

Article

Professional Readiness for Education for Sustainable Development: Development and Validation of the Teachers' Intention to Implement ESD Scale

Nena Vukelić 

Department of Education, Faculty of Humanities and Social Sciences, University of Rijeka, 51000 Rijeka, Croatia; nvukelic1@ffri.uniri.hr

Abstract

As educators play a pivotal role in advancing sustainable futures, understanding their readiness to translate sustainability-related knowledge and values into teaching practice has become an important concern in teacher education and professional development research. This study aims to develop and validate a measurement instrument assessing student teachers' intention to implement education for sustainable development (ESD). By operationalizing intention as a proximal indicator of future-oriented professional readiness for ESD, the study addresses the need for empirically grounded tools that capture educators' preparedness to engage in sustainability-oriented teaching. The Intention to Implement ESD Scale (IESDS) was developed through a theory-informed item construction process grounded in ESD literature, teacher agency, and competence-oriented approaches to sustainable education. The instrument was validated on a sample of 706 student teachers enrolled in the final years of teacher education programs. The findings indicate that a bifactor model provided the best fit to the data, with a dominant general factor supporting the interpretation of the IESDS as a primarily unidimensional measure of intention to implement ESD. In addition, intention to implement ESD was positively associated with teacher self-efficacy for ESD, providing evidence of convergent validity and reinforcing the role of perceived capability in sustainability-oriented professional action. The IESDS can support teacher education institutions and professional development providers in monitoring and strengthening educators' readiness for sustainability-oriented teaching. It may be used to evaluate the effectiveness of courses, modules, and professional learning interventions aimed at promoting teaching for sustainable futures.

Keywords: education for sustainable development; intention to implement education for sustainable development; scale development; scale validation; teacher education; teacher self-efficacy; teacher professional development; sustainable futures



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1. Introduction

As global sustainability challenges intensify, teachers are increasingly recognized as key professional agents in advancing sustainable futures through their pedagogical choices, curriculum enactment, and capacity to foster learners' sustainability competencies (Fischer et al., 2022). Across educational sectors, this places growing demands on teacher professional development, as educators are expected not only to understand sustainability-related issues but also to translate them into meaningful pedagogical action (UNESCO, 2017). Within this broader framework of professional growth for sustainable futures, Education for Sustainable Development (ESD) has emerged as a central educational approach

aimed at equipping learners with knowledge, competencies, values, and agency needed to address complex environmental, social, and economic challenges (European Commission, 2022, 2025a, 2025b; OECD, 2023a, 2023b; UNESCO, 2017, 2020, 2022). While the integration of sustainability principles into education systems is widely endorsed in policy and strategic documents, its implementation remains highly uneven across national and institutional contexts. In many countries, teachers are encouraged to engage with ESD, yet such engagement is rarely systematically embedded in professional preparation and development pathways (Cantó et al., 2025; Green et al., 2016; Sinakou et al., 2019; Supple et al., 2025). Consequently, successful ESD implementation depends not only on institutional frameworks and curricular requirements but also on teachers' perception of their professional readiness, agency, and willingness to enact sustainability-oriented teaching practices and actions (Koskela & Kärkkäinen, 2021; del Carmen Pegalajar-Palomino et al., 2021; Vukelić, 2022).

Despite the growing emphasis on teacher professional development for sustainability, empirical research has only limitedly examined how educators develop the intention to implement ESD in their future practice (e.g., Batchar & Abad, 2023; Koskela & Kärkkäinen, 2021; Stössel et al., 2021; Vukelić, 2021). This is particularly relevant in the early phases of professional formation, where beliefs, professional agency, and future-oriented teaching intentions are actively shaped (Vidal & Kuckuck, 2025). One key reason for this evidence gap is the absence of standardized, psychometrically sound instruments specifically designed to assess educators' intention and willingness to implement ESD, understood as a proximal indicator of future professional readiness and action.

Addressing this gap, the present study aimed to develop and validate the intention to implement education for sustainable development scale (IESDS), a measurement instrument designed to assess educators' intention to integrate sustainability-oriented content, pedagogical approaches, and competence-oriented learning goals into teaching practice. Empirically, the study focuses on student teachers as a strategically important group situated at the beginning of the teacher professional development continuum. To this end, the study was guided by four research questions:

- (RQ1) How can the characteristics of the intention to implement ESD be operationalized?
- (RQ2) To what extent are the items in the IESDS valid for measuring the characteristics of intention to implement ESD?
- (RQ3) How reliable are the different subscales of the IESDS?
- (RQ4) To what extent is intention to implement ESD associated with teacher self-efficacy for ESD, as evidence of convergent validity of the IESDS?

By developing and validating an instrument to assess intention as a proximal indicator of future ESD-related professional action, this study contributes to the growing literature on teacher professional development for sustainable futures. The instrument provides researchers and teacher education institutions with a tool for examining how professional preparation contexts foster future educators' intention and willingness to engage in sustainability-oriented teaching, which may reflect emerging professional readiness and agency for ESD. To further contextualize the construct of intention to implement ESD, the following section outlines the key theoretical and conceptual foundations of the study.

1.1. Conceptual and Theoretical Framework

1.1.1. Teacher Agency and Action Competence

Teacher professional development for education for sustainable development extends beyond the acquisition of sustainability-related knowledge and pedagogical techniques. Rather, it involves the gradual development of educators' capacity to make informed professional judgements, take pedagogical initiative, and enact change within complex

educational contexts (Rieckmann, 2018). In this sense, professional growth in ESD is closely linked to the development of teacher agency.

Teacher agency is commonly understood as teachers' capacity to make choices and implement actions to enact change within their professional contexts (Cong-Lem, 2021). Importantly, agency is not conceptualized as a fixed individual trait, but as a professionally developed capacity that emerges through the dynamic interaction of prior experiences, contextual opportunities, and future-oriented professional goals (Biesta et al., 2015). From this perspective, agency represents a key dimension of teachers' professional development, particularly in areas such as ESD that require educators to navigate curricular complexity, uncertainty, and value-laden societal issues.

Within the ESD literature, teachers' professional capacity for action has been further conceptualized through the construct of action competence. In contrast to the broader notion of agency, action competence refers more specifically to teachers' ability and willingness to translate sustainability-oriented knowledge, values, and professional judgements into educational action (Bertschy et al., 2013; Brandt et al., 2019, 2021; Schönstein & Budke, 2024). It encompasses interconnected dimensions that reflect teachers' readiness to implement ESD. These include knowledge of key sustainability-related themes and topics, as well as ESD-related pedagogical knowledge, recognition of the values underpinning ESD, and a sense of personal responsibility for its implementation. Combined with teachers' perceptions of their own preparedness and self-efficacy, these dimensions ultimately culminate in a willingness and intention to implement ESD in practice (Vukelić, 2022). While teacher agency captures the broader professional capacity to make choices and initiate change, action competence may be understood as the ESD-specific expression of this agency. This distinction is particularly relevant for research on teacher professional development. The development of ESD-related professional competence does not end with knowledge acquisition; rather, it culminates in educators' readiness to act upon that knowledge in their future teaching practice. Thus, both agency and action competence point toward a future-oriented dimension of professional growth: the capacity to envision and commit to sustainability-oriented pedagogical action.

Within this developmental logic, intention to implement ESD represents a proximal psychological indicator of emerging professional agency and action competence. It captures the extent to which educators are prepared and willing to translate their developing competencies into future teaching practice. This is particularly relevant in the early phases of teacher professional development, where opportunities for actual classroom enactment may still be limited. In such contexts, intention can serve as a meaningful indicator of emerging professional agency for ESD.

1.1.2. Intention to Implement ESD

From a theoretical perspective, intention is commonly defined as an individual's plan or decision to perform a specific behavior (Ajzen, 1991). The relevance of intention is well established across several psychological theories, including the theory of planned behavior (Ajzen, 1991), the theory of reasoned action (Ajzen & Fishbein, 1980), the norm activation model (Schwartz, 1977; Schwartz & Howard, 1981), and the value-belief-norm theory (Stern et al., 1999), etc. In all of these frameworks, behavior is assumed to be directly preceded by the intention to engage in a specific action.

Within professional teaching contexts, teachers' intentions are widely recognized as a central determinant of their subsequent instructional decisions and pedagogical actions (e.g., Gundlach et al., 2024; Nguyen et al., 2022; Rots et al., 2014). Accordingly, educators who report a stronger intention to engage in a particular course of action are more likely to translate this intention into actual professional behavior. In the context of EDS, intention to

implement ESD refers to teachers' self-reported readiness, willingness, and commitment to integrate ESD-related content, ESD-consistent pedagogical approaches, and learning goals into their future teaching practice (Vukelić, 2021). Given the transformative, interdisciplinary, pluralistic nature of ESD (Lotz-Sisitka et al., 2015; Wals, 2011), implementation requires teachers to move beyond mere awareness or positive attitudes toward sustainability and to actively engage in pedagogical action that reflects ESD principles. Importantly, intention to implement ESD should be understood as a multidimensional construct that reflects different aspects of teaching practice. In the present study, this includes: (a) the intention to integrate SD-related content and topics, (b) the intention to implement ESD-oriented teaching approaches and methods, and (c) the intention to focus on promoting competence-oriented ESD learning goals. Together, these dimensions reflect the holistic nature of ESD implementation by integrating what is taught, how it is taught, and for what educational purposes.

1.1.3. Intention to Implement ESD and Teacher Self-Efficacy for ESD

One of the central constructs within the theory of planned behavior is perceived behavioral control, which Ajzen (1991) defines as the expected ease of actually performing the intended behavior. Accordingly, individuals who believe they are capable of carrying out a specific activity or action are more likely to intend to perform it and, ultimately, to enact it. In the teaching context, perceived behavioral control can be conceptually aligned with teacher self-efficacy, that is, teachers' beliefs in their capability to plan, organize, and carry out instructional activities that lead to desired teaching and learning outcomes (Tschannen-Moran & Woolfolk Hoy, 2001). Teachers who perceive themselves as capable of implementing specific educational practices are more likely to express a stronger intention to do so and, ultimately, to enact those practices. Within the ESD context, teacher self-efficacy may also be understood as one of the key components of teacher action competence. In particular, the belief in one's own capacity to influence and contribute to sustainability-related change is considered a central determinant of action competence (Breiting & Mogensen, 1999; Sass et al., 2020). Similarly, motivational beliefs concerning one's professional abilities and role in implementing ESD have been identified as a core element of teacher action competence for ESD (Vukelić, 2022).

Empirical research consistently supports a positive relationship between teacher self-efficacy and various forms of teachers' professional intention, including intention to enter the profession, intention to remain in teaching, and intention to adopt specific instructional practices (e.g., Rots et al., 2014; Watt et al., 2014; Vukelić, 2021). Within the field of ESD, teacher self-efficacy has been identified as a particularly relevant construct (Gan & Gal, 2018; Vukelić, 2021; Vukelić & Rončević, 2019). Accordingly, the present study examines the relationship between the intention to implement ESD and teacher self-efficacy for ESD as evidence of the convergent validity of the newly developed instrument.

1.2. Development of the Intention to Implement ESD Scale (IESDS)

1.2.1. Scale Development

At its core, ESD is a transformative education that aims to develop capacities and competences necessary to address the SD challenges (e.g., Lange, 2018; Lotz-Sisitka et al., 2015; Wals, 2011). In line with competence-based approaches (Adomßent & Hoffmann, 2013; Wiek et al., 2016), a broad range of frameworks has conceptualized key sustainability competences, including OECD's DeSeCo, the Gestaltungskompetenz, and the more recent GreenComp framework (Bianchi et al., 2022; de Haan, 2010; Rychen, 2003). Despite differences among these models, there is a broad consensus that ESD learning goals extend beyond content knowledge to include system thinking, anticipatory or future-oriented

thinking, normative (or values thinking) competency, strategic (thinking) competency, collaboration, critical thinking, self-awareness, and integrated problem-solving (Bianchi, 2020; Rieckmann, 2018). These perspectives highlight the inherently multidimensional and competence-oriented nature of ESD.

Beyond learning goals, ESD is also widely conceptualized as a transformative and emancipatory pedagogical approach that requires a shift from dominant transmission-based models of teaching toward participatory, inquiry-based, and dialogical learning processes (Wals & Corcoran, 2006; Holdsworth & Thomas, 2016; Thoresen, 2017). Within this context, Vare and Scott (2007) distinguish between two complementary paths of ESD: ESD1, focused on informed and skillful behavior in relation to sustainability issues, and ESD2, which emphasizes learners' ability to critically engage with uncertainty, complexity, contradictions, and dilemmas inherent in sustainable development. ESD2 therefore reflects a transformative pedagogical orientation that prioritizes inquiry, dialog, and co-construction of knowledge.

One of the main defining characteristics of ESD is its pluralistic orientation, which underscores the inclusion of multiple perspectives, values, and viewpoints in teaching and learning processes (Andersson, 2017; Lijmbach et al., 2002; Rudberg & Öhman, 2018; Öhman, 2008). Rather than transmitting predetermined solutions, pluralistic ESD encourages learners to engage with diverse interpretations of sustainability and to develop their own informed positions through critical discussion and reflection (Olsson, 2018).

Given that the study focuses on student teachers in initial teacher education who have not yet fully entered professional teaching practice, the focus is on the intention to implement ESD rather than actual classroom behavior. Intention was conceptualized as a proximal indicator of future professional action, reflecting student teachers' readiness and willingness to translate ESD principles into their future teaching practice. Accordingly, an initial pool of items was generated to capture three theoretically grounded domains: (I) Intention to implement SD content, (II) Intention to implement ESD pedagogical approaches, as well as (III) Intention to promote competence-oriented ESD learning goals.

The first dimension, intention to implement SD content, refers to teachers' commitment to integrate sustainability-related themes into their professional practice. This dimension is grounded in conceptualizations of ESD that emphasize its holistic and pluralistic nature (e.g., Lijmbach et al., 2002; Rudberg & Öhman, 2018; Öhman, 2008). Holism underscores the interconnectedness of environmental, social and economic perspectives, as well as the links between past, present, and future, and between local, regional and global perspectives. This approach ensures that SD content is not taught in isolation to a specific dimension but rather as an integrated framework (Olsson, 2018; Öhman, 2008). In other words, introducing SD content and topics should be applied in a holistic way with the emphasis on the mutual connection between all of its dimensions—environment, economy, and society (UNESCO, 2017). However, previous studies indicate that teachers tend to emphasize one dimension of SD over the others, often prioritizing the environmental over the social and economic aspects (e.g., Borg et al., 2014; Uitto & Saloranta, 2017). To capture this challenge, the instrument was designed to assess both the intention to integrate individual SD dimensions and the intention to approach SD content holistically. Consequently, four items were developed to reflect (a) the inclusion of environmental, social, and economic topics, and (b) the intention to address sustainability as an interconnected whole.

The second dimension, intention to implement ESD pedagogical approaches, reflects teachers' intention to employ pedagogical practices consistent with the transformative orientation of ESD. The literature conceptualizes ESD as a learning process characterized by participation, experiential learning, personal engagement, and critical reflection (Rychen, 2003). Transformative sustainability learning frameworks emphasize the integration of

cognitive, affective, and action-oriented dimensions of learning through pedagogical approaches such as problem-based learning, action learning, and participatory approaches (Sipos et al., 2008). Similarly, reviews of ESD pedagogy identify a range of student-centered and action-oriented teaching approaches that support transformative learning, including inquiry-based learning, collaborative learning, real-world problem solving, and community-oriented activities (Burns, 2015; Frisk & Larson, 2011; Lozano et al., 2017). These approaches align with the ESD2 perspective (Vare & Scott, 2007), which emphasizes learner agency, critical engagement, and the co-construction of knowledge. Based on this body of literature, seven items were generated to assess intention to implement ESD pedagogical approaches that are participatory, student-centered, and oriented towards action and reflection.

The third dimension, intention to promote ESD learning goals, refers to teachers' intention to foster learning outcomes associated with the development of the key sustainability competencies. ESD learning goals are widely conceptualized as competence-oriented and extend beyond knowledge acquisition to include systems thinking, critical thinking, anticipatory competence, normative competence, collaboration, and responsible action (de Haan, 2010; Glasser & Hirsh, 2016; Wiek et al., 2016). Drawing on these conceptualizations, items were developed to reflect teachers' intention to promote learning goals related to (a) understanding complex human–environment relationships, (b) critical and creative thinking about sustainability challenges, (c) ethical responsibility, solidarity, and empathy, (d) active participation in addressing sustainability issues, and (e) future-oriented thinking and responsibility towards future generations. In total, twelve items were constructed to capture these competence-oriented learning goals.

1.2.2. Scale Pretesting via Expert Validation and Cognitive Interviewing

To ensure content validity and conceptual clarity, the initial item pool was reviewed by three experts in the field of ESD, teacher education and scale development. Based on their feedback, items were refined in terms of wording, relevance, and alignment with the intended constructs. The revised version of the instrument was subsequently pretested using a cognitive interviewing procedure to examine item clarity and response processes (Beatty & Willis, 2007; Willis, 2015). A total of seven student teachers enrolled at the Faculty of Humanities and Social Sciences, University of Rijeka, participated in the cognitive interviews. Data saturation was used as a guiding criterion for determining the number of interviews. After the fourth cognitive interview, no substantively new insights regarding item interpretation or response processes emerged. Nevertheless, three additional interviews were conducted to confirm saturation and ensure the robustness of the findings. All interviews followed a standardized procedure. Prior to the main task, the researcher introduced and modeled the think-aloud technique using items from an unrelated questionnaire. Participants then completed a brief practice think-aloud task to familiarize themselves with the procedure. Subsequently, participants were presented with the Intention to Implement ESD scale. They were asked to read each item aloud, paraphrase it in their own words, explain its meaning, and verbalize their thought processes while formulating their responses. Verbal probing was used when participants hesitated, expressed uncertainty, or provided unclear responses, allowing for a more in-depth examination of item interpretation and response formulation.

The results of the cognitive interviews informed several revisions aimed at improving the clarity and usability of the scale. First, a brief general definition of sustainable development was added at the beginning of the questionnaire, in response to participants' feedback. Second, the order of the subscales was revised: the Intention to implement SD content subscale, which includes examples of sustainability-related thematic areas (Table 2), was placed first. Participants reported that engaging with these items enhanced their

understanding of SD and increased their confidence in responding to subsequent items. This reordering was therefore intended to support more informed and consistent responses across the scale. Third, the instructions and response formats were refined. The instructions were revised to more explicitly prompt participants to consider their future teaching practice when responding. While the original 7-point Likert scale (1—I completely disagree, 7—I completely agree) was retained for the Intention to implement SD content subscale, it was deemed less suitable for the remaining two subscales. Consequently, the response format for the Intention to implement ESD pedagogical approaches and the Intention to promote ESD learning goals subscales was modified to assess planned frequency and degree of focus. These subscales now use a 7-point scale ranging from 1—*never* to 7—*always*, which better aligns with the behavioral and practice-oriented nature of the items.

2. Materials and Methods

2.1. Participants

The target population of this study consisted of student teachers enrolled in the final two years of initial subject teacher education programs in Croatia. Upon graduation, participants obtain a Master of Education degree in a specific subject (e.g., Master of Physics Education, Master of Art Education) and are qualified to teach in secondary schools as well as in the upper levels of elementary education. In Croatia, initial subject teacher education follows a standardized framework across all universities, ensuring comparability of study programs and learning outcomes. This framework integrates subject-specific knowledge, pedagogical knowledge, subject-specific teaching methods and school-based teaching practice. The study aimed to include the entire accessible population of student teachers enrolled in the final two years of subject teacher education programs in Croatia. Data were collected from all student teachers who were present during regularly scheduled classes at the time of data collection at their respective institutions and agreed to participate in the study. The final sample represented approximately 50% of the target population of final-year student teachers in Croatia and included students from social sciences, humanities, natural sciences, and arts education programs. A total of 706 student teachers (535 female) from all Croatian universities offering subject teacher education programs participated in the validation study. The mean age of participants was 23.54 years (SD = 2.40).

2.2. Instruments

Intention to implement ESD Scale (IESDS) was constructed based on the two previously described phases. The scale consists of 23 items divided into three subscales: (I) Intention to implement SD content subscale (4 items), (II) Intention to implement ESD pedagogical approaches (7 items) and (III) Intention to promote ESD learning goals (12 items). Participants are requested to envision their future role as a subject teacher in order to answer the questions from that perspective. All questionnaire items were assessed on a seven-point scale ranging from 1—I completely disagree/never to 7—I completely agree/always.

The *teacher self-efficacy for ESD scale* was used to assess participants' perceived teacher self-efficacy for ESD. The scale was developed based on items originally proposed by Effeney and Davis (2013), which were subsequently translated and culturally adapted into Croatian (Vukelić, 2021; Vukelić & Rončević, 2019). It consists of 7 items, with respondents indicating their level of agreement on a 5-point Likert scale (1—I completely disagree; 5—I completely agree). The scale reflects a unidimensional structure, and previous studies (Vukelić, 2021; Vukelić & Rončević, 2019) have reported acceptable internal consistency, with Cronbach's alpha values ranging from 0.66 to 0.88.

2.3. Procedure

Prior to starting the study, ethical approval has been obtained from the Ethics Committee for Scientific Research at the Faculty of Humanities and Social Sciences, University of Rijeka. Furthermore, the study was conducted according to the guidelines of the Ethics Committee at the Faculty of Humanities and Social Sciences and ethical principle of conducting research at the University of Rijeka. Informed consent was obtained from all participants involved in the study. The research was conducted by using a combination of printed and online questionnaires, which were completed during regular teacher education classes. The mode of administration depended on the preferences and organizational possibilities of course instructors at participating institutions. Both formats contained identical questionnaire items and followed the same administration procedure.

2.4. Data Analysis

The data were analyzed using Mplus 8.7. The IESDS was developed based on the assumption that its items reflect three distinct aspects of the implementation of ESD: (I) the implementation of SD content, (II) the implementation of ESD pedagogical approaches, and (III) orientation towards achieving ESD learning goals. Accordingly, a three-factor structure of the instrument was initially hypothesized. Given that all items were designed to capture different facets of the same overarching construct, the intention to implement ESD, and that the subscales demonstrated high intercorrelations, the existence of a general underlying factor was considered theoretically plausible. Therefore, two models were tested using confirmatory factor analysis (CFA): (I) a correlated three-factor model, and (II) a bifactor model comprising one general factor with three specific factors. In both models, the three first-order (or specific) factors were: (I) intention to implement SD content, (II) intention to implement ESD pedagogical approaches and (III) intention to promote ESD learning goals. These factors represent conceptually distinct yet related dimensions of the intention to implement ESD.

Both CFAs used the robust maximum likelihood estimator (MLR). To assess model fit, the following goodness-of-fit indices were used: Chi-square test, the ratio of Chi-square to degrees of freedom, RMSEA, SRMR, CFI and TLI. In this study, values of CFI and TLI that are equal to or greater than 0.9 were considered indicators of satisfactory model fit, whereas those greater than 0.95 indicate excellent model fit (Byrne, 2016; Hooper et al., 2008). Desirable values of the ratio between the value of the Chi-square and the degrees of freedom should be below 2 (Byrne, 2016), with some authors arguing that the acceptable ratio is below 5 (Hooper et al., 2008). RMSEA and SRMR values equal to or less than 0.8 were considered indicators of good model fit (Hu & Bentler, 1999). Moreover, the comparative measures of AIC, BIC and ABIC were used. When comparing tested models, the model with the lowest value for these indices has the best fit (Wang & Wang, 2020).

After testing the factor structure, the internal consistency was examined using two coefficients: Cronbach's alpha and McDonald's omega. Moreover, descriptive indicators for individual items and subscales and their intercorrelations and correlations with the results of the teacher self-efficacy for ESD scale were calculated.

3. Results

CFA was used to assess the factorial structure of the IESDS. Fit indices of the 2 tested models for the IESDS are shown in Table 1. The correlated 3-factor model did not achieve an acceptable level of fit to the data since TLI is below the cut-off of 0.90 and RMSEA is above 0.08, although SRMR was below 0.08 and CFI was above the cut-off of 0.90.

Table 1. Model fit indices for the tested models.

Model (N = 706)	χ^2 (df)	SRMR	RMSEA	CFI	TLI	AIC	BIC	ABIC
First order CFA	1318.687 (224)	0.043	0.083	0.900	0.887	41,501.81	41,843.78	41,605.64
Bifactor CFA	1050.222 (204)	0.035	0.077	0.923	0.904	41,026.3	41,459.47	41,157.82

On the other hand, the bifactor model fits the data very well. Values of all model fit indices are within the recommended range, apart from the ratio of Chi-square to degrees of freedom, whose value is slightly above the recommended range. The information criteria statistics of the bifactor model are lower than those of a first-order CFA, indicating a better model fit of the bifactor model. Thus, factor loading using the bifactor model was examined.

In order to present the results more clearly, the following individual tables (Tables 2–4) show standardized factor loadings on every specific factor (IESDS subscale factor) and on a general factor, as well as descriptive statistics for all items. Apart from that, Cronbach's alpha coefficients of internal consistency, which range for individual subscales of the instrument between $\alpha = 0.862$ – 0.965 , will be listed.

Table 2. Intention to implement SD content subscale standardized factor loadings on a specific factor and general factor, coefficient of reliability, and descriptive statistics (N = 706).

Item		Factor Loadings		Descriptive Indicators	
In My Future Teaching, I . . .		Specific Factor	General Factor	M	SD
NC1	. . . intend to include content and topics from environmental dimension of SD (e.g., climate change, preserving biodiversity, preserving ecological capital, looking after endangered species and ecosystems, etc.).	0.489	0.577	5.17	1.602
NC2	. . . intend to include content and topics from social dimension of SD (e.g., human rights, preserving cultural diversity and heritage, organizing society).	0.445	0.580	5.85	1.322
NC3	. . . intend to include content and topic from economic dimension of SD (e.g., poverty, circular economy, fair distribution of goods, fair trade).	0.607	0.538	5.29	1.42
NC4	. . . intend to emphasize mutual connection between all SD dimensions—environment, economy, and society.	0.586	0.614	5.32	1.376
M (SD)		21.63 (4.82)			
Cronbach's α		0.862			

Note: factor loadings of all items on specific and general factors are statistically significant at $p < 0.001$ level; M—mean; SD—standard deviation.

Table 3. Intention to implement ESD pedagogical approaches subscale standardized factor loadings on a specific factor and general factor, coefficient of reliability and descriptive indicators (N = 706).

Item		Factor Loadings		Descriptive Indicators	
In My Future Teaching, I . . .		Specific Factor	General Factor	M	SD
NM1	. . . intend to encourage students to become active participants during learning and teaching processes related to SD.	0.384	0.713	4.91	1.369
NM2	. . . intend to use methods in which the student becomes an active participant while teaching about SD (debates, stage shows, cooperative learning, games)	0.498	0.664	5.18	1.432
NM3	. . . intend to use methods that encourage practical work in learning while teaching about SD (experiments, devising models, devices, brochures, fliers, etc.)	0.611	0.561	4.91	1.452
NM4	intend to use problem-based learning based on situations from students' daily life, hypothetical examples or real-life situations while teaching about SD.	0.403	0.739	5.21	1.320

Table 3. Cont.

Item		Factor Loadings		Descriptive Indicators	
In My Future Teaching, I...		Specific Factor	General Factor	M	SD
NM5	... intend to encourage students to reflect on their own knowledge and learning processes regarding SD in order to learn how to monitor and control them.	0.365	0.754	5.08	1.362
NM6	... intend to use field work in teaching about SD.	0.468	0.601	4.46	1.576
NM7	... intend to create opportunities for students to gain competencies, skills, and knowledge about SD through projects in local community.	0.460	0.655	4.69	1.525
M (SD)		34.43 (8.415)			
Cronbach's α		0.929			

Note: factor loadings of all items on specific and general factors are statistically significant at $p < 0.001$ level; M—mean; SD—standard deviation.

Table 4. Intention to promote ESD learning goals subscale standardized factor loadings on a specific factor and general factor, coefficient of reliability and descriptive indicators (N = 706).

Item		Factor Loadings		Descriptive Indicators	
In My Future Teaching, I...		Specific Factor	General Factor	M	SD
NC1	... intend to encourage students to question mainstream opinions and status quo from SD perspective.	−0.116 **	0.837	4.82	1.357
NC2	... intend to challenge students' beliefs regarding their natural and social environment.	−0.054	0.891	5.17	1.307
NC3	... intend to guide students to identify and critically evaluate social and environmental states and problems.	−0.049	0.893	5.35	1.285
NC4	... intend to encourage students to reflect on their behavior and experiences connected with SD.	−0.045	0.893	5.20	1.338
NC5	... intend to encourage students to think about consequences of human actions on nature and social environment.	0.227 *	0.859	5.53	1.283
NC6	... intend to encourage students to think about consequences of their behavior on natural and social environment.	0.359 **	0.834	5.63	1.250
NC7	... intend to encourage students to develop the feeling of responsibility towards environment, living world and future generations.	0.484 **	0.793	5.72	1.224
NC8	... intend to develop students' motivation to act for the benefit of environment and all living world.	0.473 **	0.801	5.56	1.242
NC9	... intend to encourage students' active participation in decision-making processes at both school and class levels.	0.218 **	0.651	5.32	1.294
NC10	... intend to show, by my positive example, how active participation in school and local community can contribute towards a sustainable future.	0.177 *	0.742	5.37	1.241
NC11	... intend to discuss with students about their role in creating sustainable future.	0.135 *	0.850	5.21	1.259
NC12	... intend to encourage students to envision our future as well as what we can do in order to create sustainable future together.	0.155 *	0.799	5.29	1.322
M (SD)		64.15 (13.09)			
Cronbach's α		0.965			

Note: factor loadings of all items on a general factor are statistically significant at $p < 0.001$ level; M—mean; SD—standard deviation; * $p < 0.05$; ** $p < 0.01$.

Factor loadings on the general factor (the intention to implement ESD) are stronger than those on the grouping factors: all factor loadings are greater than 0.50. In contrast, only three factor loadings on the specific factors are greater than 0.50, and only two items (NC3 and NM3) have a larger loading on a specific factor than on a general factor. Furthermore, all items' factor loadings on a general factor are statistically significant at the $p < 0.001$ level. On the other hand, factor loadings of 3 out of 12 items on the third specific factor are not statistically significant.

Apart from that, the following coefficients were calculated and presented: McDonald Omega coefficient (ω), omega hierarchical coefficient (ω_h), omega hierarchical subscale coefficient (ω_s), as well as explained common variance index (ECV) (Reise et al., 2013).

Table 5 shows the omega hierarchical coefficient (ω_h), omega hierarchical subscale coefficient (ω_s) for three domain-specific factors, as well as explained common variance indexes (ECV).

Table 5. Coefficients of the bifactor model of confirmatory factor analysis for IESDS.

Omega hierarchical subscale coefficient (ω_s)	
Intention to implement the SD content subscale	0.016 **
Intention to implement ESD pedagogical approaches	0.031 **
Intention to promote ESD learning goals subscale	0.018 **
Omega hierarchical coefficient (ω_h) for the general factor	
General factor	0.911 **
Common variance index (ECV)	
General factor	0.934 **

Note: ** $p < 0.01$.

McDonald Omega coefficient (ω) for the bifactor model is 0.977. The omega hierarchical coefficient ($\omega_h = 0.911$) is above the recommended level of 0.80 (Reise et al., 2010). The omega hierarchical subscale coefficients (ω_s) for domain-specific factors are statistically significant ($p < 0.01$) but rather small: 0.016 for the Intention to implement SD content subscale, 0.031 for the Intention to implement ESD pedagogical approaches subscale, and 0.018 for the Intention to promote ESD learning goals subscale. The results show very little variance explained by the specific factors beyond the general factor. Furthermore, the explained common variance index is high (ECV = 0.934), indicating that 93.4% of the common variance is explained by the general factor. Although the factorial structure of the IESDS is multidimensional in content, these findings suggest a strong single common factor (intention to implement ESD) in the IESDS.

Furthermore, Pearson's correlation coefficients between three specific factors were calculated (Table 6). Results indicate that there is a statistically significant positive correlation between all factors. Moreover, all correlation coefficients are moderate to high and positive, which means that a higher level of one type of intention (e.g., to implement SD content) relates to every other type of teaching intention to implement ESD.

Table 6. Coefficients of correlation for all IESDS subscales and teacher self-efficacy for ESD.

	1.	2.	3.	4.
1. Intention to implement SD content	1	0.55 **	0.64 **	0.55 **
2. Intention to implement ESD teaching approaches and methods		1	0.67 **	0.57 **
3. Intention to focus on achieving ESD learning goals			1	0.55 **
4. Teacher self-efficacy for ESD				1

Note: ** $p < 0.01$.

The convergent validity of the IESDS was tested by calculating its correlation with the total score on the teacher self-efficacy for ESD scale. The correlation between the total score on the IESDS and the total score on the teacher self-efficacy for ESD scale was significant and positive ($r = 0.64$, $p < 0.001$). Also, the correlations between the IESDS subscales and teacher self-efficacy were significant and moderate to high: 0.55 for the intention to implement SD content, 0.57 for the intention to implement ESD pedagogical approaches, and 0.55 for the intention to promote ESD learning goals. The obtained correlations support the convergent validity of the IESDS and are consistent with previous research findings on

the relationship between teachers' intention and teacher self-efficacy (e.g., [Rots et al., 2014](#); [Watt et al., 2014](#); [Vukelić, 2021](#)).

4. Discussion

The aim of this study was to develop and validate a measurement instrument assessing educators' intention to implement ESD, the intention to implement ESD scale. Beyond its psychometric purpose, this study responds to the broader need within teacher education and professional development research for robust tools that can capture educators' intention to translate sustainability-oriented knowledge, values, and competencies into professional action.

The first research question concerned the operationalization of the characteristics of intention to implement ESD. This was addressed through the development of a theoretically grounded measurement instrument comprising three conceptually distinct yet closely related dimensions of ESD implementation: (a) the intention to include SD content and topics, (b) the intention to employ ESD-consistent pedagogical approaches, and (c) the intention to promote competence-oriented ESD learning goals. Through expert validation, cognitive interviewing, and subsequent empirical testing, the study provided evidence for both the content validity and response validity of the instrument.

The second research question addressed the construct validity of the IESDS. The results of the confirmatory bifactor analysis indicated a good model fit, with all items loading more strongly on the general factor than on their respective domain-specific factors. Furthermore, reliability indices, including the omega hierarchical coefficient and explained common variance (ECV), suggested that the scale is best interpreted as representing a predominantly unidimensional construct. More specifically, the findings indicate that the three theoretically derived dimensions converge on a dominant latent construct reflecting a general readiness and willingness to implement ESD in future teaching practice. This supports the use of the total score as a reliable and interpretable indicator of intention to implement ESD, while still preserving conceptual breadth through theoretically informed item content. Although item loadings were generally higher on the general factor than on the specific factors, most items also demonstrated statistically significant loadings on their respective domain-specific factors. This pattern suggests that the construct is predominantly explained by a common underlying dimension of intention to implement ESD. At the same time, the theoretically derived subdimensions appear to contribute relatively limited unique variance beyond the general factor, indicating that subscale scores should be interpreted with caution and primarily as complementary to the total score.

The third research question concerned the reliability of the IESDS. The findings demonstrated excellent internal consistency, indicating that the instrument provides a stable and coherent assessment of the construct. Lastly, the fourth research question examined the relationship between intention to implement ESD and teacher self-efficacy for ESD as evidence of convergent validity. As expected, a positive correlation was found between the two constructs, indicating that student teachers who perceive themselves as more capable of implementing ESD also report a stronger intention to do so. This finding aligns with established theoretical frameworks, particularly the theory of planned behavior ([Ajzen, 1991](#)), as well as broader research on teacher professional agency and action competence, suggesting that perceived capability is closely linked to educators' readiness for professional action.

Importantly, these findings have implications that extend beyond instrument validation. Within the context of teacher professional development for sustainable futures, intention may be understood as a proximal indicator of emerging teacher agency and ESD-related action competence. In this sense, the IESDS offers a valuable tool for examining how teacher education programs and professional learning opportunities support edu-

cators' development as sustainability-oriented professionals. Rather than focusing solely on knowledge acquisition, the scale captures a self-reported intention and willingness to engage in future sustainability-oriented teaching practice, which is central to transformative professional growth in ESD.

Beyond its use in scientific research, the IESDS also holds considerable practical value as an evaluative tool in teacher education and continuing professional development contexts. Following further validation, the instrument may be used to assess the effectiveness of study programs, university courses, professional learning modules, workshops, and other educational interventions designed to strengthen educators' capacity for sustainability-oriented teaching. In particular, the IESDS may serve as both a baseline and a post-intervention measure, enabling the evaluation of changes in educators' readiness to implement ESD as a key outcome of professional learning for sustainable futures.

Several limitations should be acknowledged. First, although the subscale addressing sustainability-related content is theoretically grounded in the three commonly distinguished dimensions of sustainable development, social, economic, and environmental (UNESCO, 2020), as well as their holistic interconnections (Lijmbach et al., 2002; Rudsberg & Öhman, 2018; Öhman, 2008), the items necessarily capture these dimensions at a relatively general level. More fine-grained instruments would be required to assess intentions related to specific sustainability topics or subject-specific ESD content.

Second, it should be noted that approximately 78% of participants in this study were female, which is consistent with the gender ratio observed in the teaching population in Croatia, i.e., 79% of teachers are women, according to OECD (2025) data. Given that female participants substantially outnumbered male participants, it was not possible to test for measurement invariance. When the sample size of one group is at least twice as large as the other, the results of factorial invariance testing may be compromised (Yoon & Lai, 2018).

Finally, the instrument was validated using a sample of student teachers, who are able to express professional intentions but cannot yet fully demonstrate sustained teaching practice. Due to that, the sample is both age- and experience-restricted. Intention should therefore be understood as a proximal antecedent of future action rather than a direct measure of behavior itself. While intention is a well-established predictor of future action, further research is needed to examine the extent to which IESDS scores are associated with observed or self-reported implementation of ESD in teaching practice. Applying the instrument to in-service teachers, particularly those engaged in professional development in the ESD field, represents an important direction for future research.

5. Conclusions

This paper presented the development and validation of the Intention to Implement Education for Sustainable Development Scale (IESDS). The findings provide initial evidence supporting the psychometric adequacy of the newly developed instrument and suggest that it can be interpreted as a primarily unidimensional measure for practical application and research use. As such, the IESDS represents a promising, theoretically grounded tool for assessing educators' readiness and intention to implement ESD as a proximal indicator of future professional readiness for sustainability-oriented teaching. The primary contribution of this study lies in providing an initial step toward addressing an important methodological and conceptual gap in the field of ESD, particularly within higher education and teacher professional development. Although intention to implement ESD represents a key prerequisite for transformative educational practice and educators' professional growth toward sustainable futures, a holistic and empirically validated instrument capturing this construct has so far been lacking. The IESDS was developed as an attempt to respond to this need by integrating the core dimensions of ESD, content, pedagogy, and learning goals

into a coherent measurement framework. From the perspective of higher education for sustainability, the instrument is particularly relevant for research and evaluation in teacher education as well as other sustainability-oriented professional learning contexts. It enables the assessment of whether education initiatives aimed at fostering sustainability-related competencies, teacher agency, and action competence effectively strengthen educators' intention and willingness to translate these capacities into future professional practice. In this sense, the IESDS may support the evaluation of the transformative potential of curricula, courses, and professional development interventions designed to advance sustainable transitions in education. Furthermore, the theoretical grounding of the IESDS in internationally recognized ESD frameworks ensures its conceptual alignment with the Sustainable Development Goals and with UNESCO's multidimensional understanding of sustainable development. By focusing on intention as a proximal antecedent of professional action, the instrument provides an important conceptual bridge between sustainability-oriented learning and the prospective implementation of ESD in educational practice.

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Abbreviations

The following abbreviations are used in this manuscript:

ABIC	Adjusted Bayesian information criterion
AIC	Akaike's Information Criterion
BIC	Bayesian Information Criterion
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
ECV	Explained Common Variance Index
ESD	Education for Sustainable Development
IESDS	Intention to Implement ESD Scale
MLR	Robust Maximum Likelihood Estimator
OECD	Organization for Economic Co-Operation and Development
RMSEA	Root Mean Square Error of Approximation
SD	Sustainable Development
SRMR	Standardized Root Mean Square Residual
UNESCO	United Nations Educational, Scientific and Cultural Organization
TLI	Tucker–Lewis Index

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