

# **PEDAGOGICAL DIAGNOSTICS AS A PART OF MANEAGEMENT OF STUDENTS'**

## **INDEPENDENT WORK**

O. Kolgatin, Doctor of Pedagogical Science, Full Professor,

L. Kolgatina

Kharkiv National Pedagogical University Named after G.S.Skovoroda, Ukraine

*The essence of pedagogical diagnostics and its functions in the learning process is considered. The use of pedagogical diagnostics in distance learning to help the student in choosing the expedient for him variant of independent work that contributes to personal orientation of the educational process is analysed. Structure of the pedagogical diagnostics system is proposed, requirements to the system, the stages and procedure of its design are discussed.*

*Keywords: pedagogical diagnostics, management, students, independent work.*

Pedagogical diagnostics is an essential component of the modern educational process. The purpose of diagnostics is informational support of the management system of the educational process in choosing an expedient option of implementing the technology of training at a particular situation. The signs of pedagogical diagnostics, which emphasize the essence of this concept, are the follows: indirect influence on the student through recommendations for choosing the method of learning; detailed analysis of the elements that make up the expected result of learning, identifying the causes of difficulties; data processing (interpretation, classification, formation of recommendations on correction of training, forecasting); diagnostics not only of the student's academic achievements, but also of his motives, some psycho-physiological properties that affect the effectiveness of teaching, as well as an initial level of knowledge and skills; the diagnostic results should be emotionally neutral; interpretation of diagnostic results is carried out after the accumulation of the necessary amount of data.

In our opinion, pedagogical diagnostics to some extent performs in the educational process such functions: realisation of the feedback mechanism (determining the response to activities implemented in the management system of educational activities); prognosis; training (systematization and consolidation of knowledge, mastery of methods of reflection and effective organization of educational activities); facilitating progress in abilities and personal qualities of the student; upbringing; motivation (external motivation through competition, internal motivation through cognitive interest, which occurs when problem solving in process of diagnostic testing, and through the awareness of certain shortcomings of their own educational achievements);

systematisation and regulation (systematization and organization of the learner's learning activity, conditioned by the systematic nature of diagnostic activities, direct influence of diagnostic information on the direction of conscious and subconscious cognitive interest); control function (comparison of achieved results with an idealized model constructed in accordance with regulatory requirements).

A significant contribution to the development of diagnostic testing was made by American researchers. In the pedagogical science of Germany, the development of pedagogical diagnostics provided for a comprehensive use of testing, interviewing, pedagogical observation, and other forms of research. In the works of the scientists of the V. M. Glushkov Institute of Cybernetics [2] questions of the functioning of the pedagogical diagnostic subsystem in automated systems by the management of the educational process were developed. Large-scale theoretical and experimental studies devoted to solving the problem of optimizing the educational process were conducted under the supervision of Yu.K. Babansky [3]: a detailed analysis of the factors influencing the school performance was done, a multiparametric model of the student is constructed, and methods of expert evaluation of the model parameters are developed. In the works of the researchers, under the guidance of I.P. Podlasiy [4], a technique for predicting the effectiveness of the lesson was developed on the basis of a model with a deterministic algorithm for interpreting data, parameters that characterize pedagogical experience and abilities of the teacher, features of the content of the teaching material, composition and features of the training of the student collective were taken into account. A significant contribution to the development of the theory of pedagogical diagnostics was made by V.P. Bepalko [5], who justified the concept of the diagnostic character of the goal of training, suggested the parameters of educational achievements and methods for their measurement. In our works the issues of the continuous design of the pedagogical diagnostic system, which develops dynamically, taking into account the experience of pedagogical forecasting and the implementation of the recommended variant of the teaching technology were considered [6].

Systems of pedagogical diagnostics find wide application in the practice of the educational process [7], [8], [9], including in systems with elements of distance learning [10]. However, despite the considerable efforts of teachers, the problem of increasing the level of personal orientation of the educational process on the basis of qualitative diagnosis and individual forecasting of each student's learning activity remains urgent [11].

In the modern educational process, distance learning is increasingly developing. Organizational models of educational systems, in which the learning management system plays an important role, are being developed [12]. In the conditions of limiting the personal interaction between a teacher and a student, the person's ability to manage the learning process at the level of pedagogical intuition is reduced, and therefore the development of the pedagogical diagnostic

system in distance learning acquires a principal importance as an instrument of operational feedback and dynamic selection of an expedient variant of the learning technology for each student individually. However, in the practice of distance learning, there is a gap between the potential possibilities of implementing a person-oriented approach to each learner and the development of technologies for implementing such an approach, which in turn requires the design of a pedagogical diagnostics system in specific conditions of remote interaction between the teacher and the learner, implementation of a pedagogical diagnostics system into the learning management system (LMS - Learning Management Systems).

The peculiarities of pedagogical diagnostics in the system of distance learning are determined by the lack of systematic personal interaction between the teacher and the student. This leads to a decrease in the effectiveness of diagnostic methods based on the communication and intuition of the teacher. Therefore, the development of a computer-oriented pedagogical diagnostics system, based on high-tech methods, primarily computer-oriented testing, is becoming an urgent need.

The system of pedagogical diagnostics is considered by us as a component of the information and communication pedagogical environment, which provides the subjects of the educational process with information about the state and dynamics of the learner's development. Such information is presented in the form of an individual pedagogical diagnosis of each student at a specific moment in the learning process. At the modern level of the development of models of the learning process, such a diagnosis can be developed on the basis of an analysis of a set of indicators and consists in classifying a trainee into a certain category according to variants of realisation of learning technology. The complex of indicators includes the psychophysiological properties of the trainee (intelligence, memory, attention focus, attention stability, perception features, cognitive interest and willpower, health status and fatigability, etc.), as well as the characteristics of his academic achievements and is determined using diagnostic methods directly in the learning process. The basis of the system [13] is a triad of models: a model of learning objectives, a student's psychological-pedagogical model, and a learning technology model. These models are implemented as information systems based on relational databases.

Let's consider the basic requirements to the automated system of pedagogical diagnostics in the directions: methodological, procedural-organizational and psychological-pedagogical [6].  
Methodological requirements:

- implementation of the system approach to diagnosis (the unity of diagnostic and learning activities, the integrated application of diagnostic methods, accounting for all significant factors);

- study of the phenomenon in development (taking into account the dynamics of the object under study and cause-effect relationships, predicting the state of the object of diagnosis in the zone of proximal development);
- implementation of the axiological approach to diagnosis (personal significance of diagnostic purposes for the student, priority of the student in making decisions regarding the collection and use of diagnostic data, the presence of a positive attitude of students to diagnostic activities);
- implementation of a person-oriented approach to diagnosis (using the model of a student in conducting diagnostic activities that takes into account his personal characteristics, the use of adaptive techniques and technologies in the diagnosis process, reliance on the active participation of the student in diagnosis);
- application of methods and tools that ensure the quality of diagnostic data (objectivity as the elimination of the dependence of diagnostic results on the personality characteristics of the subject who performs it, validity, reliability).

Procedural and organizational requirements:

- systematic implementation of diagnostic procedures;
- ensuring students' readiness for diagnostic and self-diagnosis;
- economy in the didactic aspect (the balance between the frequency of diagnostic activities and the accuracy of diagnostic data, the balance between the costs of time for diagnosis and the effectiveness of its positive impact on the learning process);
- observance of ethical-legal norms (publicity of the procedure and methods of diagnosis, using methods for interpreting diagnostic data that guarantee confidentiality of diagnostic data and the results of interpretation, the priority of the student in determining access to such data for other entities, the results of interpretation of diagnostic data relating to a specific person should be presented to this person, it should be taking into account socio-cultural traditions, as well as ethical and legal norms regarding confidential information, copyright, intellectual property et al.).

Psychological and pedagogical requirements:

- pedagogical diagnostics combination with self-control;
- professional orientation of the diagnostic activity of the student - a combination of diagnostic activity with vocational training for future teachers;
- cultivation of interest in learning activities, the formation of positive motivations that encourage creative activity and independence in learning activity.

Pedagogical diagnostics system is a nonlinear stochastic system that allows you to apply for its analysis the main provisions of synergetics. Already at the methodological level it becomes clear that the system of pedagogical diagnostics can not be built on the basis of deterministic management. Its recommendations will be of probabilistic nature, and the final choice of the variant of realisation of learning technology should always be done by the student.

Study of viewpoint of educational community on the ethical issues of pedagogical diagnostics in context of use of information technology makes it possible to state that when designing and applying a computer-based pedagogical diagnostic system, attention should be paid to the confidentiality of diagnostic data [14]. According to questionnaire, knowledge testing is the leading method of obtaining diagnostic data, but the student's consent to keeping the connection of test results with his personal information is mandatory. Use of video recording for the purpose of pedagogical diagnosis is not ethically justified on opinion of the most of teachers and students. Automated monitoring of the student's work with a computer and recording of physiological data can be used in individual cases only on initiative of the student. The main persons involved in the analysis of diagnostic data are the teacher and the student.

The system of pedagogical diagnostics is a subsystem of the pedagogical system, therefore the concept of pedagogical designing in full refers to the design of a pedagogical diagnostic system. The main feature of this design is that the forecasting of progress of the educational process is one of functions of the pedagogical diagnostics system. Active subjects of designing are students and pedagogical workers (authors of the distance course, tutors, testologists, etc.), who realise their functions with active use of the information and communication technologies. We consider it necessary to emphasize once again the continuous nature of the pedagogical design of a computer-oriented pedagogical diagnostic system.

A characteristic feature of design of a pedagogical diagnostics system for distance learning is the combination of pedagogical design with technical design of appropriate information and communication technologies: databases, Internet services, software for testing and questioning, mathematical models of data processing, algorithms and software for interpretation and presentation of diagnostic data, a system of information security, etc. All these components are designed on the principles that defined in the pedagogical project, but the possibilities of modern technology, technical and mathematical problems arising during such design often cause the need to make corrections or updates in the pedagogical project.

After completing the design of the structure of the system and the beginning of its implementation, the system of pedagogical diagnostics produces the function of designing its own innovations. Such possibility corresponds to the purpose of the system and is provided by the

availability of diagnostics and forecasting components. The system of pedagogical diagnostics, designed to create recommendations for the selection of an appropriate variant of educational activity, develops and implements such recommendations for itself, improving own structure, management links, algorithms and diagnostic tools, basic student models and learning content, classification systems and forecasting techniques. The attempt to design improvements to the current system of pedagogical diagnostics from the outside, without the participation of the subjects of diagnosis, does not correspond to the ideas of the synergetic methodological approach. It is necessary to distinguish the design of the updates of the pedagogical diagnostics system from the management of this system (which it also performs itself, according to the purpose of the learning process and the corresponding optimization criteria coming into the system from the outside. We should emphasize that management of the educational process is not a function of the diagnostic system and is performed by other subsystems of the pedagogical system.

Thus, in the process of designing the system of pedagogical diagnostics, it is advisable to distinguish two stages: external design, when a structure is being created and the subjects of pedagogical diagnostics are being determined, - the preparation of the starting variant of the project is carried out, and internal design, when approbation and introduction of the pedagogical diagnostics system begins, and it, itself through activity of its subjects, carries out designing of own updates. A more detailed definition of the logic of design actions for the system of pedagogical diagnostics leads to the need to apply non-linear algorithmic schemes with ramifications and repetitions. Some actions can be performed in parallel. Therefore, the design process is better represented not as a list of design stages, but as a network schedule of works. The scheme of the process of designing the pedagogical diagnostics system at the stage of preparation of the initial version of the project is shown in Fig. 1. Mandatory logical relationships that define the sequence of actions are shown by solid lines, feedbacks by dotted lines.

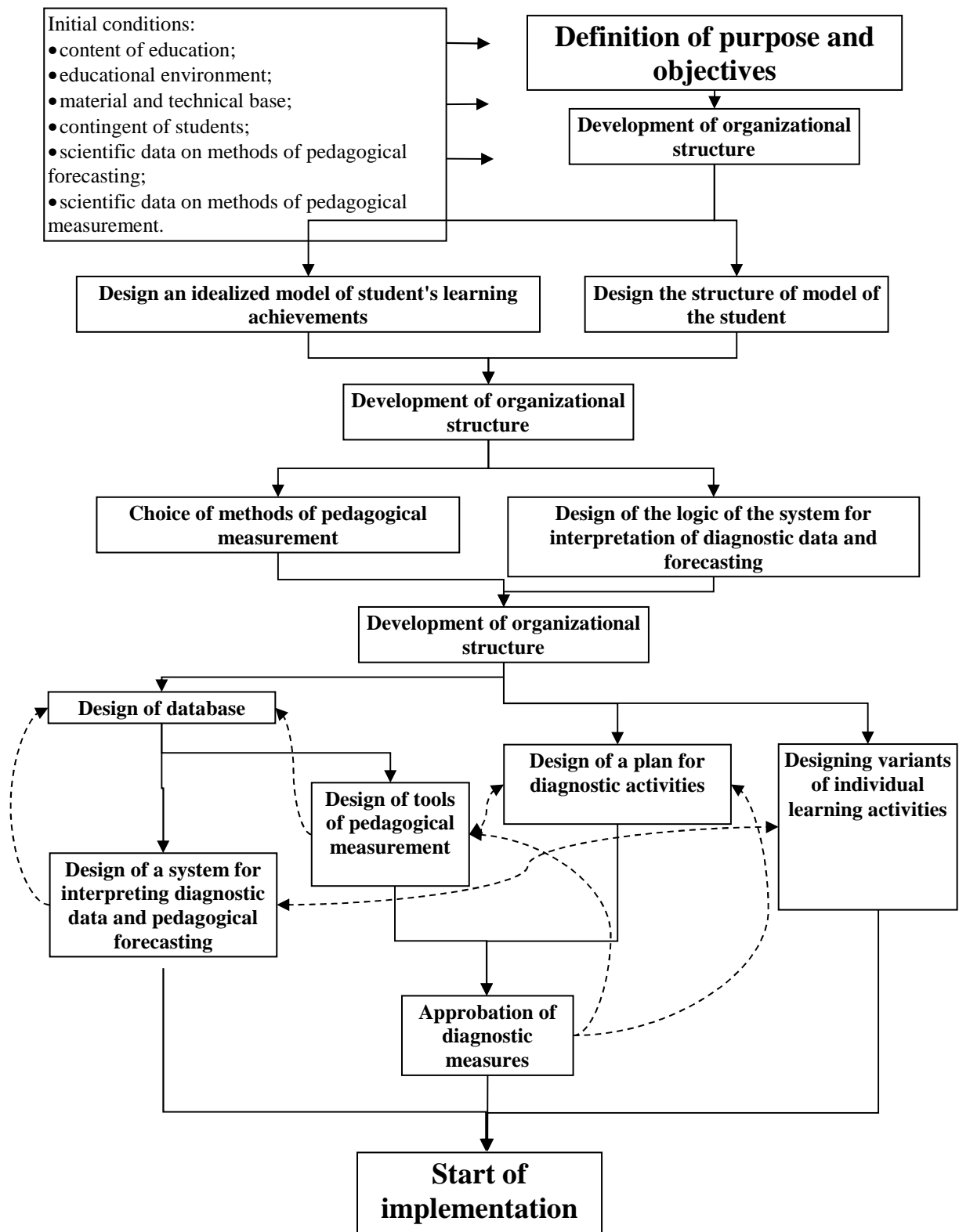


Fig. 1. Diagram of the process of designing the pedagogical diagnostics system at the stage of preparation of the starting project version

The design process begins with the definition of goals and objectives of the pedagogical diagnostics system and involves an analysis of such issues: content of the educational material; possibilities of the educational environment of the educational institution (forms and methods of

learning activities, taking into account the individual approach); material and technical base of the educational institution (marginal costs for the creation and maintenance of an automated pedagogical diagnostics system, the level of development of the information and communication environment); real needs of subjects of the educational process in helping to determine the individual trajectory of students' learning activities; students' attitudes toward diagnostic activities and ethics of pedagogical diagnostics; features of students' motivation to receive education; achievements of pedagogical science regarding the methods of pedagogical measurement and forecasting. The definition of goals and objectives of the system of pedagogical diagnostics also provides for the construction of the conceptual foundations of the future system, namely: development of general requirements for the content of knowledge as the goal of diagnostic and prognostic activity; substantiation of the system of measurement methods; justification of the form of recommendations for the student's choice of specific educational activities within the existing information and communication pedagogical environment.

As shown in Fig. 1, the development of the organizational structure of the system of pedagogical diagnostics, the definition of some categories of pedagogical workers and students as subjects of this system is carried out in stages. The construction of an idealised model of the student's academic achievements assumes the construction of an idealized system of knowledge and skills with an accurate definition of the level of achievements and qualities of knowledge. This stage does not provide for the development of a system of diagnostic tasks, but the requirements for knowledge and skills should be specified. The best way of such concretisation is to develop examples of diagnostic tasks according to each level of educational achievement. The construction of the structure of the model of the student assumes, firstly, the allocation of psychological and pedagogical characteristics of the student, which it is advisable to measure and take into account to forecast of his learning activities and justify the effectiveness of the chosen method of learning at a certain stage, and secondly, design of the detailed structure for recording the student's academic achievements Taking into account their dynamics. Such work should be conducted with the involvement of students through the organization of discussions and interviews. It is at this stage that students begin to actively participate in the design. There are conditions for the creation of a student team of active participants in the system of pedagogical diagnostics; such work becomes possible through the use of services of the information and communication pedagogical environment, which acts as an organizing factor ensuring communication and integration of the efforts of all persons. In the implementation of the task of building the structure of the student model, such technical components of the information and communication pedagogical environment as forums, feedback systems (polls, voting), social networks, etc. can be used. It should be noted that the effective functioning of a computer-based system of pedagogical diagnostics is determined



by its wide application by students outside the classrooms, and therefore it is very important to design pedagogical measurements that allow students to use them independently, provide the possibility of data exchange with the server for involving information and communication pedagogical environment in the diagnosis and interpretation of data, with a view to improving the diagnostic components.

The scheme of the process of designing and functioning of the pedagogical diagnostics system at the approbation and introduction stage is shown in Fig. 2. At this stage, a part of the components of the preparation phase of the project start-up is used, but in a slightly modified form. Other components are specific for the stage the introduction and testing of the pedagogical diagnostics system.

The implementation of the diagnostic activity is the beginning of the implementation of the system and is further carried out by the system according to a certain plan and systematically. Participation of students in such activities can be organised both synchronously and asynchronously. The reliability of the diagnostic data is analysed automatically according to the algorithms that were developed at the stage of preparation of the initial version of the project. Analysis of the impact of diagnostic activities on students assumes an assessment of the quality of the implementation of such functions of pedagogical diagnostics as training, facilitating progress in abilities and personal qualities of the student; upbringing; etc. Based on the results of the analysis, it is possible to correct the plan for diagnostic measures or to modernise diagnostic methods with the aim of improving the learning process. It is necessary to pay attention to the influence of diagnostic activity on the personality of the student, the formation of objective self-esteem, a positive attitude toward life, positive attitude to learning and diagnostic activities. The analysis of the quality of forecasts regarding the student's educational activity assumes a kind of continuous conduct of a pedagogical experiment to test the effectiveness of the variational learning activity offered to the student. The analysis is complicated by the impossibility to form a fixed control and experimental group, because of the priority of the student regarding the acceptance or disregard of the advice of the diagnostics system.

Correction of the goals and objectives of pedagogical diagnostics provides for a continuous analysis of the external conditions of the functioning of the pedagogical diagnostic system and the timely change of the content of diagnostic tasks, the idealized model of student knowledge, optimization criteria, the form of diagnostic activities, etc. as a dynamic response to the development of educational standards, material base of the university, contingent of students, introduction of new finds of a science in the field of pedagogical measurement and forecasting etc. The main persons of this work are teachers, representatives of the administration of the educational institution, specialists in pedagogical measurements.

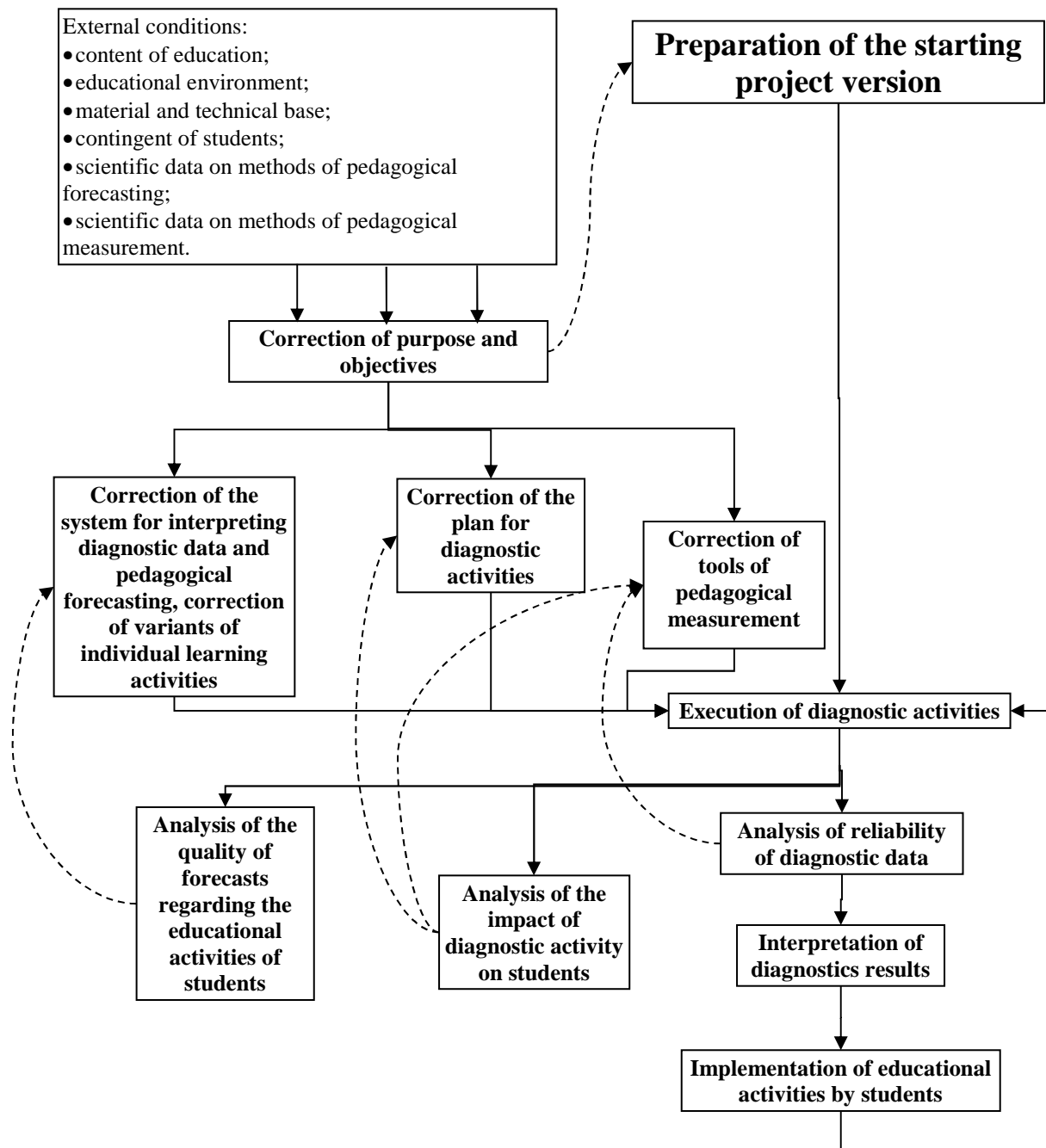


Fig. 2. Diagram of the process of designing the pedagogical diagnostics system and its functioning at the stage of project implementation

## Resume

1. When organizing independent work of university students by means of distance learning to ensure an individual approach to the management of independent work, it is advisable to rely on a computer-based pedagogical diagnostic system that will combine the data of traditional pedagogical observation during classroom activities and new diagnostic capabilities in the interaction of students with the information and communication pedagogical environment.

2. Process of designing a computer-based system of pedagogical diagnostics is continuous.

Prospects for further investigations in the direction of this study are related to the accumulation of experience in the design of the pedagogical diagnostic system in real pedagogical systems and the further theoretical and experimental development of the apparatus of pedagogical forecasting.

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