (Logachev et al., 2022, 2023; Manenti et al., 2019; Sabharwal et al., 2019). Our study also uncovers the objects and the connections between them ensuring their interaction in the ecosystem of the educational organization.

Importantly, the nature of the obtained results agrees with the results of designing information and other intelligent systems in other areas not related to educational activities (e.g., the digitalization of agriculture (Krasnikov et al., 2024; Mudrakova et al., 2024), sustainable development of the territories of settlements (Korotun et al., 2024; Logachev, Limarev, 2024), and ecology (Krasnikova, Kulibaba, 2024; Krasnikova, Orlik, 2024)).

### CONCLUSION

Any adaptation program for foreign university students has to fulfill numerous functions: developmental (social development of the individual and support for the expression of their abilities), protective (eliminating negative effects of the environment on the student's personality and the processes of its development), regulatory (systematizing interpersonal relationships between students and university staff), informational (providing exhaustive reference material on educational programs, rules of stay, legal and ethical norms of behavior), socializing (speeding up the adaptation process), and correctional (minimizing negative impacts in students' behavior and communication).

An effective mechanism for managing foreign students' sociocultural and educational-professional adaptation process is provided by the unified system of access to educational information resources that also enables responsible interaction of all structural divisions within the educational organization. The implementation of such a system is only feasible with the use of modern digital technologies. Digital technologies allow for processing large data sets, keeping them updated and coordinated, predicting changes, and developing a set of measures for prompt process management and strategic planning.

The development of a software product that supports the practice-oriented education of foreign students and their adaptation in the Kyrgyz Republic creates a unified and transparent management system for the educational organization, advances the content of educational programs, and popularizes the export of educational services.

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