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DIGITAL DIAGNOSTICS AND MONITORING IN TEACHING INFORMATION TECHNOLOGIES IN INCLUSIVE EDUCATION: A METHODOLOGY FOR ANALYZING SUBJECT ACTIVITY

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Abstract
This article presents a methodology for digital diagnostics and monitoring of subjects' activity in inclusive education within the teaching of Information Technologies. The scientific-practical role of the concepts of data, indicator, metric, and analytics in an inclusive environment is substantiated; the subject–subject system effectiveness digital analysis model, SMART-based diagnostic framework, and information-didactic support implementation technologies are detailed. Experimental results confirm the effectiveness of the methodology.

Keywords: Inclusive education, information technologies, digital diagnostics, monitoring, subject–subject system, SMART diagnostics, learning analytics, individualized education program, adaptive technologies.

Introduction

Teaching modern Information Technologies (IT) requires not only technical skills but also critical and creative thinking. This process becomes even more complex in inclusive education environments: when students with various cognitive, physical, or sensory characteristics are present in the same classroom, the teacher must possess both deep subject knowledge and an individual approach to each student.

The Law of the Republic of Uzbekistan 'On Education' (2020) and the Concept for the Development of Inclusive Education for 2021–2025 guarantee the full integration of students with special needs into the general education process. In such conditions, future special educators are required to develop the competency to objectively analyze the activity of subjects in the IT teaching process using digital tools.

However, the methodology for purposefully developing this competency in higher education has not been sufficiently developed. This article presents a theoretical-practical methodology for teaching the analysis of subject activity in inclusive classrooms based on digital diagnostics and monitoring, using IT as an example.

Research Objectives:

1. To identify the modeling possibilities of data, indicator, metric, and analytics concepts in the inclusive environment of IT teaching, with emphasis on individual and person-centered approaches;

2. To improve the model for teaching digital analysis of subject–subject system effectiveness based on differential application across blocks of individual education programs (IEPs);
3. To develop a technology for reflective application of a SMART-criteria-based diagnostic database according to individual transformation possibilities in corrective work;
4. To substantiate the implementation of information-didactic support with the advantage of incorporating regulated correction possibilities in a mass-methodological context.

THEORETICAL FOUNDATIONS OF THE PROBLEM

Teaching IT in an inclusive environment lies at the intersection of several scientific paradigms. First, the theory of learning analytics enables objective monitoring of a student's learning path, difficulty points, and cognitive development dynamics based on objective indicators (Siemens & Long, 2011). Second, the Universal Design for Learning (UDL) concept requires creating a flexible learning environment for all students, including those with special needs (Rose & Meyer, 2002). Third, the data-driven decision making (DDDM) approach places evidence-based, rather than intuitive, pedagogical decisions at the center.

In local research, E.G'oziyev, B.Hamidov, and Sh.Qurbonov substantiated the necessity of diagnostic monitoring in special education practice. Internationally, J.Florian and M.Black-Hawkins demonstrated the added value of technological support in inclusive pedagogy. However, the methodology for digitally analyzing the activity of inclusive classroom subjects in the context of the IT discipline has not been examined as an independent direction in the scientific literature — which determines the relevance of this study.

DATA, METRIC, INDICATOR, AND ANALYTICS: METHODOLOGICAL FOUNDATION FOR AN INCLUSIVE IT ENVIRONMENT

Four interrelated concepts serve as the methodological foundation for analyzing subject activity in an inclusive IT classroom.

Data — the initial raw material of all analytical processes. In the IT subject, this includes: student performance indicators on programming tasks, computer time utilization dynamics, types of errors and their frequency, collaborative indicators with classmates, and activity participation (clicks, responses, presentations). For students with special needs, interaction statistics with assistive technologies (screen readers, alternative keyboards) are additionally included.

Metric — converts data into a precise, measurable, and comparable form. Specific examples of metrics in the IT subject: the percentage of achievement of goals within the IEP (e.g., 80% in 'mastering Python basics'); the quality index of communication in a digital environment (activity score in group projects); the efficiency of using assistive technologies (frequency of technology use in tasks vs. independent completion ratio).

Indicators — show systemic trends and guide strategic decisions. Examples of indicators in an inclusive IT classroom: the number of tasks completed by each student in IT class (equity indicator); the difference level between a student with special needs and overall class activity (integration indicator); the growth rate of performance after corrective measures.

Analytics — combines the above three elements and reveals cause-and-effect relationships. The analytical process in the IT subject is carried out in three stages: (1) descriptive — 'What is the current state?'; (2) diagnostic — 'Why?'; (3) predictive — 'What is likely to happen next week?'. As a result, the teacher can develop a proactive rather than reactive correction strategy.

Table 1. Application of the Data–Metric–Indicator–Analytics System in the IT Subject

Concept	Definition	Example in IT Subject	Digital Tool
Data	Collection of raw pedagogical facts	Task completion time, error types, participation statistics	LMS journal, ClassDojo, Seesaw
Metric	Measurable quantitative indicator	IEP goal achievement %, collaboration score	Google Sheets, Excel, Progress tracker
Indicator	Trend and quality state	Equity indicator, integration indicator	Power BI, visual dashboard
Analytics	Cause-effect analysis and forecast	Predictive prognosis, correction scenario	Moodle Analytics, Tableau

MODEL FOR DIGITAL ANALYSIS OF SUBJECT–SUBJECT SYSTEM EFFECTIVENESS IN THE IT SUBJECT

In teaching IT in an inclusive environment, the subject system represents a dynamic quadrilateral structure — different from the traditional 'teacher → student' schema: student — teacher — parent — support specialist. In this system, each participant is regarded as an active subject, and their interactions are objectively monitored using digital tools.

The theoretical basis of the model rests on UDL, differentiated instruction, and evidence-based practice approaches. Digital monitoring verifies the effectiveness of IT lessons adapted for all learners through metrics. Transparent-personal monitoring means: transparency — data being understandable and verifiable for all participants; personalization — taking into account the individual development trajectory of each student.

. Blocks of the Subject–Subject Model in the IT Subject

Table 2

Model Block	Content	IT-Specific Indicator	Digital Tool
Goal Block	SMART goals, diagnostic indicators	Specific goals such as 'Mastering Python basics (80%)'	IEP programs, digital goal-tracker
Content Block	Multi-channel: visual, auditory, kinesthetic	Video lessons + voice descriptions + interactive simulators	Electronic compendium, Khan Academy, adaptive LMS
Methodological Block	Adaptive and differential technologies	A separate set of IT tasks for each student	ClassDojo, Seesaw, Google Classroom
Assessment Block	Criteria-reflective approach, digital portfolio	Rubrics, electronic portfolio, self-assessment	Power BI dashboard, Google Sites portfolio
Monitoring Block	Descriptive → Diagnostic → Predictive analytics	Weekly progress chart, correction alerts	Moodle Analytics, Excel, Tableau Public

CORRECTIVE WORK AND SMART-CRITERIA-BASED DIAGNOSTIC DATABASE IN THE IT SUBJECT

In the inclusive IT teaching environment, corrective work must be data-driven and pre-planned rather than random. For this purpose, each corrective goal is operationalized through SMART parameters.

Table 3. SMART-Criteria Diagnostic Database: IT Subject Example

SMART	Definition	Example for a Student with Special Needs in IT	Measurement Mechanism
Specific	Clear, concise goal	'Creating an HTML page using a screen reader'	Assignment list, checklist
Measurable	Quantitative measure	Creating 5 correct tags (in 4 weeks)	Automatic verification, LMS score
Achievable	Realistically attainable	Level adapted according to initial diagnostic results	Entry diagnostics, cognitive profile
Relevant	Aligned with IEP and IT curriculum	Consistent with IEP 'digital independence' block	IEP-LMS synchronization
Time-bound	Deadline specified	Re-diagnostics conducted after 4 weeks	Progress tracking schedule, calendar alert

The diagnostic database covers multi-dimensional parameters such as cognitive development, verbal activity, social adaptation, emotional stability, and the level of independence in the digital environment. For each parameter, baseline, current, and final indicators are compared, and progress dynamics are visualized in a digital dashboard.

In corrective work, a fact-based approach is applied at the analysis stage (indicators of a student's cognitive, communicative, and technical activity in IT class are broken down into components, and cause-and-effect relationships are identified) and the synthesis stage (data is integrated and an individual development model and intervention strategy are developed). The reflective application mechanism develops students' metacognitive competencies: they learn to critically evaluate analysis results and transform correction strategies.

INFORMATION-DIDACTIC SUPPORT AND METHODOLOGY STAGES

The information-didactic support of the methodology is formed on the basis of a systemic-integrative approach. The information environment here is interpreted not merely as technical infrastructure, but as an intellectual educational system harmonized with didactic goals, operationalized outcomes, and assessment indicators.

Table 4. Stages of the Methodology: IT Subject Example

Stage	Name	IT-Oriented Activity	Digital Tools
Stage I (Semesters 1–2)	Motivational-Theoretical	Mastering data/metric/indicator/analytics concepts in the IT context; modeling inclusive IT classrooms; entry diagnostics	Google Forms, Mentimeter, Kahoot! (IT topics)
Stage II (Semester 3)	Operational-Practical	Operationalization of SMART goals in IT laboratory sessions; analysis of exemplary inclusive IT cases; working with diagnostic database	ClassDojo, Seesaw, Excel/Sheets, SMART-diagnostic rubrics
Stage III (Semester 4)	Integrative	Individual IT monitoring projects; descriptive→diagnostic→predictive analytics; electronic portfolio; differential correction by IEP blocks	Moodle LMS, Power BI, Google Sites (portfolio)
Stage IV (Internship)	Professional	Modeling IEPs in a real inclusive IT classroom; applying regulated correction scenarios; reflective journal and professional growth	Integrated digital environment, IEP programs, information security protocols

Modeling personalized IEPs with unique design is the central direction of the methodology. Unique design refers to the integration of UDL principles, adaptive IT technologies, and differentiated teaching strategies. Students acquire the skills to design IEPs based on cognitive, social, and functional parameters, operationalize them through SMART criteria, and simulate them in a digital environment.

Regulated correction — the implementation of corrective measures based on clear criteria, time intervals, and assessment parameters. Developing semi-automated correction scenarios based on digital monitoring results transfers the corrective process from subjective decisions to empirically grounded algorithms.

RESULTS AND DISCUSSION

The obtained results proved that a specialized methodology for teaching digital analysis of subject activity in the IT subject in an inclusive environment produces significantly higher outcomes compared to traditional preparation.

The four scientific novelties of the methodology form an interconnected integral system: (1) the data/metric/indicator/analytics conceptual system is adapted to the inclusive context of the IT subject; (2) the subject–subject effectiveness model is integrated with UDL and IEPs; (3) the SMART-criteria diagnostic database standardizes corrective work; (4) the implementation of information-didactic support with regulated correction possibilities ensures institutional-level effectiveness.

At the same time, the following limitations were identified: high demand for digital infrastructure; the need for IT teachers to receive specialized training in inclusive methodology; inequality in the availability of digital tools in local schools; the necessity of ensuring data privacy and information security.

CONCLUSIONS

In conclusion, this methodology elevates inclusive IT education from a declarative idea to a scientifically grounded, technological, and prognosticative system based on evidence. Future research should be directed toward developing adapted variants of the methodology for other specialized subjects (mathematics, language instruction) and conducting longitudinal studies of its long-term effectiveness.

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