

Fostering Students' Engagement and learning through Simplex Didactics Approach¹

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Several studies, both nationally and internationally, highlight how student engagement is a strong predictor of academic performance. In the literature, the term “engagement” is described as a multidimensional construct, comprising behavioral, emotional, and cognitive components, which together provide a holistic understanding of the school experience. Given the increasing complexity of educational contexts, this multidimensional nature underscores the need for teachers to adapt their practices to students' needs and cognitive styles, promoting active participation in the teaching-learning process. In this perspective, the approach of Simplex Didactic becomes particularly relevant. Grounded in a bio-educational vision, it offers an innovative approach to understand and guide the adaptation of complex systems - such as educational ones - to the principles of living systems. Recognized as an effective tool for promoting inclusion, Simplex Didactic may also serve as a valuable strategy to enhance student engagement. Based on these premises, the present study aims to validate the adapted Italian version of the Engagement Questionnaire (Abbasi et al., 2023) to assess engagement levels among future support learning teachers participating in a 30-hour training course on Simplex Didactic. The research is part of a broader investigation designed to explore whether the adoption of simple teaching practices fosters engagement, learning, and school inclusion.

Keywords: Engagement; Simplex Didactics; Teaching-Learning process; Inclusion

Introduction

In the broader discussion on inclusive education, student engagement embodies both educational equity and inclusivity, serving as a key factor in promoting academic achievement by fostering active participation, a sense of belonging, and equitable access to learning opportunities. According to Fredricks et al. (2004), Guthrie & Anderson (1999), and Wigfield et al. (2000), student engagement is characterized by active, affective and reflective involvement in the learning process. This multidimensional perspective (cognitive, behavioral, and emotional) has become a shared orientation in literature. Empirical evidence shows that inclusive pedagogies rooted in engagement theories may promote benefits, particularly for students with special educational needs or at risk of marginalization (Aiello, Pace, & Sibilio, 2023; Alnahdi, Poblete & Schwab, 2022; Di Gennaro et al., 2018; Joshi et al., 2022; Zollo et al., 2018). In this

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perspective, engagement is not merely an individual trait but a relational outcome, shaped by the interaction among teachers' pedagogical perspectives, their professional agency and their ability to critically reflect on their educational actions. Within this framework, teacher agency assumes a pivotal role to foster both the learning process and students' engagement, understood as the «capacity of teachers to act purposefully and constructively to direct their professional growth and contribute to the quality of education» (Priestley, Biesta & Robinson, 2015, p. 137). This agency encompasses professional judgment, reflection-in-action (Schön, 1983), and the willingness to adapt instructional strategies to meet diverse learning profiles (EADSNE, 2012; Di Gennaro et al., 2016; OECD, 2018).

Nevertheless, in the Italian context, validated tools to measure engagement are still lacking, especially in teacher education programs. This gap makes it difficult to systematically assess and promote engagement in inclusive classrooms. Addressing this limitation requires not only reliable instruments but also a clearer understanding of how inclusive learning environments actually work and how teachers should act to foster students' engagement and learning process.

Inclusive learning environments should be conceived as dynamic systems that evolve over time rather than as static contexts. Their key aim is to guarantee that all students, regardless of abilities, socioeconomic background or preferred learning styles, have equitable access to and may fully participate in meaningful and engaging educational experiences. From this perspective, the challenge for teachers is to develop adaptive strategies that move beyond linear and standardized models of instruction.

To navigate the complexity of classroom life, teachers require approaches that enable them to flexibly respond in real time. In this sense, Alain Berthoz's (2012) theoretical insights and their pedagogical elaboration (Sibilio, 2020, 2023) offer a useful conceptual framework. According to Berthoz, human cognition relies on adaptive strategies of simplification that allow individuals to efficiently address complex situations, without compromising responsiveness, intentionality, flexibility or emotional sensitivity (Berthoz, 2012). Its didactic transposition, known as Simplex Didactics, provides a foundation for rethinking the teaching-learning process as a complex, relational system where both teachers and students co-construct knowledge, identity and sense of belonging (Sibilio, 2012, 2015, 2020). At the heart of this approach lies the teacher's adaptive gaze that is, the ability to recognize and respond in real time to the variability of classroom life, while valuing students' diversity and potential (Aiello, Pace & Sibilio, 2023).

By promoting full participation, embracing diversity and fostering deep learning, Simplex Didactics offers a pedagogical framework based on principles of complexity management. It equips teachers with theoretical and practical tools to address today's educational challenges, moving away from one-size-fits-all teaching toward more personalized, differentiated and contextually responsive practices. Within this framework, teachers are encouraged to create learning environments that are simultaneously structured and flexible, where their agency emerges as a cornerstone of inclusive pedagogy.

Given that the development of professional agency and reflexivity is a major concern in teacher education, the applicability of Simplex Didactics is even more apparent. Professional development depends on metacognitive awareness and the

capacity to reflect on, in and about one's own actions (Schön, 1983). According to the theory of Simplexity, teacher candidates should learn how to use their innate adaptive abilities (such as pattern recognition, affective attunement, and strategic inhibition) pedagogically rather than being taught about them. Building on these theoretical premises, the present study focuses on a specific objective: validate the adapted Italian version of the Engagement Questionnaire (Abbasi et al., 2023) to assess engagement levels among future support learning teachers participating in a 30-hour training course on Simplex Didactic. Through the validation of this instrument, the study aims to provide quantitative data useful for promoting more personalized, differentiated and complexity-sensitive teaching practices, reinforcing the idea that engagement is a collective achievement rather than a mere individual attribute.

Simplex Didactics' Theoretical Framework

The increasing complexity of learning environments underscores the need to identify effective strategies to ensure that all students, regardless of their individual needs, feel involved, interested and actively engaged in the learning process, so they can maximize the benefit of the educational experience (Fredricks et al., 2004). Within this framework, the construct of engagement assumes particular importance. Defined as a multidimensional process encompassing behavioral, cognitive and emotional components (Fredricks, Blumenfeld & Paris, 2004), engagement is recognized as crucial for fostering meaningful and sustained participation in educational activities. High level of engagement is associated with improved academic performance, greater task persistence, and deeper intrinsic motivation.

On the other hand, there is an ongoing debate about the set of skills teachers should have to feel adequately equipped to act professionally and effectively in increasingly complex educational contexts (Aiello et al., 2023). In the field of national pedagogy, a noteworthy contribution comes from neurophysiology through Berthoz's Simplexity theory, which has increasingly gained attention. This theory offers a compelling vision of how complex systems, such as in the educational one, adapt harmoniously by activating a series of biological mechanisms that emerged over the course of evolution (Aiello et al., 2023). Rather than challenging or replacing existing pedagogical models, this theory provides a systemic and integrative perspective and may also represent a conceptual toolbox for teacher training that enables educators to operate within what Van Geert and Steenbeek (2014) describe as an epistemologically complex system such as education, managing to understand the system and achieve important things from their own perspective (Van Geert and Steenbeek, 2014).

The properties and principles of Simplexity provide an integrated operational and theoretical framework, useful for designing educational experiences that stimulate cognitive engagement (through the modular and comprehensible structuring of content), behavioral engagement (through flexible teaching strategies that respond to environmental stimuli), and emotional engagement (through the creation of a climate of reliability, cooperation, and positive anticipation). In his theory of Simplexity, Berthoz identifies a set of «biological devices, or processes [that] have appeared in

the course of evolution to enable animals and people to survive on our planet [by] processing complex situations very quickly, elegantly and efficiently, taking into account past experience and anticipating the future» (Berthoz 2012). The cognitive physiologist and neuroscientist identify a list of six properties or action patterns that constitute the tools for life and six principles or rules that define the framework of reality (Aiello et al., 2023). These are applied independently or in parallel to create different models of action and interaction to effectively solve complex problems. These cognitive processes work in cooperation with emotion that quickly attributes values to possible solutions based on the memory of past decisions or regret to anticipate the future. In line with complexity thinking, the principle of intersubjectivity is fundamental in his theory as it allows complex adaptive systems to understand and predict not only the consequences of their actions, but also the intentions of others (Berthoz, 2003, 2012).

Within this framework, logic is neither linear (that is, linking a problem to a single, fixed solution) nor reproductive, automatic, which would involve replicating solution technically modeled by others (Sibilio, 2023). Instead, the framework of Simplicity, invites us to reflect on the relational nature of meaning-making, highlighting how the process of understanding is inseparable from the process of explanation, especially when we seek to determine the personal or contextual significance of something.

Focusing on the teaching-learning process, Sibilio (2014) argues that this theory may guide teachers to deal with the complexity of inclusive educational contexts. In his works, Sibilio (2012, 2015, 2017) provides an analogy between the above characteristics of Complex Adaptive Systems and the teaching-learning process, stating that the latter is a dynamic system that constantly interacts with many other elements that are part of a larger system. Such interactions are highly characterized by non-linear behaviors that require constant reorganization that in turn lead to emergent structures that are highly unpredictable (Aiello et al., 2023). Consequently, by tracing the simplex properties and principles within this process, it is hypothesized that if teachers gain awareness of these innate laws and tools that regulate behavior within complex adaptive systems, they will be able to deal with emerging complexity more effectively (Aiello, Sharma, and Sibilio 2016; Sibilio 2015).

Teachers need to develop explicit awareness of these laws and tools, as their use often becomes automatic in complex classroom scenarios. Close to reflexive or learned behaviors (such as breathing, walking, or driving) these practices may operate unconsciously, shaping classroom interactions without deliberate reflection (Aiello et al., 2023). It is scientifically proven that improving, changing or eliminating some of these tendencies may improve our well-being. Focusing on breathing, for example, may reduce tiredness and anxiety (Burtch et al., 2017). Focusing attention on posture can help relieve back pain (Qaseem et al., 2017), while focusing more on driving improves performance and in turn limits road accidents (Allahyari et al., 2008). Supporting this view is the importance given to reflective practice before, during and in action as a core competence and fundamental practice in all professions for transformative action (Schön, 1983), without exception for teachers (EADSNE2012; Shulman2004).

Berthoz's theory has been applied to date in several research fields as a guide to understanding how complex systems organize themselves to thrive in harmony with their environment. Its principles and properties, simplifying themselves complex,

provide a feasible approach to address complexity rather than denying it. This theory may be considered a suitable theory to guide research and practice in different educational systems since it is based on premises that are neither context-specific nor tied to the culture of the time (Berthoz, 2012; Sibilio, 2014; Aiello et al., 2021). Further research is needed to be able to validate its potential to improve teaching action to enable the teacher to act in an engaging and inclusive way.

Engagement: A Multidimensional Construct

Studies in the literature show that the term engagement should be understood as a multidimensional construct, consisting of intrinsically related and interdependent components (Hookham & Nesbitt, 2019; Fredricks et al., 2004). In line with Fredricks et al. (2004), it is framed as a meta-construct within which behavioral, emotional, and cognitive vectors interact (Guthrie & Anderson, 1999; Wigfield & Guthrie, 2000). When considered synergistically, these vectors allow for a holistic and comprehensive description of the school experience (Trowler, 2010). The integration of the paradigm of Simplicity (Berthoz, 2012) provides an effective interpretive framework to understand how engagement emerges from the dynamic interaction of multiple action patterns that educational actors adopt to manage the complexity of the learning context. This paradigm highlights how the behavioral dimension of engagement manifests through flexible and adaptive modules, enabling students to modulate their conduct in relation to environmental stimuli and feedback. In the literature, the behavioral dimension is articulated into three main areas: positive conduct, referring to compliance with rules and the absence of deviant behaviors (Finn, 1993; Finn, Pannozzo & Voelkl, 1995); commitment to instructional activities, including persistence, attention, concentration, and active participation (Birch & Ladd, 1997; Skinner & Belmont, 1993); and participation in school and administrative activities (Finn, 1993; Finn et al., 1995). Interpreted through the lens of Simplicity, these aspects appear as modular and interconnected elements of a complex system that regulates student behavior in a dynamic and context-sensitive way.

The emotional component of engagement concerns students' affective reactions during the school experience, such as interest, happiness, boredom, sadness, and anxiety (Connell & Wellborn, 1991; Skinner & Belmont, 1993). Simplicity emphasizes the role of reciprocal regulation of emotions within the learning system, considering the emergence of affective states as the result of interactions among individuals, environment, and teaching strategies. This perspective makes it possible to move beyond the dichotomy between situational and personal interests, highlighting the importance of co-constructing a sense of belonging and motivation within the educational system (Fredricks et al., 2004). The cognitive dimension focuses on psychological investment in learning, including flexibility in problem-solving, a preference for challenging tasks, and the adoption of self-regulation strategies (Connell & Wellborn, 1991; Corno et al., 1983). From a Simplicity perspective, these cognitive processes are interpreted as dynamic and adaptive patterns that enable students to self-organize and respond flexibly to the complexity of the learning environment, supporting the transfer and generalization of competences. In this scenario, the Simplicity paradigm may take on a

fundamental role as an operational tool for teachers, offering a model that facilitates the dynamic and modular management of educational complexity. Through principles such as modularity, adaptability, and co-regulation, teachers can use Simplicity to foster higher levels of engagement, flexibly calibrating teaching strategies to the needs of students in inclusive and complex contexts (Fredricks et al., 2004).

Increasing Student Engagement through Simplex Didactics

Engagement is a complex and multidimensional concept, and its definition is essential for the development of an appropriate methodological and interpretative framework. From the review of the reference literature, it emerges that the "engagement" should be understood as a multidimensional construct, which includes in its nature various intrinsically correlated components. For this reason, in agreement with Fredricks and colleagues (2004), it is believed that it should be thought of as a "meta-construct" within which behavioral, emotional and cognitive vectors move (Guthrie & Anderson, 1999; Wigfield, & Guthrie, 2000) which, if considered in a synergic way, have the peculiarity of being able to describe the school experience in a holistic and comprehensive way (Trowler, 2010).

The behavioral vector of the construct is commonly considered in three different ways depending on the reference studies: the first associates behavioral engagement with positive conduct carried out by the student in the classroom and more generally within the school environment; the indicators considered concern the ability to follow the main rules of behavior and the consequent absence of incorrect behavior (Finn, 1993; Finn et al., 1995; Finn, & Rock, 1997); the second group of indicators refers to the commitment that the student exerts in carrying out schoolwork (involvement in learning and academic tasks) and includes effort, persistence, concentration, attention and the set of those behaviors that recall the active conduct carried out during a lesson, such as asking questions or contributing to the discussion in class (Birch & Ladd, 1997; Finn et al., 1995; Skinner, & Belmont, 1993); The third group of studies talks about participation in school-related activities, considering the activities related to school management or administration (Finn, 1993; Finn et al., 1995).

The emotional component refers to the set of actual reactions that the student experiences when he or she is at school or in class and includes constructs such as interest, happiness, boredom, sadness and anxiety (Connell & Wellborn, 1991; Skinner & Belmont, 1993). Even within this component, precise distinctions must be made: while some research analyses emotional engagement by focusing on the emotional reactions that students experience towards school and their teachers (Lee & Smith, 1995; Stipek, 2002), others conceptualize it with the sense of belonging, defined as feeling important for the school in which one is enrolled (Finn, 1989; Voelkl, 1997); a second body of research focuses on feelings of appreciation towards school, teachers and activities, contrasting them with perceptions of boredom or disinterest (Epstein & McPartland, 1976; Yamamoto et al., 1969); finally, a further widely investigated dimension, which is usually associated with emotional disengagement, is anxiety. It is considered as an emotional response to any present

or future situation perceived as a direct threat to self-esteem. The main limit of this wide heterogeneity of the emotional dimension of the construct emerges from the comparison between the reference literature on Engagement and that which instead speaks of motivation. According to the National Research Council (2003) the terms *engagement* and *motivation* are often considered synonymous. Research on motivation typically differentiates between situational interests, which relates to specific characteristics of the activity, and personal interests, which refers to a student's deliberate choice to engage in an activity. In contrast, studies on engagement tends not to make this distinction. This represents a key limitation of the emotional dimension of engagement, as it is often difficult to determine the exact source emotional reaction being analyzed. For instance, it may be unclear whether a student's engagement stems from the teaching content itself, the influence of peers or effectiveness of teachers' instructional strategies (Fredricks et al., 2004).

Finally, when examining the cognitive component of the engagement construct, it becomes evident that a significant body of research focuses on the psychological investment that the student uses in the learning processes; for example, it can manifest itself in the desire to go beyond the teacher's requests or in preferring challenging situations. Connell & Wellborn (1991) conceptualize cognitive engagement by including in the macro construct of "psychological investment" flexibility in problem solving, the preference for demanding and challenging tasks and positive coping styles. Overall, literature identifies two main perspectives in defining the cognitive dimension of engagement. The first emphasizes students' psychological investment during the learning processes, whereas the second emphasizes the connection of cognitive engagement with the use of learning strategies. Clearly, neither perspective alone can be exhaustive and, as the reference literature underlines As Fredricks et al. (2004) suggest, it is essential to consider both dimensions in an integrated and holistic manner.

Therefore, the present study is grounded in a well-established theoretical framework that defines engagement as a three-dimensional construct, encompassing behavioral, emotional, and cognitive components. In line with this perspective, it is hypothesized that the principles and properties inherent to the Simplicity paradigm may synergistically act upon these dimensions, promoting both a qualitative and quantitative increase in students' engagement levels within educational contexts.

Building on the literature discussed thus far, this study proposes that the properties and principles of Simplicity could serve as a valuable pedagogical toolbox for teachers aiming to make their instructional practices more inclusive and engaging. In particular, the integration of Berthoz's six properties and six principles with the dimensions of engagement may enhance teaching effectiveness and promote deeper, more meaningful learning. The following hypotheses outline how these elements may interact with the various components of engagement:

<i>Simplex Didactics' properties and principles</i>	<i>Possible adoption to foster several components of engagement</i>
<i>Specialization and modularity</i>	May foster the cognitive dimension of engagement, as they would allow students to process and understand tasks in a more accessible and comprehensible way. This would also make the cognitive process clearer and more structured, stimulating students' interest and helping them stay focused.
<i>Rapidity</i>	May play a key role for managing the behavioral dimension of engagement, keeping students actively involved in the learning process without losing rhythm or motivation.
<i>Reliability</i>	Could enhance the emotional dimension of engagement, as students would feel secure, knowing that their needs are being recognized and met.
<i>Flexibility and the ability to adapt to changes</i>	Flexibility and adaptability in choosing the most appropriate teaching strategy based on stimuli from the environment, may be essential in maintaining high engagement while supporting students' emotions.
<i>Memory</i>	Could help regulate the cognitive dimension of engagement by anticipating students' needs, allowing for a more targeted and effective response.
<i>Generalization</i>	Could support both the behavioral and cognitive dimensions of engagement, as transferring acquired skills and knowledge to different contexts stimulates meaningful learning.
<i>Inhibition and the principle of rejection</i>	May help to avoid routine and stimulate the cognitive and emotional dimensions of engagement, promoting the introduction of new ideas, methods, and tools that engage students more deeply.
<i>Specialization and Selection</i>	Could support emotional, cognitive, and even behavioral engagement, as they would carefully select stimuli and information most suited to students' interests.
<i>Cooperation and Redundancy</i>	could be strengthened through the creation of a cooperative environment that encourages students' participation and emotional engagement.
<i>Probabilistic anticipation</i>	By allowing forward-thinking based on past experiences and contextual data, may sustain cognitive and behavioral engagement, helping students remain oriented and focused on future learning goals.
<i>Deviation</i>	It involves the creative adaptation of the teaching path according to the diverse needs of students, and for this reason, it may support emotional, cognitive, and behavioral engagement.
<i>Sense</i>	Based on the creation of significant goals, which can help strengthen all three dimensions of engagement (behavioral, emotional, and cognitive), leading students to feel motivated and involved in authentic and meaningful learning

Methodology

Objective

The main objective of this study is the adaptation and validation of the Italian version of the Engagement Questionnaire (Abbasi et al., 2024) on a sample of future support learning teachers. This step is crucial to provide a reliable and culturally appropriate tool for measuring engagement in inclusive educational contexts. The validation is part of a broader research agenda that will subsequently investigate the potential of the Simplexity paradigm as a theoretical and operational framework capable of enhancing student engagement levels.

Procedure and Participants

The study involved prospective Learning Support Teachers (LSTs) enrolled in a Specialization Course in Special Education designed to prepare educators to work with students with disabilities at the upper secondary school level. The course was conducted at the University of Salerno, and a total of 733 trainees voluntarily participated in the study by completing the questionnaire in its entirety. The participants, aged between 25 and 61 years, represent an adult learner population engaged in professional teacher training. Among the respondents, 86% reported previous experience as support teachers, whereas only 27.5% indicated prior experience as curricular (subject-specific) teachers.

The questionnaire was administered at both the beginning and the end of a course titled “Special education: cooperative and metacognitive approach”. The course consists of 30 hours of classes, including 15 hours of theoretical content focused on the inclusive potential of cooperative and metacognitive strategies. The remaining 15 hours were dedicated to the metacognitive approach of Simplex didactics, combining theoretical instruction with practical exercises. These sessions emphasized the application of simplex principles and properties in special education, general education, and subject-specific teaching.

Tool

Based on a comprehensive review of both international and national literature (La Manna et al., 2024; Abbasi et al., 2024), the Engagement Questionnaire (Abbasi et al., 2024) was selected, as it represents the most recent and multifactorial instrument aligned with the theoretical framework on engagement utilized in the present study. The authors (Abbasi et al., 2024) employed a rigorous, stepwise methodological approach to develop the questionnaire aimed at assessing student engagement in online English language classes. This process commenced with a thorough literature review addressing perceptual, methodological, and systemic variables (Abbasi et al., 2024). To operationalize the engagement indicators and generate questionnaire items, multiple existing engagement scales were examined, with particular attention to the three-dimensional model of engagement. Some items

were newly constructed, while others were adapted by the researchers to better fit the online learning context.

Abbasi et al. (2024) reported that the questionnaire was easy to administer and collect, demonstrating good adaptability and usability. To assess its reliability and construct validity, Cronbach's alpha and exploratory factor analysis were conducted using SPSS. The final version of the Engagement Questionnaire includes 54 items on a 5-point Likert scale, divided into three sections: behavioral engagement (15 items), emotional engagement (16 items), and cognitive engagement (17 items). In the present study, the questionnaire was initially translated from English into Italian, followed by a detailed item-by-item review and adaptation to ensure suitability for face-to-face classroom settings, aligned with the training course "Special Education: Metacognitive and Cognitive Approach" (Table 2). The questionnaire was then programmed on the Google Forms platform, through which a QR code and link were generated and distributed, enabling participants to access and complete the survey. Responses were recorded using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Data Analysis

A descriptive analysis (Table.1) was initially conducted, showing the mean and standard deviation for each item. There were no missing responses, and all 733 participants answered every item.

An internal consistency assessment was then performed for each factor using Cronbach's alpha, calculated through the Jamovie application. Preliminary analysis revealed a good reliability level of 0.875 (Table.2; Table.3). However, some items (C50, C46, C38, B25, B26, A9, A6, A7) reduced internal consistency, as they were negatively worded statements. Therefore, we applied reverse coding to these items.

We then recalculated Cronbach's alpha, obtaining an excellent reliability value of 0.918 (Table.4; Table.5), confirming that the items consistently measure the same construct and that the questionnaire is highly stable. The reversed items did not reduce reliability, indicating that they were properly formulated and well-integrated. The scale can be effectively used to measure the construct of interest, as it does not present reliability issues. No significant modifications to the questionnaire structure are needed.

Finally, we calculated the reliability for each dimension of the questionnaire: Cronbach's Alpha for the behavioral dimension is 0.805, with a mean of 4.13 and a standard deviation of 0.385; for the emotional dimension, Cronbach's alpha is 0.763, with a mean of 3.94 and a standard deviation of 0.763; for the cognitive dimension, reliability is 0.850, with a mean of 4.05 and a standard deviation of 0.373.

Table 1. Descriptive

	N	Missing	Mean	Median	SD	Minimum	Maximum
A1	733	0	4.85	5	0.391	1	5
A2	733	0	4.63	5	0.562	1	5
A3	733	0	3.70	4	0.937	1	5
A4	733	0	4.29	4	0.740	1	5
A5	733	0	3.76	4	0.835	1	5
A6REV	733	0	3.65	4	0.995	1	5
A7REV	733	0	4.05	4	0.870	1	5
A8	733	0	4.20	4	0.689	1	5
A9REV	733	0	3.93	4	1.148	1	5
A10	733	0	4.35	4	0.599	2	5
A11	733	0	3.98	4	0.846	1	5
A12	733	0	4.51	5	0.656	1	5
A13	733	0	4.47	5	0.590	1	5
A14	733	0	4.29	4	0.715	1	5
A15	733	0	3.66	4	0.884	1	5
A16	733	0	4.17	4	0.726	2	5
A17	733	0	3.67	4	0.773	1	5
B18	733	0	4.69	5	0.482	3	5
B19	733	0	3.72	4	0.880	1	5
B20	733	0	3.50	4	1.103	1	5
B21	733	0	4.55	5	0.600	1	5
B22	733	0	4.14	4	0.876	1	5
B23	733	0	3.39	3	0.861	1	5
B24	733	0	4.33	4	0.639	1	5
B25REV	733	0	4.36	5	0.940	1	5
B26REV	733	0	4.25	4	0.863	1	5
B27	733	0	3.81	4	0.974	1	5
B28	733	0	3.86	4	0.703	2	5
B29	733	0	4.24	4	0.669	2	5
B30	733	0	3.70	4	0.807	1	5
B31	733	0	4.35	4	0.670	1	5
B32	733	0	3.99	4	0.749	1	5
B33	733	0	3.00	3	0.904	1	5
B34	733	0	3.04	3	0.961	1	5
C35	733	0	3.68	4	0.802	1	5
C36	733	0	4.19	4	0.622	2	5
C37	733	0	4.17	4	0.685	1	5
C38REV	733	0	3.78	4	0.948	1	5
C39	733	0	3.84	4	0.712	1	5
C40	733	0	4.18	4	0.668	1	5
C41	733	0	4.31	4	0.628	2	5
C42	733	0	4.21	4	0.623	1	5
C43	733	0	4.40	4	0.607	1	5
C44	733	0	4.14	4	0.509	3	5
C45	733	0	3.95	4	0.711	1	5
C46REV	733	0	4.07	4	0.919	1	5
C47	733	0	3.20	3	0.859	1	5
C48	733	0	3.50	4	0.894	1	5
C49	733	0	3.93	4	0.755	1	5
C50REV	733	0	4.29	4	0.900	1	5
C51	733	0	4.04	4	0.747	1	5
C52	733	0	4.25	4	0.618	2	5
C53	733	0	4.29	4	0.600	1	5
C54	733	0	4.67	5	0.575	1	5

Table 2. Scale Reliability Statistics

scale	Media	SD	α di Cronbach
	3.73	0.280	0.875
Note. Items 'C50', 'C46', 'C38', 'B25', 'B26', 'A9', 'A6', and 'A7' are negatively correlated with the total scale and should probably be reverse-coded.			
Item Reliability Statistics	If the item is discarded		
	α di Cronbach		
A1			0.874
A2			0.873
A3			0.871
A4			0.871
A5			0.869
A8			0.871
A10			0.871
A11			0.871
A12			0.872
A13			0.872
A14			0.872
A15			0.871
A16			0.869
A17			0.870
B18			0.873
B19			0.871
B20			0.872
B21			0.871
B22			0.872
B23			0.871
B24			0.870
B27			0.874
B28			0.872
B29			0.870
B30			0.873
B31			0.872
B32			0.872
B33			0.872
B34			0.870
C35			0.870
C36			0.870
C37			0.870
C39			0.871
C40			0.871
C41			0.871
C42			0.870
C43			0.871
C44			0.871
C45			0.870
C47			0.870
C48			0.874
C49			0.872
C51			0.871
C52			0.871
C53			0.871
C54			0.872
C50			0.879
C46			0.879
C38			0.879
B25			0.878
B26			0.878
A9			0.879
A6			0.881
A7			0.880

Table 3. Scale Reliability Statistics

	Media	SD	α di Cronbach
scale	4.04	0.335	0.918
item reliability statistics			
	If the item is discarded		
	α di Cronbach		
A1			0.917
A2			0.916
A3			0.917
A4			0.916
A5			0.915
A6REV			0.916
A7REV			0.916
A8			0.914
A9REV			0.920
A10			0.915
A11			0.916
A12			0.916
A13			0.916
A14			0.916
A15			0.917
A16			0.915
A17			0.916
B18			0.916
B19			0.916
B20			0.918
B21			0.915
B22			0.917
B23			0.917
B24			0.915
B25REV			0.917
B26REV			0.917
B27			0.917
B28			0.916
B29			0.914
B30			0.917
B31			0.916
B32			0.916
B33			0.919
B34			0.916
C35			0.915
C36			0.915
C37			0.915
C38REV			0.917
C39			0.916
C40			0.916
C41			0.916
C42			0.915
C43			0.915
C44			0.916
C45			0.916
C46REV			0.916
C47			0.916
C48			0.917

C49	0.916
C50REV	0.917
C51	0.916
C52	0.915
C53	0.915
C54	0.916

Table 4. Behavioral Dimension: Scale Reliability Statistics

	Media	SD	α di Cronbach
scale	4.13	0.385	0.805

Table 5. Emotional dimension: Scale Reliability Statistics

	Media	SD	α di Cronbach
scale	3.94	0.374	0.763

Table 6. Cognitive Dimension: Scale Reliability Statistics

	Media	SD	α di Cronbach
scale	4.05	0.373	0.850

Discussion

The results emerging from the quantitative analysis of the *Engagement Questionnaire* (Abbasi et al., 2024), adapted to the Italian context and administered to a sample of 733 prospective special education teachers, suggest good internal validity and excellent overall reliability of the instrument, with a Cronbach's alpha value of 0.918 after reverse coding of negatively worded items. This finding confirms that the questionnaire is capable of consistently measuring the multidimensional construct of engagement, articulated across the three dimensions—behavioral, emotional, and cognitive—as proposed by international literature (Fredricks et al., 2004; Hookham & Nesbitt, 2019). The reliability value for the behavioral dimension ($\alpha = 0.805$) and that for the cognitive dimension ($\alpha = 0.850$) indicate excellent internal consistency, while the emotional dimension, although showing a slightly lower value ($\alpha = 0.763$), still falls within acceptable parameters, considering the subjective and fluctuating nature of emotions within the educational process. These results highlight that the three dimensions were consistently interpreted by the participants and are well-suited for investigation in educational contexts aimed at fostering reflective and inclusive professional development. Moreover, the high mean scores recorded across all dimensions ($M_{\text{behavioral}} = 4.13$; $M_{\text{emotional}} = 3.94$; $M_{\text{cognitive}} = 4.05$) suggest a positive perception of one's own engagement in the training process, particularly in relation to the applied phase of *Simplex didactics*. This finding supports the initial hypothesis that a training approach based on *Simplex didactics* (Berthoz, 2012; Sibilio, 2020) may serve as a valid tool for promoting student engagement and, by extension, fostering more inclusive educational environments. The presence of a

high level of engagement among participants, even in the initial phase of the course, may reflect intrinsic motivation and professional interest in innovative teaching methodologies. However, it is worth considering that the formative effect resulting from the introduction of *Simplex didactics* may have contributed to strengthening this engagement through the activation of reflective and adaptive strategies. From this perspective, the internalization of the principles and properties of *Simplex didactics* appears to enhance the ability of future teachers to address the complexity of the school context in a flexible, dynamic, and responsive manner, in line with a genuinely inclusive pedagogy (EADSNE, 2012; Aiello et al., 2021). This study successfully validated the Italian adaptation of the *Engagement Questionnaire* proposed by Abbasi et al. (2024), confirming its effectiveness in detecting the engagement of future special education teachers participating in a training pathway grounded in *Simplex didactics*. The collected data suggest that this pedagogical approach may act as a significant mediator in enhancing engagement, outlining a favorable framework for the systemic adoption of *Simplex didactics* in both initial and ongoing teacher education. The findings lay the groundwork for further longitudinal studies aimed at exploring the effectiveness of *Simplex didactics* in everyday teaching practices and in fostering inclusive and participatory environments where every student can feel like an integral part of the learning process. In this regard, future research is encouraged to explore not only the relationship between engagement and this pedagogical approach, but also the impact of these variables on the actual improvement of educational outcomes for students, especially those with special educational needs or at risk of exclusion. In conclusion, *Simplex didactics*, understood as a training paradigm based on adaptive simplification and the dynamic integration of knowledge, emerges as a promising pedagogical tool capable of enhancing both teacher and student engagement, thereby substantially contributing to the realization of a fair, inclusive, and actively participatory school environment for all stakeholders.

Conclusion and future directions

Future research should employ a longitudinal design to examine how support teachers operationalize, modify, and sustain Simplex Didactics concepts in actual classroom settings, building on the positive outcomes of the engagement measures during training. Higher trainee involvement suggests that the training program was effective in the short term, but it has not yet been experimentally demonstrated that it will have a lasting impact on inclusive pedagogical practice. Reflective practice, which Schön (1983) emphasizes as the characteristic that sets competent practitioners apart in complex contexts, is intrinsically linked to the development of such sustained professional competence. This perspective is reinforced by Sibilio's Simplex Didactics (2012, 2020, 2023), which characterizes teaching and learning as dynamic, nonlinear, and intersubjective processes. Berthoz's (2012) neurocognitive theory of Simplicity serves as the foundation for Simplex Didactics, which gives teachers cognitive and emotional skills, including inhibition of habitual reactions, probabilistic anticipation, modularity, and flexible adaptation, that support real-time decision-making and effective management of classroom complexity.

In the field of inclusive education, where educational measures must be continuously modified to meet the evolving needs of diverse student groups, this approach holds great promise. Simplex Didactics encourages a professional "adaptive gaze" (Sibilio, 2020) as an alternative to prescribing static procedures. This enables teachers to recognize and address new patterns in the behaviors, needs, and potentials of their students. This perspective is in line with broader trends in educational research that advocate for redefining inclusion as a structural commitment to pedagogical flexibility, reciprocal engagement, and cognitive equity rather than as a set of add-on solutions for particular groups (EADSNE, 2012; OECD, 2018). Crucially, this is connected to the growing recognition of teacher agency as a fundamental component of inclusive education. Priestley, Biesta, and Robinson (2015) state that the ability to make morally sound, well-informed, and adaptable decisions in a socio-professional setting is a component of teacher agency. By establishing agency in relational, embodied practices as well as metacognitive awareness, Simplex Didactics adds to this framework. According to Aiello, Pace, and Sibilio (2023), it encourages a teaching identity that actively works to change the classroom into a participatory, meaning-driven, and inclusive setting in addition to being sensitive to diversity.

Therefore, future longitudinal studies should investigate how support teachers who have received training in Simplex Didactics incorporate its tenets into their regular teaching methods and whether doing so results in quantifiable gains in student inclusion and engagement, especially for students with disabilities or those who are at risk of marginalization. Such studies would contribute to the creation of flexible, equity-focused pedagogies in ever-more complex educational environments and offer solid evidence in favor of the institutionalization of Simplex Didactics within teacher education programs.

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Appendix 1. Engagement Questionnaire (Abbasi et al., 2024)

1- I treat my classmates and teachers with respect either in Skyroom or in the WhatsApp group
2- I comply with the rules in the class by doing all my homework and being punctual
3- I work with great effort to answer the teacher's questions by typing in the chatbox or by clicking the Raising Hand icon
4- When I encounter a hard homework exercise, I continue working on it till I think I've answered it
5- I participate 1 actively in activities such as presenting a lecture and participating in class discussions by asking the teacher to turn on my microphone
6- When I'm in class, my mind wanders
7- I discover that when the teacher is teaching, I think of other things and don't really listen to what is being said
8- When I am in class, I listen carefully
9- I turned in a homework assignment late or not at all
10- I never use my mother tongue in class; I keep speaking English
11- When I do not understand something in class, I request the teacher to clarify it
12 I fully charge my telephone, laptop, and internet to not disconnect during the class to lose the materials
13 When I do a task in class, I try to relate the task to prior knowledge
14 I tutored or taught the class materials to other students in the WhatsApp group after the class
15 When I participate in class discussions or present a lecture, I pause frequently to remember a word, or I laugh
16 I fully attend the class by affirming the teacher by typing "yes" or "that's right" in the chatbox
17 I speak fluently in class
18- I enjoy learning new things in online classes
19 The online class is one of my favorite places to be
20 When I run out of the internet or lose the connection, I worry a lot about it
21- I enjoy learning new things in class
22- When I have a project to do, I worry a lot about it not being disconnected
23- My teacher praises me most of the time when I work hard
24- I am interested in the work, discussions, and exercises in my class
25- When I'm not interested in the class, I excuse myself for a camera or microphone
26- When the teacher wants to teach new things, I complain by typing "no, please"
27- I feel relaxed doing exercises or during a discussion
28- I believe I can do it well during answering the exercise
29- I am all ears when my teacher teaches a new thing
30- My classmates always affirm my correct answers by typing "yes" or "very good"
31- Students in my class are there for me when I need them
32- I believe in myself when I want to present a lecture
33- When I present a lecture, I need my teacher's affirmation by saying "that's right" or nodding her head while her camera is on
34- I Volunteer to present in the class by clicking on the Raising Hand icon
35- Because I work hard, I succeed in class
36- I check my class- work to ensure that I have done it correctly
37- When I study for an exam, I attempt to combine the information from the book and the class

38- Finding the main ideas of a text is difficult for me
39- When my classmates do an exercise or present a lecture, I try to justify their answers or lecture
40- When I study or learn new things, I attempt to put the ideas in my own words
41- I make my own examples to understand the important concepts I learn from the class
42- When I study for a test, I repeat the important points several times
43- When I am studying a topic, I try to connect everything properly
44- When I am studying my coursebook, I try to outline its chapters to learn better
45- I try to give directions to my classmates when they do not know how to do the task
46- When lessons are difficult, I either stop studying or study only the easy parts
47- I work on practice exercises and answer the end-of-chapter questions even when I don't have to
48- Even when lessons are uninteresting, I continue studying till I finish
49- I try to use dictionaries or reference books in doing tasks and exercises
50- I prevent exchanging ideas with my peers or teachers during a discussion
51- I attempt to think carefully about topics and find what I'm expected to learn from them, instead of studying topics by just reading them over
52- When I am studying course materials, I try to join different pieces of information together in innovative ways
53- When I finish working on an exercise, I check my answer to see if it is reasonable
54- English class is important for achieving my future goals

Appendix 2. Adapted items of the Engagement Questionnaire

1- I treat my classmates and the teacher with respect
2- I abide by the classroom rules by doing all my homework and being on time
3- I work hard to answer the teacher's questions
4- When I encounter a hard assignment, I continue to work on it until I think I have answered it
5- I actively participate in activities during class
6- When I am in class, my mind wanders
7- I find that when the teacher is teaching, I think about other things and not really listen to what is being said
8- When I am in class, I listen attentively
9- I have turned in a homework assignment late or not done it at all
10- I use knowledge learned outside of class
11- When I do not understand something in class, I ask the teacher to clarify it
12- I take care of my notes and materials related to the class
13- When I do a homework assignment in class, I try to connect the assignment to prior knowledge
14- I use knowledge learned, teaching them to my students
15- When I participate in class I talk or laugh with other classmates
16- I participate actively by interacting with the teacher
17- I feel I have mastered the topics
18- I like learning new things
19- I feel like I belong in my class

20- When I am distracted from class, I get worried or annoyed
21- I am interested in simple topics
22- When I do group work, I get annoyed if I am distracted
23- My teacher gives me adequate reinforcement when I try hard
24- I am interested in simple exercises
25- I am not interested in the topics covered in class
26- I often complain about new topics
27- I feel relaxed during group work
28- I believe I can do the assigned exercises well
29- I am all ears when my teacher teaches something new
30- My classmates correct me when I make mistakes
31- My classmates give me support
32- I believe in myself when doing exercises
33- I always seek the teacher's approval when completing the assignment
34- I volunteer to raise doubts or questions
35- I succeed in exercises because I work hard
36- I always check my work in class to make sure it is done well
37- When I study, I integrate information from other sources
38- It is difficult for me to identify the main concepts of the topics explained
39- During a class project, I try to give explanations to my classmates about the topic learned
40- When I study a topic, I try to explain it in my own words
41- I use examples to better understand the topics
42- I repeat the important points of the topics explained
43- When I study, I try to make sure that the information I have is correct
44- I try to identify from the beginning which topics of the course are to be studied
45- I try to give directions to my classmates on how to do the assignment
46- When the topic is difficult, I stop studying or I only learn the easier things
47- I practice the topics learned even when it is not required
48- I continue studying even when the topics do not interest me
49- To do the exercises assigned I refer a lot to notes
50- I avoid exchanging ideas with my peers or teachers during a discussion
51- I try to carefully process new topics, rather than simply reading them.
52- When studying the course materials, I try to make new connections with another knowledge already possessed
53- When I finish an exercise, I check whether my answer is reasonable
54- The course is important to improve my teaching practice

