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The Interaction Between Teacher Self-Efficacy and Ascription of Responsibility and Its Influence on Teachers' Intention to Implement ESD: A Polynomial Regression With Response Surface Analysis

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Annotation. This study examines predictors of teachers' intention to implement education for sustainable development (ESD), emphasizing the role of teacher self-efficacy and ascription of personal responsibility for ESD implementation. Based on a sample of 698 student teachers, the results from polynomial regression and response surface analysis indicate that congruence between teacher self-efficacy and ascription of responsibility is associated with increased intention to implement ESD.

Keywords: *ascription of responsibility, intention to implement education for sustainable development, Norm Activation Model, polynomial regression, response surface analysis, teacher self-efficacy.*

Introduction

As society seeks to find a way to successfully address the most pressing societal, environmental, and economic challenges today, education is recognized as a key driver

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of the desired changes, that is, a framework within which it is possible to achieve the empowerment and training of individuals to face today's challenges in an efficient, collaborative, and systematic way. Furthermore, education for sustainable development (ESD) emerged as UNESCO's response to the urgent challenges the planet faces. In ESD, the focus is on developing sustainability competencies among all stakeholders in the educational process so that they can successfully meet these challenges and work towards building a sustainable future (UNESCO, 2017). In scientific and professional literature, the idea that teachers should be able to navigate the ever-changing nature of the world and to empower learners to address global socio-environmental challenges is increasingly present (Fischer et al., 2022).

In most countries worldwide, despite being an internationally promoted goal (European Commission, 2025a; 2025b; OECD, 2023a; 2023b; UNESCO, 2017; 2020; 2022), the implementation of ESD remains non-mandatory and largely reliant on the voluntary efforts of dedicated individuals (Green et al., 2016). However, increasing pressure is being placed on (future) teachers to serve as key actors in fostering a sustainable future, making it only a matter of time before ESD becomes an integral aspect of their professional responsibilities. Moreover, the successful implementation of ESD requires committed (future) teachers who act as agents of change and facilitate the transition toward sustainable development (SD) (Koskela & Käekkäinen, 2021; del Carmen Pegalajar-Palomino et al., 2021). Therefore, it is essential to explore the factors that influence (future) teachers' intention to implement ESD. However, research on this topic remains limited, with few studies examining teachers' intention to implement ESD or identifying the determinants of this intention (e.g., Koskela & Käekkäinen, 2021; Stössel et al., 2021; Vukelić, 2021).

Intention to Implement ESD

In a professional teaching environment, teachers' intention has been identified as the key predictor of teachers' consequential actions and choices (e.g., Gundlach et al., 2024; Nguyen et al., 2022; Rots et al., 2010; 2014). In other words, teachers who show intent to act in a certain way are more likely to exhibit that behavior. In the ESD context, it can be assumed that teachers' intention to implement ESD represents a key predictor of teachers' behavior regarding ESD implementation in the future.

In this study, the norm activation model (NAM, Schwartz, 1977; Schwartz & Howard, 1981) was used as a framework for studying teachers' intention to implement ESD. The key assumption of the NAM is that an individual is willing to engage in a particular behavior only subsequent to the activation of their personal norm, i.e., after they have taken responsibility regarding their behavior (ascription of responsibility) and after they have assessed their ability to behave in a certain way. The latter is defined in educational research as the (teacher) self-efficacy construct (Tschannen-Moran & Woolfolk Hoy, 2001).

Therefore, according to the NAM, one can assume that self-efficacy beliefs as well as ascription of personal responsibility both influence teachers' intentions. However, there is a limited number of studies that examine the interaction between these two predictor variables in shaping teachers' intention, especially in the ESD research field (e.g., Vukelić, 2021). Therefore, this study aimed to investigate the interaction effect of teacher self-efficacy and ascription of responsibility on teachers' intention to implement ESD.

This can be tested in two ways: (I) through moderation analysis or (II) by examining the interaction effect of predictors on the outcome variable. Moderation assesses whether a variable influences the strength or direction of the relationship between a predictor and an outcome variable (Aiken & West, 1991), determining the conditions under which this statistical relationship holds (Wu & Zumbo, 2008). Interaction, on the other hand, represents a condition in which joint effects of two interacting predictors (here, teacher self-efficacy and ascription of responsibility) act on an outcome variable (Wu & Zumbo, 2008), in this case teachers' intention to implement ESD. Therefore, in this study the latter approach will be used. First, both potential predictors of intention to implement ESD – teacher self-efficacy and ascription of personal responsibility – will be introduced.

Teacher Self-Efficacy

One of the key predictors of a teacher's intention to take certain action in the education framework is teacher self-efficacy. Self-efficacy is defined as a belief in one's own ability to successfully perform various tasks or behaviors (Bandura, 1997), whereas this construct, applied in both educational theories and research and referring to (student) teachers, is called teacher self-efficacy. Teacher self-efficacy construct refers to teacher's belief into their own ability to plan and achieve teaching goals (Tschannen-Moran & Woolfolk Hoy, 2001), i.e., it represents teacher's belief into their own ability to organize and conduct activities needed to achieve desired educational goals (Skaalvik & Skaalvik, 2007). Teacher self-efficacy influences teachers' set goals, the effort they put in order to achieve them, as well as the level of determination needed to cope with challenges in professional work (Woolfolk et al., 2009).

Numerous studies have confirmed the important role of teacher self-efficacy in shaping teaching practice (e.g., Rubie-Davies et al., 2012; Ryan et al., 2015; Tschannen-Moran & McMaster, 2009). For example, Huitt (2003) emphasizes that teacher self-efficacy represents the most important predictor of teacher's behavior in class as well as students' achievements. In this regard, teachers with higher levels of self-efficacy more often use new ideas, approaches, and teaching strategies while respecting students' autonomy, setting realistic goals and showing more determination while facing students' academic failure (Ross & Bruce, 2007). Furthermore, teacher self-efficacy has a highly positive correlation with student's achievements, motivation as well as

students' academic self-efficacy (Caprara et al., 2006; Tschannen-Moran & Barr, 2004; Tschannen-Moran et al., 1998).

Studying the construct of teacher self-efficacy is particularly relevant in the context of student teachers in ESD for several reasons. First, research indicates that teachers with higher self-efficacy in teaching a specific subject or content area are more likely to dedicate increased time and effort into teaching it. Conversely, when self-efficacy for implementing a particular subject or educational approach is low, teachers are more inclined to avoid its implementation (Graham et al., 2001; Riggs & Enochs, 1990). Therefore, a high level of teacher self-efficacy in ESD significantly enhances the likelihood of its effective implementation.

Second, research consistently shows that (student) teachers with high levels of teacher self-efficacy are more open to new ideas and more willing to experiment with innovative teaching methods to better address their students' needs (Ross & Bruce, 2007; Šimić Šašić & Sorić, 2010). These qualities are also essential for effective teaching in ESD. Successful ESD implementation requires teachers with strong teacher self-efficacy, who feel prepared to embrace its challenges, experiment with diverse pedagogical approaches, move beyond traditional teaching methods, and engage in continuous professional development and growth.

Finally, self-efficacy plays a key role in encouraging changes in actions and behavior towards a sustainable future. Thus, it is essential that future generations of teachers remain open to change and feel prepared to implement ESD. For instance, Gibson and Dembo (1984) found that the key determinant of success in projects aimed at transforming teachers' actions and behaviors is their assessment of teacher self-efficacy, i.e., their belief in their ability to effect change, improve their own practice as well as support even the most disengaged student. Similarly, Gregoire (2003) suggests that, even when teachers recognize the benefits of a particular teaching method, their decision to implement it depends primarily on their confidence in their ability to use it effectively. If the goal is to initiate social change through ESD, it is imperative to cultivate teachers who feel ready to embrace new ideas, experiment with methods, and maintain a flexible approach to teaching.

Ascription of Personal Responsibility

According to the NAM (Schwartz, 1977; Schwartz & Howard, 1981), the second potential predictor of intention (e.g., to implement ESD) is ascription of personal responsibility. Personal responsibility refers to the feeling of internal responsibility to either create or prevent certain outcomes (Lauermann & Karabenick, 2011). The abovementioned responsibility is characterized by the sense of devotion and obligation to a certain goal, self-determination, and critical self-reflection.

In educational research, the ascription of a teacher's personal responsibility typically refers to their internal sense of responsibility for individual educational outcomes

(Guskey, 1981; Kozel, 2007; Lauermann, 2014). Moreover, prior studies indicate that teachers' sense of responsibility is significantly associated with their beliefs regarding the teaching profession, job satisfaction, engagement, and students' achievement, motivation, and learning (e.g., Eren, 2014; Halvorsen et al., 2009; Lauermann, 2014; Matteucci, 2007; Silverman, 2010; Polat & Mahalingappa, 2013). Therefore, teachers who assume greater personal responsibility for student learning outcomes tend to be more engaged and satisfied with their profession, while their students often demonstrate higher academic success. These teachers also exhibit greater motivation and respect for the teaching profession (Lauermann, 2014). Silverman (2010) placed student teacher's ascription of responsibility at the core of their research on how student teachers conceptualize multiculturality. Silverman argued that, without a sense of responsibility, student teachers lack motivation to engage in behaviors that are neither externally motivated nor formally required (e.g., by the law or institutional directives). In other words, although teachers are not explicitly required to incorporate multicultural education, those who feel responsible for fostering an inclusive learning environment are more likely to take proactive steps to develop students' multicultural competencies. A similar parallel can be drawn with ESD. In most countries, the implementation of ESD is not obligatory and largely depends on teachers' willingness to integrate sustainability content into their teaching (Vukelić, 2021). It can be assumed that student teachers who perceive themselves as responsible for preparing future generations to address sustainability challenges more effectively are also more inclined to implement ESD.

In both ESD and environmental education, environmental responsibility has been a central topic of discussion for many years (Aarnio-Linnanvuori, 2019), with fostering behavior driven by a sense of personal responsibility recognized as a key goal of environmental education (Gough, 2013). However, the construct of teachers' ascription of (personal) responsibility has been largely overlooked in ESD research. Existing studies (e.g., Nikel, 2007; Sund, 2015; Sund & Wickman, 2008; Vukelić, 2021; Vukelić & Rončević, 2019) on this topic are predominantly qualitative, offering insights into how (student) teachers perceive their personal responsibility in addressing sustainability challenges and how this perception relates to their (future) teaching practices. Moreover, these studies suggest that the ascription of responsibility plays a crucial role in shaping teachers' (future) engagement in ESD. Specifically, teachers' perception of responsibility for addressing sustainability challenges influences their decision-making, particularly regarding whether, how, and to what extent they will integrate ESD into their professional practices.

Interaction Between Teacher Self-Efficacy and Ascription of Personal Responsibility

One of the key factors connected with teacher's personal responsibility is teacher self-efficacy. According to Lauermann & Karabenick (2011), individuals who assume responsibility for a specific action (e.g., they perceive it is their duty to address a particular issue) tend to exhibit stronger beliefs in their own ability to carry out that action effectively. In other words, when teachers perceive themselves as both capable and competent to implement, for example, ESD, they are less likely to be preoccupied with the risk of failure. This, in turn, reduces the likelihood of employing defensive strategies such as avoidance or denial of responsibility, which often serve to protect the individual from self-criticism.

The relationship between teacher self-efficacy and teacher's ascription of personal responsibility has also been empirically supported. For example, Kozel (2007) found teacher self-efficacy to be a key factor that forms student teacher's intention to engage in multicultural education in their future practice. This was followed by the teachers' evaluation of whether a given strategy is likely to produce the desired learning outcomes, as well as their sense of responsibility to address a particular issue or achieve specific goals. Moreover, the study showed that even when teachers believe a certain pedagogical approach will be effective and that they are competent to implement it, they are unlikely to do so in the absence of a personal sense of responsibility. In the context of ESD, Vukelić and Rončević (2019) found that student teachers who perceive themselves as responsible for addressing issues related to sustainability tend to report higher levels of confidence in their ability to implement ESD in practice.

Based on the NAM and the findings of previously cited studies (Kozel, 2007; Schwartz & Howard, 1981; Vukelić, 2021), both teacher self-efficacy and the ascription of personal responsibility, when considered independently, emerge as significant predictors of teachers' behavioral intentions. Accordingly, it is reasonable to anticipate that individuals who simultaneously exhibit a strong sense of self-efficacy and personal responsibility are more likely to engage in the implementation of ESD. Moreover, it may be posited that the joint effect of these two constructs plays a critical role in strengthening teachers' intention to incorporate ESD into their educational practice. Therefore, we propose:

Hypothesis 1. The teacher's self-efficacy and ascription of personal responsibility will be positively related to teachers' intention to implement ESD.

Hypothesis 2. Teachers' intention to implement ESD will be higher when both teacher self-efficacy and ascription of personal responsibility are high than when both are low.

Hypothesis 3. The larger the difference between teacher self-efficacy and ascription of responsibility, the lower the level of teachers' intention to implement ESD.

Material and Methods

Participants and Procedure

Data were collected from 698 student teachers, 528 of whom were female, enrolled in the final two years of their initial subject teacher education. Upon completion of their studies, they will achieve an academic degree and the title Master of Education in a specific subject (e.g., Master of Chemistry Education, Master of English Language Education). The average age of student teachers was 22.54 (SD = 2.42). Questionnaires in both printed and online formats were administered during standard teacher education classes. All participants gave their informed consent prior to taking part in the study.

Prior to starting the study, ethical approval has been obtained from the Ethics Committee at the Faculty of Humanities and Social Sciences, University of Rijeka (Croatia). Furthermore, the study conformed to the directives established by the Ethics Committee at the Ethics Committee at the Faculty of Humanities and Social Sciences (University of Rijeka), and the ethical principle of conducting the research at the University of Rijeka.

Instruments

Intention to implement ESD scale (Vukelić, 2021) was used to assess student teachers' intention to implement ESD. The instrument comprises 33 items organized into four subscales: intention to implement: (I) ESD content subscale (4 items), (II) ESD teaching approaches and methods (7 items), (III) focus on achieving ESD learning goals (12 items) and (IV) general intention to implement ESD subscale (10 items). Participants responded to each item using a 7-point Likert scale, ranging from 1 – *I ompletely disagree/never* to 7 – *I completely agree/always*. The scale demonstrates a four-dimensional structure, with internal consistency coefficients for the subscales ranging from α = .86 to α =.97 (Vukelić, 2021).

Teacher self-efficacy for ESD scale was used to assess teacher self-efficacy for ESD. The scale was adapted from Effeney & Davis (2013), with items translated into Croatian and modified for contextual relevance (Vukelić, 2021; Vukelić & Rončević, 2019). The scale comprised seven statements, each rated on a 5-point Likert scale (1- *I completely disagree; 5 – I completely agree).* The instrument is characterized by a unidimensional structure, with previously determined internal consistency coefficients of α = .66 – .88 (Vukelić, 2021; Vukelić & Rončević, 2019).

Teacher ascription of responsibility for ESD scale was used to measure student teachers' ascription of personal responsibility to implement ESD. The instrument consists of 7 items whereas participants' task is to express the degree of agreement with every listed item on a 5-point Likert scale (1 – *I completely disagree; 5 – I completely agree).* The instrument has a one-factor structure, whereas its internal consistency is α = .86.

Statistical Analyses

The polynomial regression analysis combined with response surface analysis was applied in the study. Within the polynomial model, four distinct dimensions of the intention to implement ESD served as outcome variables. These were regressed on the teacher self-efficacy for ESD (X) and the teacher ESD responsibility [1](Y), the squared terms of each predictor (X^2 and Y^2) as well as their interaction term, representing the cross-product of the teacher self-efficacy and teacher ESD responsibility (XY). This approach allows for a more refined investigation of the various degrees to which agreement and discrepancy between two predictors (in the present context: (X) teacher self-efficacy for ESD and (Y) the teacher ESD responsibility) can occur as well as the functional patterns underlying their (in)congruence. The application of this model is justified since an equivalent scale was used to measure both predictors (Edwards & Parry, 1993).

In order to illustrate the results of the polynomial regressions, the three-dimensional response surface plots were created. These visual representations enable the interpretation of the ways in which an agreement, the degree of discrepancy, and the direction of discrepancy between teacher self-efficacy for ESD and teacher ESD responsibility relate to different dimensions of intention to implement ESD. In these surface plots, the x-axis represents the teacher self-efficacy for ESD, the Y-axis represents the teacher ESD responsibility, and the Z-axes represent the different dimensions of the intention to implement ESD. In the surface plots, two lines are relevant for the analysis: (I) the line of congruence, which extends from the front to the back of the plot (where X = Y) and (II) the line of incongruence, which spans from the left to the right side of the plot (where X = -Y). The slope and the curvature along these lines, defined by the four surface coefficients (a1 – a4), provide insight into how the agreement and the discrepancy between the predictor variables is associated with the outcome variable (Shanock et al., 2010). The slope of the line of congruence is defined by the surface coefficient a1=b1+b2 and indicates how the agreement between teacher self-efficacy for ESD and teacher ESD responsibility relates to the different dimensions of intention to implement ESD. It shows the levels of intention to implement ESD when the levels of the teacher self-efficacy for ESD and teacher ESD responsibility are the same across the continuum from low to high scores. The a2 coefficient (a2 = b3+b4+b5) indicates whether there is a curvature along the line of congruence. Thus, it indicates whether the relationship between the agreement and intention to implement ESD is linear or curvilinear. To examine how the discrepancy between teacher self-efficacy for ESD and teacher ESD responsibility related to intention to implement ESD, the a3 coefficient (a3 = b1-b2) and a4 coefficient (a4 = b3-b4*b5) were examined. The slope of the line

[1] The abbreviated name of the variable *teacher ascription of personal responsibility for ESD implementation* (teacher ESD responsibility) will be used in the description of statistical analyses and the display of results.

of incongruence is defined by the a3 coefficient and indicates how the direction of the discrepancy affects the intention to implement ESD. Lastly, the curvature of the line of the incongruence is defined by the a4 coefficient and indicates how the degree of the discrepancy affects the intention to implement ESD.

To facilitate the interpretation of the surface plots and to avoid problems with multicollinearity, the predictor variables, teacher self-efficacy and teacher ESD responsibility, were scale-centered by subtracting the midpoint of the scale.

Results

The descriptive data (means and standard deviations), intercorrelations, and reliability coefficients of all the variables in the study are presented in Table 1. The correlation matrix shows that teacher self-efficacy for ESD, teacher ESD responsibility, and intention to implement ESD are positively related to one another. As the significant relationship between these variables was found, the polynomial regression analysis for the joint impact of teacher self-efficacy for ESD and teacher ESD responsibility was run.

Table 1
The Descriptive Data, Intercorrelations and Cronbach Alpha Coefficients for all the Variables

	1	2	3	4	5	6	M	SD	α
1. General intention	1	.73**	.68**	.67**	.59**	.61**	50.41	11.31	.911
2. ESD Content		1	.59**	.66**	.56**	.55**	21.67	4.81	.861
3. ESD Methods			1	.78**	.59**	.58**	34.47	8.41	.928
4. ESD Goals				1	.57**	.64**	64.26	13.04	.965
5. Teacher self-efficacy					1	.50**	22.38	5.09	.883
6. ESD responsibility						1	25.29	4.71	.858

**$p < 0.01$

To test whether the teacher self-efficacy for ESD and teacher ESD responsibility were jointly related to intention to implement ESD, the four separate polynomial regression analysis were for each aspect of intention to implement ESD.

In all four polynomial regression analyses the significant R^2 and response surface parameters were obtained (Table 2 and Figure 1–4). Following the significance of the models, the surface plots were investigated. The results of polynomial regression analyses of teacher self-efficacy for ESD and teacher ESD responsibility on intention to implement ESD are presented in Table 2 and Figure 1–4.

Table 2

Polynomial Regression Analysis of Teacher Self-Efficacy for ESD and Teacher ESD Responsibility With Intention to Implement ESD

	General intention	Content	Methods	Goals
	b (SE)	b (SE)	b (SE)	b (SE)
Constant	4.495 (0.05)**	4.9 (0.05)**	4.391 (0.05)**	4.784 (0.05)**
X (b1)	0.7 (0.06)**	0.8 (0.07)**	0.73 (0.07)**	0.63 (0.06)**
Y (b2)	0.58 (0.08)**	0.44 (0.09)**	0.67 (0.09)**	0.67 (0.08)**
X^2(b3)	0.02 (0.05)	0.03 (0.06)	0.03 (0.05)	0.05 (0.05)
XY	-0.21 (0.08)*	-0.29 (0.09)**	-0.11 (0.09)	-0.22 (0.08)**
Y^2(b5)	0.14 (0.06)*	0.21 (0.07)**	0 (0.06)	0.09 (0.06)
R^2	.486**	.424**	.458**	.503**
Congruence line				
Slope (a1)	1.28 (0.07)**	1.24 (0.07)**	1.4 (0.07)**	1.3 (0.06)**
Curvature (a2)	-0.04 (0.05)	-0.05 (0.04)	-0.08 (0.05)	-0.07 (0.03)*
Incongruence line				
Slope (a3)	-0.12 (0.13)	-0.36 (0.15)*	-0.07 (0.14)	0.05 (0.12)
Curvature (a4)	0.37 (0.12)**	0.54 (0.13)**	0.14 (0.12)	0.37 (0.11)**

Note: X – teacher self-efficacy; Y – teacher ESD responsibility; **p < 0.01; *p < 0.05

Figure 1

Response Surface for General Intention to Implement ESD

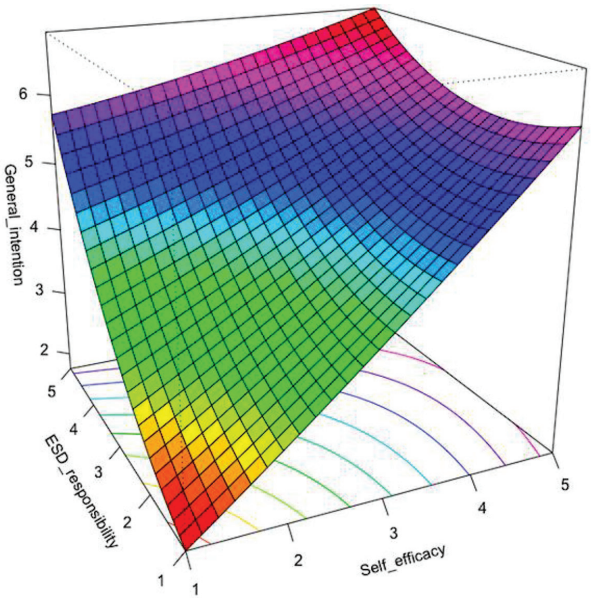


Figure 2
Response Surface for Intention to Implement ESD Content

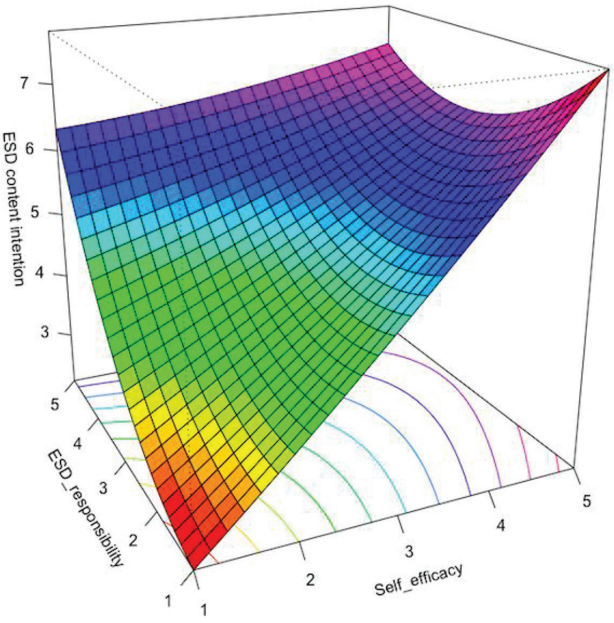


Figure 3
Response Surface for Intention to Implement ESD Methods

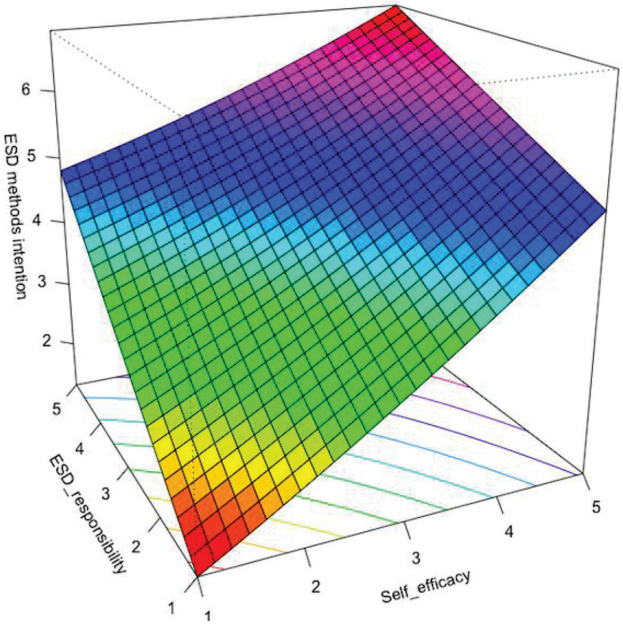
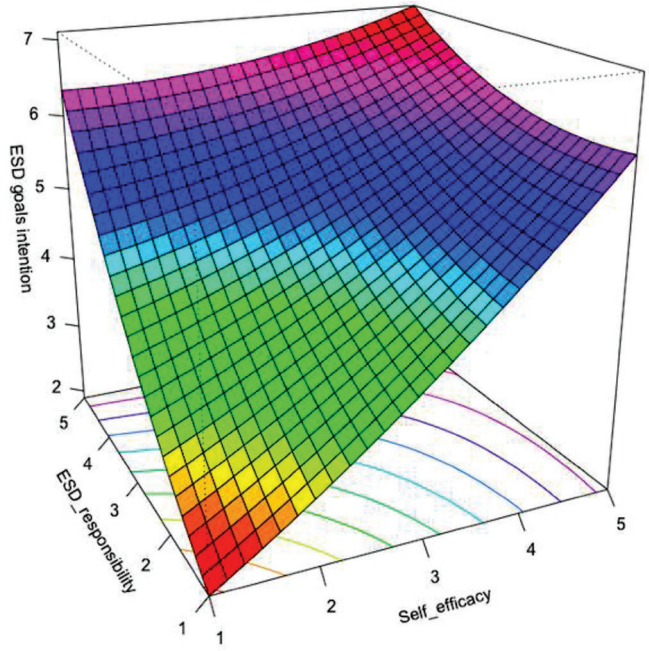


Figure 4

Response Surface for Intention to Implement ESD learning Goals



For all four dimensions of intention to implement ESD (general intention and intention to implement ESD content, methods, and learning goals), the results show that the significant response surface parameter was a1. Parameter a1 is significant and positive, suggesting that when teacher self-efficacy and ascription of ESD responsibility were congruent, intention to implement ESD would increase as teacher self-efficacy and ascription of ESD responsibility both increased. As shown in Figures 1–4, the higher levels of (different dimensions of) intention to implement ESD were at the back corner of the figures, where teacher self-efficacy and ascription of ESD responsibility are both high. In contrast, the lower levels were at the front, where both teacher self-efficacy and ascription of ESD responsibility were low.

Regarding (I) general intention to implement ESD (Figure 1), (II) intention to implement ESD contents (Figure 2), and (III) intention to focus on achieving ESD learning goals (Figure 4), the results show that the response surface parameter a4 was also significant. Positive a4 suggests that student teachers' intentions would increase when the discrepancy between teacher self-efficacy and ascription of ESD responsibility became larger.

Considering intention to implement ESD content (Figure 2), a significant a3 parameter was obtained. Parameter a3 is negative, suggesting that student teachers' intention to

implement ESD content is higher when the discrepancy is such that teacher self-efficacy is higher than ascription of ESD responsibility than vice versa.

Regarding intention to focus on achieving ESD learning goals (Figure 4), a significant and negative a2 parameter was found, implying that student teachers' intention to focus on achieving ESD learning goals increases more sharply as both teacher self-efficacy and ascription of ESD responsibility become higher, and decreases more sharply as they both become lower.

Discussion

In this study, a deeper understanding of how teacher self-efficacy and ascription of personal responsibility interact with each other to affect teachers' intention to implement ESD is presented. In other words, we examined how teachers' intention to implement ESD responds to the variation of both teacher self-efficacy and ascription of personal responsibility for ESD implementation. A polynomial regression analysis with response surface analysis was methodologically employed (Shanock et al., 2010).

The Joint Effect of Teacher Self-Efficacy and Ascription of Personal Responsibility on Teachers' Intention to Implement ESD

As expected, it was determined that teacher self-efficacy and ascription of responsibility are positively related to teachers' intention to implement ESD. Furthermore, we argued the joint effect of ascription of responsibility and teacher self-efficacy strengthens teachers' willingness to engage in ESD implementation. It was expected that teachers' intention to implement ESD will be higher when both teacher self-efficacy and ascription of personal responsibility are high than when both are low. This was also confirmed. When both predictors were in agreement, intention to implement ESD would increase as teacher self-efficacy and ascription of responsibility for ESD implementation both increased. When both teacher self-efficacy and ascription of responsibility for ESD implementation were low, the intention to implement ESD was also low.

The findings align with the theoretical framework of the NAM (Schwartz, 1977; Schwartz & Howard, 1981) and are consistent with prior research (e.g., Kozel, 2007; Vukelić, 2021). Student teachers who more strongly perceive themselves as personally responsible for addressing sustainability-related challenges, such as through the application of ESD principles, tend to report higher levels of teacher self-efficacy. In other words, they perceive themselves as better prepared and more capable of implementing ESD in their future professional practice. Consequently, they show higher levels of intention to implement ESD. It could be that student teachers who believe that it's their responsibility to deal with sustainability challenges and issues also recognize ESD as a framework within which they can start initiating actions which would help resolve

the abovementioned issues. Thus, they show a more mindful approach in preparing to implement ESD in their prospective professional career, consequently feeling readier and express higher levels of intention to take this step.

The Difference Between Teacher Self-Efficacy and Ascription of Responsibility on Teachers' Intention to Implement ESD

The hypothesis that a larger discrepancy between teacher self-efficacy and ascription of responsibility would result in a lower level of teachers' intention to implement ESD was not confirmed. Instead, the findings showed that student teachers' intentions – specifically their general intention to implement ESD, intention to implement ESD contents and intention to focus on achieving ESD learning goals – tended to increase as the gap between teacher self-efficacy and ascription of responsibility for ESD implementation widened. These results suggest that higher levels of either predictor contribute to greater teacher intention to implement ESD. Although the highest levels of intention were observed when both teacher self-efficacy and ascription of responsibility were high, it appears that higher levels of at least one of these predictors are sufficient for student teachers to intend to implement ESD. The only exception was the intention to implement ESD content. It was found that student teachers were more likely to intend to implement ESD content when the discrepancy is such that teacher self-efficacy is higher than ascription of responsibility than vice versa. In other words, when teacher self-efficacy was high, student teachers showed strong intentions to implement ESD content even if their levels of ascription of responsibility for ESD implementation were low. Conversely, when teacher self-efficacy was low, higher levels of ascription of personal responsibility did not result in a greater intention to implement ESD content. These findings highlight the significant role of teacher self-efficacy in determining the intention to implement ESD content. It is possible that teacher self-efficacy is closely related to their perceived knowledge and familiarity with the subject of ESD. Further investigation could explore whether this is linked to taking courses in ESD during initial teacher education.

It is notable that higher levels of personal responsibility for ESD alone are not sufficient to induce the intention to implement ESD contents. Rather, these levels must be supported by higher levels of teacher self-efficacy. The implementation of SD content is considered the most basic level of ESD integration into education systems. It is an accommodation process that Sterling (2004) calls 'education about sustainability' i.e., sustainability concept is introduced without the fundamental transformation of established practices. More profound levels of sustainability integration require a transformation of the education paradigm, positioning transformative education as the foundation for SD. In this context, the emphasis is placed on achieving learning outcomes through a student-centered approach that encourages action, collaboration, and transformative thinking. As the integration of SD content is generally considered

to be the most basic level of ESD integration, it is plausible that student teachers do not need to feel personally responsible for implementing ESD content, but rather, they need to evaluate themselves as ready to do so. In contrast, a sense of personal responsibility may be more influential when it comes to deeper levels of ESD engagement, particularly those requiring commitment to realizing ESD-related goals. Shifting toward a more transformative education paradigm likely depends on teachers recognizing such change as part of their responsibility. In this regard, personal responsibility appears to be a stronger predictor of teachers' intention to pursue ESD learning objectives and employ corresponding teaching methods.

Implications and Contribution

The primary contribution of this study lies in expanding the understanding of the factors that shape the intention to implement ESD and how the interaction of these factors influence said intention. Two theoretically supported predictors – teacher self-efficacy and ascription of personal responsibility – were identified, opening the door for further research into various teacher behaviors and intentions, particularly using the Norm-Activation model to explain these factors.

In addition to its theoretical implications, from the educational viewpoint related to the long-term pre-service and in-service teacher education and training, this study has some important practical implications. The findings underscore the importance of both teacher self-efficacy and attribution of personal responsibility in preparing teachers to implement ESD. Teacher education programs should focus on developing these aspects, rather than solely emphasizing knowledge specific to sustainable development. This suggestion aligns with previous research indicating that although subject knowledge about SD is crucial, acquisition of SD knowledge alone does not guarantee sustainable behavior (e.g., Heimlich & Ardoin, 2008; Jensen, 2002; Kollmuss & Agyeman, 2002; Wolf & Moser, 2011), or successful implementation of ESD (e.g., Cutter-Mackenzie & Smith, 2003; Liddy, 2012; Stevenson, 2007; Tomas et al., 2017). Moreover, empirical findings suggest that effective implementation of ESD is hindered by low levels of teacher self-confidence (e.g., Evans et al., 2013; Kennelly et al., 2012; Nolet, 2009), highlighting the critical importance of fostering teacher self-efficacy for ESD. Furthermore, for (future) teachers to develop a sense of responsibility for ESD, higher education institutions must integrate SD values into their activities and promote the transition toward more sustainable university practices.

Furthermore, this study contributes to the field of educational sciences by introducing the use of polynomial regression analysis with response surface analysis in educational research (Shanock et al., 2010). This approach allows for the examination of the combined effects of two predictor variables on a single outcome variable, providing a three-dimensional visualization of their interaction, which is underexplored in educational literature.

Limitations and Future Directions

This study is not without limitations. First, while teachers' intention to implement ESD is influenced by multiple factors, this study zoomed in on two key predictors – teacher self-efficacy and ascription of responsibility – based on the NAM (Schwartz, 1977; Schwartz & Howard, 1981). Other relevant factors were not examined, and future research should consider a broader range of influences.

In addition, intention to implement ESD is likely a dynamic construct that evolves over time, shaped by various contextual and individual factors. To gain a clearer understanding of its development, future studies should employ different methodological approaches, such as longitudinal studies that track changes in student teachers' intentions across different phases of their education and professional development. In this regard, educational experts should monitor the progression of student teachers' intention to implement ESD throughout their initial training.

Another limitation pertains to the sample, which consisted exclusively of student teachers from Croatian universities, with a predominance of female participants. Regarding the gender ratio of the sample, it is not unusual that (student) teacher population is primarily female. During the sampling process, the focus was on assuring that participants' gender ratio mirrors ratios that exist in the teacher population, i.e., student teachers. To be more specific, 75.65% of the participants in this study were female, which corresponds to the percentage of female teachers in Croatia (78% according to OECD, 2019). However, the extent to which the intercorrelations observed in this study may apply to male student teachers remains unclear. Future research should explore potential gender differences in the predictors of intention to implement ESD, potentially by testing the moderator effect of gender in the regression model. However, this would require a more balanced sample with even gender distribution.

Finally, the national scope of the sample limits the generalizability of the findings to a broader, multicultural context. Future research should include an international sample to determine whether the observed relationships hold across different educational and cultural settings.

Conclusion

This study contributes to the existing body of research on teachers' intention to implement ESD by examining its predictors and their combined effects. The findings indicate that student teachers' intention to implement ESD is positively shaped by both their ascription of responsibility and their teacher self-efficacy. Moreover, when these two factors are congruent, the intention to implement ESD strengthens as both teacher self-efficacy and ascription of personal responsibility increase. Conversely, when levels of both teacher self-efficacy and ascription of personal responsibility are

low, student teachers exhibit a similarly low intention to engage in ESD implementation. The findings point to the need for systematically equipping future teachers to implement ESD, both through initial teacher education and ongoing professional development. This involves not only strengthening their sense of self-efficacy for ESD implementation but also fostering personal commitment to advancing SD. In doing so, teacher education programs can more effectively prepare teachers to take an active role in building a sustainable future.

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Mokytojo saviveiksmingumo ir atsakomybės priskyrimo sąveika bei jos įtaka mokytojo ketinimui įgyvendinant darnaus vystymosi švietimą: polinominė regresija su atsako paviršiaus analize

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Santrauka

Kadangi sėkmingam darnaus vystymosi švietimo (angl. ESD) įgyvendinimui reikalingi įsipareigoję (būsimieji) mokytojai, kurie veiktų kaip pokyčių agentai ir palengvintų perėjimą prie darnaus vystymosi, būtina tirti veiksnius, lemiančius (būsimųjų) mokytojų ketinimą įgyvendinti ESD. Šiame tyrime nagrinėjami mokytojų ketinimo įgyvendinti DVS prognozės veiksniai, pabrėžiant mokytojo saviveiksmingumo bei asmeninės atsakomybės už ESD įgyvendinimą prisiėmimo vaidmenį. Apklausoje dalyvavo 698 studentai – būsimieji mokytojai. Tyrimui atlikti buvo taikyta polinominė regresija su atsako paviršiaus analize. Nustatyta, kad mokytojo saviveiksmingumo ir atsakomybės prisiėmimo dermė yra susijusi su didesniu ketinimu įgyvendinti ESD. Be to, bendras mokytojo saviveiksmingumo ir asmeninės atsakomybės prisiėmimo poveikis yra svarbus siekiant sustiprinti mokytojų ketinimą įgyvendinti ESD. Kai mokytojo saviveiksmingumas ir atsakomybės už ESD įgyvendinimą priėmimas sutampa, ketinimas įgyvendinti ESD stiprėja, didėjant tiek mokytojo

saviveiksmingumui, tiek asmeninės atsakomybės prisiėmimui. Ir atvirkščiai, kai mokytojo saviveiksmingumo ir asmeninės atsakomybės prisiėmimo lygis yra žemas, būsimieji mokytojai rodo ir žemą ketinimą įsitraukti į ESD įgyvendinimą.

Esminiai žodžiai: *atsakomybės prisiėmimas, ketinimas įgyvendinti darnaus vystymosi švietimą, normų aktyvavimo modelis, polinominė regresija, atsako paviršiaus analizė, mokytojo saviveiksmingumas.*

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