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Sustainable student engagement in digital and hybrid learning environments: a pedagogical reconceptualization

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Abstract: In digital and hybrid learning environments, student engagement can be observed through numerous traces of activity, whereas the quality of engagement and the conditions supporting its continuity require a broader interpretation. This paper examines the pedagogical sustainability of engagement through a theory synthesis that integrates research on its multidimensionality, learning analytics, participation trajectories, study demands and resources, and well-being. The analysis clarifies the relationships among manifestations of engagement, the conditions that support its development, and the criteria for assessing its pedagogical sustainability. Sustainability is considered in relation to the trajectory of engagement, taking into account the possibilities for maintenance, adaptation, and recovery, the educational significance of the experience, and its compatibility with student well-being.

Keywords: student engagement; sustainable engagement; student well-being; digital education; blended learning.

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1. Introduction

Digital transformation has progressively reshaped learning contexts, expanding access to content, communication, collaboration, and monitoring.

However, the availability of technologies does not in itself guarantee the quality of the educational experience, which depends on instructional design and on the alignment between tools, activities, and educational objectives.

Within this context, student engagement can be regarded as a relevant interpretive category. The literature describes it as a multidimensional construct encompassing behavioral, emotional, and cognitive components (Fredricks et al., 2004). An agentic dimension can also be included, referring to students' proactive contribution to learning activities (Reeve & Tseng, 2011).

In digital environments, some manifestations of engagement are more readily observable than others. Studies using learning analytics predominantly rely on behavioral indicators, whereas cognitive and emotional dimensions are less directly accessible through platform data (Bond et al., 2020; Bergdahl et al., 2024). The availability of digital traces therefore raises the question of how the activities observed through these data should be interpreted.

Moreover, student engagement is also related to how students experience learning and to their well-being. Engagement and well-being may be reciprocally

related over time (Datu & King, 2018), while the concept of online engagement fatigue draws attention to fatigue associated with the demands of online participation (Maloney et al., 2023). The relationship between study demands and available resources also contributes to understanding the conditions under which learning takes place (Bakker & Mostert, 2024).

The relationship among engagement, well-being, and study conditions also raises the question of how participation can be sustained over time, particularly when educational demands change or difficulties arise. This issue provides the basis for research on sustainable student engagement, which has been examined in the literature through measures developed for e-learning contexts (Kim et al., 2018; Lee et al., 2019; Fayda Kinik, 2026) and through perspectives addressing the continuity, recovery, and fragility of participation (Zhang et al., 2026; Wheeler, 2026).

Although these studies have already highlighted the importance of continuity in engagement, opportunities for adaptation, and the conditions that facilitate recovery, further investigation is needed into how these aspects can be considered together with the quality of the educational experience in digital and hybrid environments. Continuity of participation alone does not make it possible to understand the educational significance of engagement or its relationship with student well-being.

On these premises, this paper aims to develop a pedagogical reconceptualization of sustainable student engagement in digital and hybrid learning environments.

2. Conceptual approach and analytical criteria

This study adopts a theoretical-conceptual approach based on theory synthesis, aimed at integrating different perspectives in order to develop a more comprehensive understanding of the phenomenon under examination (Jaakkola, 2020). Sustainability serves as the common point of reference across these perspectives.

The analysis connects five theoretical domains: the multidimensionality of student engagement; its measurement in digital environments, with particular attention to learning analytics; the relationships between engagement and well-being; study demands, resources, and processes involved in regulating participation; and previous conceptualizations of sustainable student engagement.

The analysis proceeds through three interrelated operations: distinguishing engagement from the indicators used to observe it and from the conditions that influence it; examining continuity, adaptation, and recovery across the different perspectives; and integrating these insights with educational significance and well-being in order to clarify how sustainability can be pedagogically assessed.

3. Student engagement in digital environments: multidimensionality, visibility, and quality

Conceptualizing student engagement as a multidimensional construct requires its boundaries to be distinguished from the factors that precede it, support it, or result from it. Kahu's (2013) model distinguishes engagement from its antecedents and consequences, situating it within personal, institutional, and sociocultural relationships. Teacher support, available resources, and characteristics of the

learning environment therefore contribute to explaining participation and its variations.

Context contributes to understanding how engagement takes shape. Fredricks et al. (2004) emphasize its sensitivity to environmental conditions, while Kahu and Nelson (2018) describe the interaction between students and institutions through the educational interface. The object of engagement also requires attention, distinguishing engagement in learning activities from engagement related to belonging to the educational community (Wong & Liem, 2022).

These distinctions become particularly important in digital environments, where some student activity leaves persistent traces. Logins, time spent on the platform, access to materials, interactions, and assignment submissions document recorded behaviors. Cognitive processing, emotional experience, and agentic contribution require additional information in order to be interpreted. The issue therefore concerns the relationship between the theoretical construct and the indicators used to observe it.

In their review of 159 studies on learning analytics in higher education, Bergdahl et al. (2024) found that 95% considered behavioral indicators and 56% relied exclusively on them. Bond et al.'s (2020) mapping further highlights the variety of definitions and measurement approaches used to investigate engagement in educational technology research. The technical possibilities for observation therefore contribute to shaping which aspects of engagement are most extensively documented.

The frequency of platform access may have different meanings depending on course organization and on the presence of collaborative or face-to-face activities. Understanding the function of the activities is therefore necessary, as is connecting digital traces to the different dimensions of engagement and integrating them with information about students and educational processes.

On this basis, the distinction between *engagement visibility* and *engagement quality* is used as an analytical tool. The former refers to the extent to which activity becomes detectable through digital technologies; the latter concerns the quality of engagement in relation to its components and educational objectives. This distinction helps organize an already recognized problem by connecting data availability with educational meaning.

Attention to quality also concerns the criteria used for observation. In discussing the evaluation of technologies in higher education, Nuzzaci (2015) emphasizes the need to connect indicators with educational objectives. The same requirement applies to the study of engagement: information acquires interpretive value when it makes it possible to understand which activities are being carried out, through which learning processes, and under what conditions.

4. Engagement, well-being, and the conditions of digital participation

The relationship between student engagement and well-being involves different levels of the educational experience. Wong et al.'s (2024) meta-analysis, which primarily addresses school-age students, documents positive but differentiated associations between components of engagement and subjective well-being. In a two-wave longitudinal study, Datu and King (2018) identified reciprocal associations over time. These findings suggest that well-being should be considered both in

relation to the conditions of engagement and to the development of the educational experience over time.

Different models position engagement and well-being in different relationships. Kahu and Nelson (2018) consider well-being among the psychosocial mechanisms of participation; Bakker and Mostert (2024) investigate engagement and burnout within the broader domain of student well-being, adopting a definition based on vigor, dedication, and absorption. Some aspects of engagement are also included within conceptualizations of cognitive well-being (Centeno et al., 2025). The present paper examines these relationships using explicit definitions while taking possible conceptual overlaps into account.

In digital environments, well-being also depends on the interaction between individuals, technologies, and conditions of use (Gui et al., 2017; Vanden Abeele, 2021). Digital competencies, accessibility, and protective practices contribute to the quality of the experience (Nuzzaci & Maviglia, 2025). The review by Topluk and Genc (2026) documents the variety of factors associated with well-being, while the Joint Research Centre further examines its pedagogical, social, and organizational dimensions (Centeno et al., 2025).

The demands associated with online participation include communication, assignments, interactions, and time management. Maloney et al. (2023) qualitatively describe experiences of online engagement fatigue associated with overexposure to online activities and interactions. It is therefore necessary to consider how students experience these demands without attributing fatigue to a single cause.

Study Demands–Resources Theory provides a framework for further examining this relationship. Study demands require cognitive, emotional, and organizational investment; personal and contextual resources, such as autonomy, support, and feedback, contribute to motivation and may mitigate the effects of more burdensome demands (Bakker & Mostert, 2024). Some demanding activities may constitute sustainable educational challenges when accompanied by appropriate conditions and resources. In the present analysis, this model is used to interpret the conditions of the educational experience while retaining the multidimensional conception of engagement outlined above.

The conditions of participation include opportunities to organize time, modify strategies, and seek support. As previously noted, agentic engagement specifically refers to students' proactive contribution to the learning situation (Reeve & Tseng, 2011). The relationship between personal initiative and available resources may contribute to maintaining or restoring engagement.

The comparison therefore identifies interconnected levels of experience: the configuration of engagement, the conditions under which it develops, the processes supporting its regulation, and its relationship with well-being. Considering these levels jointly provides the basis for examining sustainability across the educational trajectory.

5. Sustainable student engagement: previous research and open questions

In the literature using the expression sustainable student engagement, sustainability has been addressed through personal resources, study activities, and processes supporting continuity of participation. In the study by Kim et al. (2018), learning agility statistically mediates the relationship between digital competence and

attitudes and engagement within a university sample; the cross-sectional design makes it possible to examine the associations specified by the model.

Lee et al. (2019) propose an instrument for measuring sustainable engagement in e-learning comprising six factors: psychological motivation, peer collaboration, cognitive problem solving, interaction with instructors, community support, and learning management. The scale represents the phenomenon through a composite configuration in which manifestations of participation, study strategies, and relational elements converge. The authors' discussion attributes different functions to these factors, making it important to distinguish the dimensions being measured from the conditions that may support engagement.

In Fayda Kinik's (2026) Turkish adaptation, the scale is reorganized into four factors, highlighting the need to assess the conceptual equivalence of measurement instruments. The studies by Lee et al. and Fayda Kinik are cross-sectional: they identify configurations associated with sustainable engagement, whereas examining its actual development requires repeated observations over time. Fayda Kinik explicitly acknowledges this limitation.

The temporal dimension has also been investigated through different approaches. Saqr and López-Pernas (2021) reconstruct multi-year trajectories of online activity across an educational program; their indicators primarily concern digitally observable behaviors. Through interviews with university students, Zhang et al. (2026) examine recovery following periods of reduced engagement and the role of support networks. In inclusive education, Wheeler (2026) proposes a model of participation sustainability that considers intensity of effort, environmental dependency, consistency across contexts, responses to change, and duration. These studies already recognize the relevance of continuity, adaptation, and the fragility of participation.

Comparison across these contributions requires attention to differences in their objects of analysis and contexts. E-learning scales, digital trajectories, students' narrated experiences, and models developed for inclusive education provide different types of evidence: some describe engagement, whereas others concern its conditions, the effort involved, and processes of recovery. The operational meaning of sustainability therefore depends on the level of analysis and on the information collected.

In digital and hybrid environments, it becomes particularly important to connect the partial nature of recorded traces with the development of engagement and with the conditions of the educational experience. Comparison with the literature on well-being and educational quality raises a further question: on what basis can a trajectory of participation be pedagogically assessed, taking into account what students do, how their engagement changes, and the conditions under which the experience takes place? This question guides the reconceptualization proposed here.

6. A pedagogical reconceptualization of sustainable student engagement

The issues identified above make it possible to clarify the meaning of sustainability when applied to student engagement. Continuity, adaptation, and recovery of participation are already recognized in the literature examined. The present proposal integrates these contributions with the multidimensionality of

engagement and with an interpretation of the quality of the educational experience in digital and hybrid environments.

From this perspective, sustainable student engagement is examined in relation to the trajectory of an engagement that can be maintained, adapted, or restored over time.

Pedagogical sustainability is understood as a quality attributed to this trajectory on the basis of the educational significance of participation, the conditions that enable its development, and its compatibility with student well-being. It is therefore an interpretive proposal in which the trajectory identifies the object of analysis, while conditions and well-being contribute to understanding and assessing its sustainability.

This delimitation draws on the distinction between engagement, antecedents, and consequences (Kahu, 2013). Behavioral, emotional, and cognitive components describe forms of engagement; demands and resources help explain the conditions within which engagement can develop; and regulatory processes provide insight into how it can be modulated. Differences across educational contexts and situations contribute to configuring different opportunities for participation. Sustainability is therefore examined as a quality of the relationship among these levels throughout the educational pathway.

The temporal dimension makes it possible to consider changes, difficulties, and recovery in engagement. Zhang et al. (2026) and Wheeler (2026) offer perspectives on continuity as a process sensitive to resources and environmental changes. The temporal perspective concerns the possibility of maintaining a meaningful relationship with learning activities while accommodating changes through processes of adjustment and reorganization.

Reconstructing the trajectory requires information that is consistent with the construct. Platforms document patterns of logins, submissions, and interactions; assessing the quality of engagement requires information about cognitive and emotional processes and about the meaning of the activities. The distinction between *engagement visibility* and *engagement quality* thus acquires a temporal dimension: digital traces reveal one part of how participation develops over time and need to be connected with educational objectives and study conditions.

Well-being also contributes to the pedagogical assessment of sustainability by providing information about students' experiences and the compatibility between educational demands and their resources. The relationships between engagement and well-being are dynamic and conceptualized in different ways (Kahu & Nelson, 2018; Datu & King, 2018; Bakker & Mostert, 2024). Within the proposed framework, this information makes it possible to examine the sustainability of the conditions of participation while considering the intensity, duration, and context of any difficulties. A demanding activity may retain educational value even when it involves effort; persistent signs of overload, by contrast, require closer examination of demands and available support. Well-being thus becomes a relevant evaluative criterion without being treated as a single indicator or assumed to be external to all possible definitions of engagement.

The educational significance of participation concerns its relationship with learning. Activities acquire pedagogical relevance in relation to educational objectives, the processing of content, and opportunities for development. Research on the evaluation of educational technologies (Nuzzaci, 2015) and on cognitive

activation (Trinchero, 2018) draws attention to educational processes. Assessing sustainability therefore requires this educational significance to be considered together with its relationship to well-being.

The synthesis yields three interpretive steps: describing engagement by specifying what the indicators actually document; reconstructing the trajectory and conditions of participation, including opportunities for recovery; and assessing the trajectory in relation to educational significance and well-being. These operations organize the evidence and do not constitute either a new measurement scale or new psychological dimensions of engagement.

The value of the proposal becomes clearer when the evidence is considered jointly. Regular logins and completed assignments may coexist with overload, while a temporary reduction in activity may form part of a recovery process. Assessment requires information about the work undertaken, the conditions of participation, and the student's experience. When such information is unavailable, any judgment remains provisional: sustainability cannot be inferred from an isolated indicator.

The specific contribution of the proposal lies in connecting engagement trajectories, digital observation, and pedagogical quality. Although the temporal and contextual interpretation of sustainability has already been explicitly addressed by Wheeler (2026), the present framework further examines the inferences drawn from digital traces and their relationship with learning and well-being.

7. Conclusions and directions for future research

The proposed reconceptualization highlights the responsibility involved in instructional design. In digital and hybrid environments, activities, timing, interactions, tools, and feedback configure both opportunities and demands for students. Study Demands–Resources Theory examines the relationship between demands and resources (Bakker & Mostert, 2024), while the European framework on digital well-being highlights the role of pedagogical and organizational choices (Centeno et al., 2025).

Instructional design can clarify communication expectations, provide forms of support and opportunities for recovery, and distribute activities in relation to educational objectives. Digital competencies and accessibility affect students' actual opportunities for participation (Nuzzaci & Maviglia, 2025). Sustainability therefore requires attention to students' study conditions.

Observation and assessment require instruments that are consistent with the construct being examined. Digital traces can help reconstruct variations over time, while other sources can provide insight into the less visible dimensions of engagement (Bond et al., 2020; Bergdahl et al., 2024). Feedback based on these data can support reflection, provided that it is connected to educational objectives. In hybrid learning, activities taking place outside the platform must also be considered.

The proposed framework suggests the need for longitudinal studies and, where appropriate, mixed-methods designs capable of connecting changes in engagement with demands, resources, regulation, and well-being. Future research will need to define appropriate time intervals and contexts of observation while distinguishing potentially overlapping constructs. Scales, digital traces, and students' perspectives may contribute to examining configurations of engagement over time.

The literature considered encompasses different educational contexts and populations, ranging from higher education to inclusive education. The application

of the proposed framework should therefore take into account the characteristics of educational activities and the different ways in which engagement is observed and supported.

In conclusion, the proposed reconceptualization offers a pedagogical perspective from which to consider the relationship among engagement, learning, and well-being, while acknowledging the role of educational design in creating conditions conducive to the development of individual potential. Supporting meaningful and sustainable engagement, in this sense, means promoting educational experiences that are attentive to the needs and resources of each learner, capable of fostering the development of practical skills essential for entering the world of work, while also contributing to student well-being and quality of life.

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