

ASSESSING STUDENTS' SOCIO-EMOTIONAL DEVELOPMENT THROUGH DIGITAL DIAGNOSTIC TOOLS IN THE EDUCATION SYSTEM

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Accepted: 27 Avgust 2026
Published: 27 Avgust 2026

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Iqtibos uchun: Xamroyeva, N. S. ASSESSING STUDENTS' SOCIO-EMOTIONAL DEVELOPMENT THROUGH DIGITAL DIAGNOSTIC TOOLS IN THE EDUCATION SYSTEM / N. S. Xamroyeva // Buxoro xalqaro universiteti ilmiy axborotnomasi. — 2026. — T. 8, № 1. — B. 278–281.

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Abstract. This article examines the limitations of conventional questionnaire- and observation-based methods for assessing students' socio-emotional development and proposes a digital diagnostic model designed to address these gaps. The model integrates behavioral data collection, an indicator framework covering core socio-emotional competencies, and an analytical module for interpreting outcomes. Findings suggest that the digital approach enhances objectivity and enables real-time monitoring compared with traditional assessment instruments.

Keywords: socio-emotional development, digital diagnostics, assessment model, educational technology, student monitoring.

TA'LIM TIZIMIDA O'QUVCHILAR IJTIMOY-EMOTSIONAL RIVOJLANISHINI RAQAMLI DIAGNOSTIKA VOSITALARI ORQALI BAHOLASH

Annotatsiya. Ushbu maqolada o'quvchilarning ijtimoiy-emotsional rivojlanishini baholashda an'anaviy so'rovnomalar va kuzatuv usullarining cheklavlari tahlil qilinib, ularning o'rnini bosuvchi raqamli diagnostik model taklif etiladi. Model xulq-atvor ma'lumotlarini yig'ish, hissiy-ijtimoiy ko'nikmalar bo'yicha ko'rsatkichlar tizimi hamda natijalarni tahlil qiluvchi analitik modulni o'z ichiga oladi. Tadqiqot natijalari raqamli yondashuvning obyektivlik va real vaqt monitoringi imkoniyatlarini ta'minlashini ko'rsatadi.

Kalit so'zlar: ijtimoiy-emotsional rivojlanish, raqamli diagnostika, baholash modeli, ta'lim texnologiyalari, o'quvchi monitoringi.

ОЦЕНКА СОЦИАЛЬНО-ЭМОЦИОНАЛЬНОГО РАЗВИТИЯ УЧАЩИХСЯ С ПОМОЩЬЮ СРЕДСТВ ЦИФРОВОЙ ДИАГНОСТИКИ В СИСТЕМЕ ОБРАЗОВАНИЯ

Аннотация. В статье анализируются ограничения традиционных опросных и наблюдательных методов оценки социально-эмоционального развития учащихся и предлагается цифровая диагностическая модель, восполняющая эти пробелы. Модель включает сбор поведенческих данных, систему индикаторов социально-эмоциональных навыков и аналитический модуль обработки результатов. Полученные результаты свидетельствуют о том, что цифровой подход обеспечивает объективность оценивания и возможность мониторинга в режиме реального времени.

Ключевые слова: социально-эмоциональное развитие, цифровая диагностика, модель оценивания, образовательные технологии, мониторинг учащихся.

Introduction. Over the past three decades, socio-emotional competence has increasingly been recognized as a determinant of academic achievement and long-term wellbeing rather than a peripheral outcome of schooling. Goleman (1995) popularized the notion that emotional intelligence shapes how learners regulate impulses, cooperate with peers, and cope with setbacks, while Zins, Weissberg, Wang, and Walberg (2004) argued that social and emotional competencies function as a foundation on which academic learning is built. The Collaborative for Academic, Social, and Emotional Learning (CASEL, 2020) later consolidated this line of work into five interrelated domains - self-awareness, self-management, social awareness, relationship skills, and responsible decision-making - that continue to guide curriculum design worldwide.

Empirical support for intervening in this domain is substantial: a meta-analysis by Durlak, Weissberg, Dymnicki, Taylor, and Schellinger (2011) covering over two hundred school-based programs found consistent gains in both social-emotional skills and academic performance following systematic instruction. Yet the instruments used to assess these outcomes have changed comparatively little, remaining dependent on self-report questionnaires and teacher rating scales that are time-consuming to administer and vulnerable to subjective bias (Denham, 2006). The emergence of learning analytics (Siemens, 2013) and educational data mining (Baker & Inventado, 2014) has opened an alternative pathway, in which behavioral traces - interaction logs, written responses, and

classroom activity patterns - are analyzed computationally to infer socio-emotional states with less reliance on retrospective self-report.

Despite this potential, most digital tools adopted in schools were originally built for academic progress tracking and only loosely adapted to socio-emotional constructs, leaving a gap between what learning analytics can measure and what socio-emotional frameworks require. The present article addresses this gap by proposing a digital diagnostic model that operationalizes the CASEL competency domains into measurable indicators, aggregates multiple data sources into a single analytic pipeline, and returns interpretable output for classroom teachers. The remainder of the article reviews relevant prior work, describes the architecture of the proposed model, presents its indicator structure, and discusses implementation considerations.

Literature Review. Classical instruments for evaluating socio-emotional competence fall into three broad categories: self-report inventories, informant ratings completed by teachers or parents, and structured observation protocols. Denham (2006) noted that each of these approaches carries a distinct weakness - self-reports are constrained by learners' limited introspective vocabulary, informant ratings are shaped by the rater's own expectations, and observation protocols demand extensive trained personnel time - so that no single instrument yields a fully objective picture on its own. Comparative studies conducted since then have generally confirmed that combining sources improves reliability but does little to reduce the administrative burden associated with paper-based tools.

Parallel developments in educational technology have demonstrated that computational analysis of naturally occurring learner behavior can supplement, and in some respects replace, deliberate self-report. D'Mello and Graesser (2012) showed that affective states such as frustration and engagement could be inferred from interaction patterns during computer-based learning with accuracy comparable to human observers. Baker and Inventado (2014) extended this line of inquiry under the label of educational data mining, arguing that log-level behavioral data - response latency, revision frequency, help-seeking behavior - constitutes a rich and largely underused signal for modeling non-cognitive constructs. More recently, UNESCO (2021) cautioned that the introduction of such analytic systems into schools must be accompanied by explicit safeguards for data privacy and algorithmic transparency, a concern the model proposed in Section 3 attempts to address by design rather than as an afterthought.

Proposed Digital Diagnostic Model. The proposed model is organized around three functional layers: a data-collection layer that captures behavioral and self-report signals through classroom software, a competency-mapping layer that translates raw signals into the five CASEL domains, and a reporting layer that renders results as an interpretable dashboard for teachers. Unlike generic learning-analytics dashboards, each indicator in the mapping layer is deliberately tied to a specific, observable data source so that scores remain traceable to concrete evidence rather than to an opaque composite metric.

Table 1.

Indicator framework of the proposed digital diagnostic model

Competency Domain	Sample Indicator	Primary Data Source
Self-awareness	Frequency of accurate self-rating vs. peer/teacher rating	Digital self-assessment logs
Self-management	Recovery time after a flagged frustration episode	Interaction timestamps, task logs
Social awareness	Sentiment alignment with group discussion tone	Text analysis of collaborative chat
Relationship skills	Reciprocity index in peer-help requests	Peer-interaction network logs
Responsible decision-making	Consistency between stated intention and logged action	Reflective journal entries, task logs

As shown in Table 1, each domain is operationalized through indicators derived from data the school software already generates, which minimizes additional data-collection burden while preserving interpretive traceability for teachers.

Discussion. The indicator framework presented above offers two practical advantages over conventional instruments. First, because indicators are computed from data teachers' existing software already logs, the model imposes no additional data-entry burden on either students or staff, addressing the administrative-cost concern raised by Denham (2006). Second, because each score is traceable to an underlying behavioral trace rather than to an aggregated black-box output, teachers retain the ability to inspect the evidence behind a given result, which supports the transparency principle emphasized by UNESCO (2021) for AI-assisted assessment in schools.

The approach nonetheless carries limitations that warrant caution before wide deployment. Behavioral proxies for socio-emotional constructs are inherently indirect, and a student's atypical interaction pattern may reflect factors unrelated to the competency being measured, such as unfamiliarity with the interface or a temporary technical issue. Validating the model therefore requires triangulation against established instruments such as teacher ratings or the Devereux Student Strengths Assessment before any diagnostic output is used to inform individual decisions about a student.

The analysis of students' socio-emotional development through digital diagnostic tools demonstrates that digital technologies can provide new opportunities for identifying emotional, interpersonal, and behavioral characteristics within

the education system. Unlike traditional diagnostic procedures that are often conducted at specific stages and require considerable time for data collection and processing, digital tools can facilitate systematic assessment and provide educators with more timely information about students' socio-emotional needs.

One of the most important advantages of digital diagnostic tools is their ability to collect and organize multidimensional information about students. Socio-emotional development includes several interconnected components, such as emotional awareness, emotion regulation, empathy, social interaction, self-confidence, resilience, and responsible decision-making. Digital assessment platforms can combine questionnaires, situational tasks, self-assessment scales, behavioral indicators, and teacher observations, thereby creating a more comprehensive picture of student development.

At the same time, the results of digital diagnostics should not be interpreted as fixed characteristics of a student. Socio-emotional competencies are dynamic and can change under the influence of educational experiences, peer relationships, family environment, classroom climate, and personal development. Therefore, digital diagnostic results are more useful when they are viewed as indicators of current developmental tendencies rather than definitive labels.

An important finding concerns the potential of digital tools for identifying students who may require additional educational support. For example, repeated indicators of difficulties in emotional regulation, social interaction, or adaptation may encourage educators to provide targeted developmental activities. However, such indicators should be interpreted carefully and, where necessary, complemented by direct observation and professional assessment. Automated results alone should not become the basis for making high-stakes judgments about a student's personality or abilities.

The effectiveness of digital diagnostics is also closely connected with the quality of the assessment instruments. A technically sophisticated platform does not necessarily guarantee valid psychological measurement. The diagnostic scales and tasks incorporated into digital systems should correspond to established psychological and pedagogical constructs, demonstrate appropriate reliability and validity, and be adapted to the students' age and cultural context. Particular attention should be paid to the language used in digital questionnaires because poorly formulated or culturally inappropriate items can distort assessment results.

Another important aspect is the role of teachers. Digital diagnostics should not replace the teacher's professional judgment but should function as a decision-support mechanism. Teachers can use assessment information to identify developmental priorities, differentiate educational activities, and monitor changes over time. For example, if assessment indicates difficulties with cooperation, classroom activities can incorporate collaborative problem-solving, role-playing, peer interaction, and reflection. Thus, diagnosis becomes connected with intervention rather than remaining an isolated measurement procedure.

The repeated assessment of socio-emotional development creates additional opportunities for monitoring individual progress. Instead of comparing students only with one another, digital systems can help educators examine changes within the same student over time. This longitudinal perspective is particularly important because socio-emotional development is characterized by gradual change rather than immediate transformation. Progress indicators can therefore be used to evaluate whether particular educational interventions are producing the expected developmental effects.

Nevertheless, several challenges must be considered. Privacy, data security, informed consent, algorithmic bias, and responsible interpretation of psychological data are particularly important when digital diagnostic systems are used with students. Educational institutions should ensure that collected information is protected and used only for legitimate educational purposes. Students should not be stigmatized or excluded because of temporary emotional or behavioral indicators identified through digital assessment.

Another limitation is the possibility of reducing complex socio-emotional experiences to numerical scores. Emotional states and interpersonal behavior are context-dependent and cannot always be adequately represented by a single scale or index. Consequently, the most reliable approach is to combine digital assessment with qualitative information, teacher observations, student reflections, and, where appropriate, communication with parents or other educational professionals.

The discussion also suggests that digital diagnostic tools are most effective when integrated into a continuous socio-emotional learning system. The optimal sequence can be represented as: assessment → interpretation → individualized support → repeated assessment → adjustment of intervention. Such a model transforms digital diagnostics from a one-time testing procedure into an instrument for continuous educational improvement.

Overall, digital diagnostic tools have considerable potential for assessing students' socio-emotional development, provided that they are used within a scientifically grounded and ethically responsible framework. Their greatest value lies not simply in automating assessment, but in enabling educators to obtain timely, structured, and development-oriented information. When combined with professional interpretation and appropriate pedagogical interventions, digital diagnostics can contribute to a more individualized, responsive, and student-centered education system.

Conclusion. Digital diagnostics offer a credible complement, though not yet a full replacement, for traditional socio-emotional assessment in schools. By tying each of the five CASEL competency domains to a specific, low-burden data source, the model proposed here narrows the long-standing gap between what learning-analytics infrastructure can capture and what socio-emotional frameworks require to be measured meaningfully. Future work should prioritize longitudinal validation against established instruments, cross-cultural adaptation of indicator thresholds, and the development of governance protocols that keep data use transparent to students, parents, and teachers alike.

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