Students' Topic Interest and Its Effect on Their Self-Perceived Digital and Sustainability Competencies and Their Perceived Mode of Acquisition

Luka Goropečnik [a,*] Danijela Makovec Radovan [b] Nina Kristl [b] and Jože Kropivšek [a]

In an era defined by digital transformation and the pursuit of sustainability, education functions both as a reflection of societal change and as a catalyst for it. This study examines how students' interest in topics of digital and sustainability competencies affects their self-perceived proficiency and the extent to which they attribute their competency acquisition to formal education. The research employs established frameworks for digital and sustainability competencies, along with a set of professional competencies. Data were collected from 453 final-year students enrolled in upper secondary vocational and technical education, short-cycle higher vocational education, bachelor's, and master's programs in wood science and technology education in Slovenia and analyzed using multiple regression models. All six competence dimensions identified through exploratory factor analysis showed significant positive effects of topic interest on self-perceived competence, with the strongest association observed for generic sustainability competencies. Topic interest also positively predicted the share of competencies students reported acquiring through formal education, with the largest effects for technical professional and generic sustainability competencies. These findings highlight topic interest as an important motivational factor shaping students' perceptions of their digital and sustainability competencies, while the educator's role appears especially crucial at this early stage of interest development for digital and sustainability topics.

DOI: 10.15376/biores.21.1.1706-1724

Keywords: Topic interest; Interest in digital and sustainability topics; Sustainability competencies; Digital competencies; Wood science and technology education; Education; Self-assessment; Self-perception

*Contact information: a: Department of Wood Science and Technology, Biotechnical Faculty, University of Ljubljana, 1000 Ljubljana, Slovenia; b: Department of Educational Sciences, Faculty of Arts, University of Ljubljana, 1000 Ljubljana, Slovenia; *Corresponding author: luka.goropecnik@bf.uni-lj.si*

INTRODUCTION

If industry wants to maintain its prosperity in Europe, it must continually adapt to evolving challenges. This requires ongoing innovation, driven by the integration of increasingly advanced digital technologies, as envisioned in Industry 4.0, while also addressing urgent sustainability challenges. Industry 5.0 builds on this foundation by expanding the focus beyond technological and economic progress to also prioritize social and environmental impacts (Breque *et al.* 2021). This is reflected in the European Commission's current top priorities: the Green Deal, a strategy to achieve climate neutrality by 2050, and Europe Fit for the Digital Age, which promotes technological innovation while ensuring that digital transformation aligns with European values and regulations.

The wood and furniture industry, one of the conventional bioeconomy sectors, must adapt to this new industrial paradigm to remain competitive and prepared for the future. As an important economic sector in the EU, it includes a wide range of downstream forestry activities (Scarlat *et al.* 2015). In the NACE system, it is classified as C16 (manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials) and C31 (manufacture of furniture). However, the so-called twin transition, both digital and green, is creating a growing demand for new competencies in almost all occupations (Muench *et al.* 2022). Although this demand is widespread, it is especially pronounced in traditional sectors such as wood and furniture, where progress toward digital and sustainable transformation is hindered not only by financial constraints but also by significant gaps in the knowledge and skills required for successful implementation (Kropivšek 2018; Kropivšek and Grošelj 2020; Muench *et al.* 2022 Goropečnik *et al.* 2024, 2025). The European policy framework has already initiated comprehensive educational reforms at all levels in Slovenia, affecting vocational education and training (Ahačič *et al.* 2024; Skubic Ermenc *et al.* 2024), higher vocational education (Mali *et al.* 2025), and higher education (Vlada Republike Slovenije 2022). These reforms prioritize sustainability and digital literacy and actively shape the future direction of education, including in wood science and technology, which is the focus of this study. In this field, students at lower levels of education are trained as carpenters and wood technicians, while those who pursue higher education develop expertise as wood engineers, mainly for the wood and furniture industry.

Aligned with the principles of competence-based education that guide these reforms, two major European reference frameworks, the Digital Competence Framework for Citizens (DigComp) and the European Sustainability Competence Framework (GreenComp), provide direction for integrating digital and sustainability competencies into curricula. However, integrating these competencies should not be seen as simply adding items to a checklist, but as an integral part of a coherent pedagogical approach (Makovec Radovan 2025). The mere inclusion of competencies in curricular documents does not ensure their development in students; their acquisition depends on how teaching and learning are designed, implemented, and internalized, considering the multiple factors that influence learning and its outcomes (Chaudhary and Singh 2022).

Among these factors, interest is one of the psychological variables influencing comprehension and learning that has long been recognized (Berlyne 1949). However, that aspect has been largely overlooked in educational research (Schiefele 1992). Interest is considered a motivating factor and is the psychological state that drives engagement, causing individuals to repeatedly interact with certain objects, events, or ideas over time (Hidi and Renninger 2006). It mainly results from a person's interaction with their environment (Krapp *et al.* 1992), meaning that external conditions can play a decisive role in triggering and maintaining interest. A distinction is made between situational interest, which is usually triggered externally and may be temporary, and individual interest, which develops over time, is self-sustaining, and leads to deeper engagement with a topic (Krapp *et al.* 1992). Hidi (1990) argues that situational and individual interests are not separate, isolated phenomena, but rather interact dynamically, with situational interest possibly facilitating the development of individual interest over time. According to the four-phase model of interest development, interest progresses through triggered situational interest, maintained situational interest, emerging individual interest, and well-developed individual interest, with each phase characterized by increasing persistence, knowledge, and intrinsic motivation (Hidi and Renninger 2006). Each phase involves both affect and cognition, with

affect being more prominent in the initial phases and cognitive processing becoming more significant in later phases. Flowerday and Shell (2015) highlight that situational interest plays a crucial role in learning, engagement, and attitude, while Lee *et al.* (2014) found that individual interest is a significant and independent predictor of academic self-regulation, contributing to achievement through self-regulatory processes. Similarly, Ainley and Ainley (2011) demonstrated that student interest reflects learning effects in science education, as enjoyment of science strongly predicts students' desire to further engage with specific science topics.

In addition to situational and individual interest, researchers have examined topic interest (Bathgate *et al.* 2014), which is triggered by the presentation of specific topics and themes (Renninger and Hidi 2017). Topic interest can serve as a personalization strategy to spark and sustain student interest (Walkington 2013). Ainley *et al.* (2002) reported that interest in a topic can be influenced by both situational factors (interest in a new topic) and individual factors (pre-existing interest in the topic). Supporting this, Unsworth and McMillan (2013) found that high topic interest was associated with lower rates of mind-wandering and, consequently, improved reading comprehension. Therefore, one approach to understanding student interest is to identify the topics that students find interesting (Swarat 2008).

Previous research has examined students' perceived interest in learning sustainability competencies and shown that interest varies across competence domains and fields of study and is related to students' pro-ecological worldviews (Hyytinen *et al.* 2023). Although interest in digital competencies has not been examined directly, conceptual literature defines digital competence as encompassing not only technical skills but also the meaningful and critical use of digital technologies and the motivation to participate in digital culture (Ilomäki *et al.* 2016). Because genuine interest is reflected in the time and effort individuals are willing to invest (Ginsberg *et al.* 1951), interest can be understood as a psychological basis for sustained engagement with learning activities. Empirical research supports the relevance of this mechanism in sustainability education, as students' engagement has been shown to be associated with the development of sustainability competencies (Núñez *et al.* 2024). In digital learning environments, frequent use of digital tools has been found to increase student engagement and improve learning outcomes. This highlights engagement as an important condition through which digital competencies may be fostered through practice, even if not measured directly (Zafeer *et al.* 2025). Empirical evidence from wood science and technology education also confirms the importance of motivational factors, as students' academic motivation has been shown to significantly predict their self-perceived digital and sustainability competencies (Goropečnik *et al.* 2026). Although this research does not measure interest directly, the findings align with the thesis that interest constitutes an important motivational factor underlying sustained learning behavior. To our knowledge, no previous study has explicitly examined how students' interest in digital and sustainability topics relates to the development or self-perception of their digital and sustainability competencies.

Purpose of the Present Study

Given the established impact of students' topic interest on the development of competencies and the potential to initiate and sustain interest through customized learning environments, this study examines how students' interest in topics of digital and sustainability competencies affects their self-perceived competency levels. The study also examines whether students' topic interest motivates them to acquire these competencies

outside formal education, as such self-directed learning may indicate a more advanced phase of interest. Understanding a student's phase of interest assists teachers design instructional strategies that effectively promote and sustain engagement. This article is part of a larger study focused on fostering the development of digital and sustainability competencies among students in wood science and technology education programs. The main research questions (RQ) were:

RQ1: Does students' interest in the topics of digital and sustainability competencies affect their self-perceived proficiency in these competencies?

H1a: Interest in generic digital competencies positively affects self-perceived generic digital competencies.

H1b: Interest in generic sustainability competencies positively affects self-perceived generic sustainability competencies.

H1c: Interest in professional digital and sustainability competencies positively affects self-perceived professional digital and sustainability competencies.

RQ2: Does students' interest in the topics of digital and sustainability competencies affect whether they acquire these competencies outside formal education?

H2a: Interest in generic digital competencies positively affects the share of generic digital competencies acquired outside formal education.

H2b: Interest in generic sustainability competencies positively affects the share of generic sustainability competencies acquired outside formal education.

H2c: Interest in professional digital and sustainability competencies positively affects the share of professional digital and sustainability competencies acquired outside formal education.

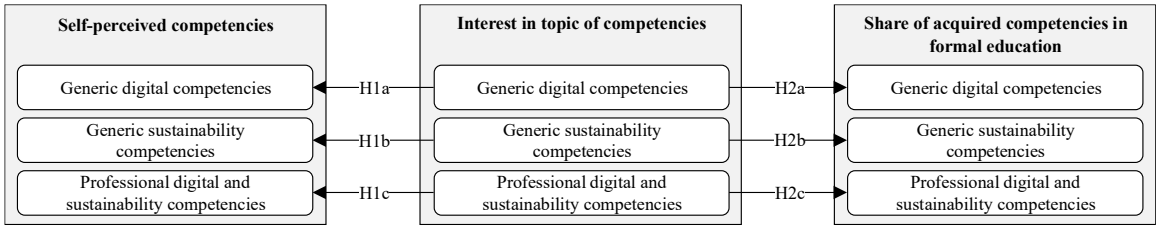

Fig. 1. Hypothesized relationships

The remainder of this article is structured as follows: First, the methodology is presented, including data collection, measures, sampling, and data analysis. Next, the findings are presented, followed by a discussion, the study's limitations, and concluding remarks.

EXPERIMENTAL

Data Collection

This study focused on students in wood science and technology education in Slovenia. Therefore, purposive sampling was used. This is a non-probability method best suited for studying a specific group (Tongco 2007). Data collection occurred between March and May 2024. During this period, the team visited all educational institutions in Slovenia that offer the study programs analyzed in this research. This included 35 graduating classes in wood science and technology education. The survey was administered in supervised classrooms, where students completed the questionnaire

individually on school computers. This approach ensured that the team provided clear instructions and consistent guidance to all participants throughout the process.

In accordance with standard procedures at Slovenian secondary and higher education institutions, students (and parents of minors) provide general written consent to participate in research activities, such as surveys and other comparable non-invasive data collection methods, at the time of enrollment. Additionally, participants were informed of the study's objectives before the survey and were assured that their responses would remain anonymous and that participation was entirely voluntary. Verbal consent was also obtained before the survey began. The study was conducted in strict compliance with ethical principles and informed participation guidelines; however, formal ethical approval was not obtained because Slovenian regulations did not require it for educational studies based on surveys at that time.

Measures

The questionnaire, part of a larger study, included three content sections and a demographic section. The first content section, which is the focus of this study, asked students to assess their level of digital and sustainability competencies, their interest in topics of these competencies, and the extent to which they believe they have acquired these competencies through formal education. The second and third sections addressed aspects not covered in this article, such as the schools' learning environment and students' academic motivation. A previously validated multidimensional instrument was used to measure students' self-perceived generic digital competencies (Vuorikari *et al.* 2022) and generic sustainability competencies (Bianchi *et al.* 2022). For the assessment of professional digital and sustainability competencies, a customized list of competencies specific to the wood and furniture industry was developed (see next section).

Assessment of students' digital and sustainability competencies

To assess students' competencies, 21 digital competencies were used from the five domains of the DigComp framework: Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Safety, and Problem Solving in Digital Environments (Vuorikari *et al.* 2022). Additionally, 12 sustainability competencies were included from the four domains of the GreenComp framework: Embodying Sustainability Values, Embracing Complexity, Envisioning a Sustainable Future, and Acting for Sustainability (Bianchi *et al.* 2022).

As both frameworks primarily address generic competencies, a set of 24 professional competencies was developed related to digitalization and sustainability, specifically tailored to the wood and furniture sector, to capture sector-specific professional requirements that are not sufficiently represented in the competence frameworks used. The development of this set followed a multi-step process, with the primary aim of providing a contextualized basis for comparison with generic digital and sustainability competencies rather than establishing a definitive or exhaustive list of professional competencies. First, key topics were identified, highlighted in the Implementation Document for the Development of the Slovenian Wood Industry until 2030 (Ministry of Economic Development and Technology and Wood Industry Directorate 2022) as essential for wood science and technology graduates. These fields include design, construction, architecture, cultural heritage preservation, mechanical wood processing, practical training, public relations, and relevant social sciences.

Next, 12 experts from diverse professional backgrounds were asked to define the key competencies in their respective domains, ensuring alignment with the identified areas and a focus on digitalization and sustainability. Each expert provided a description of the scope and content of the proposed competencies. After consolidating overlapping items, a refined list was created, which was then subjected to assessment. Using a four-point Likert scale, the same group of experts assessed the importance of each competency for wood science and technology graduates. Based on these ratings, a set of 24 professional competencies was constructed that formed the basis for the students' self-assessment.

Students assessed their competencies according to the eight proficiency levels of DigComp 2.1 (Carretero *et al.* 2017), which describe progression in terms of task complexity and autonomy (Table 1). Each competency was presented to the students with its full name and definition. For the DigComp and GreenComp frameworks, the official Slovenian translations of the questionnaires were used.

Table 1. Rating Scale for the Proficiency Level of Competencies Based on Task Complexity and Autonomy (Carretero *et al.* 2017)

Proficiency Levels	Complexity of Tasks	Autonomy
1	Simple tasks	With guidance
2	Simple tasks	Autonomy and with guidance where needed
3	Well-defined and routine tasks, and straightforward problems	On my own
4	Tasks, and well-defined and non-routine problems	Independent and according to my needs
5	Different tasks and problems	Guiding others
6	Most appropriate tasks	Able to adapt to others in a complex context
7	Resolve complex problems with limited solutions	Integrate to contribute to the professional practice and to guide others
8	Resolve complex problems with many interacting factors	Propose new ideas and processes to the field

Assessment of students' topic interest of competences

After the students had self-assessed their level of competence, they were asked to rate how interesting they found each topic of competence. The interestingness of each topic was rated on a 5-point Likert scale from '1 - Not interesting' to '5 - Very interesting'.

Assessment of students' share of acquired competences in formal education

Finally, students indicated the share of each competence that they had acquired through formal education by selecting from ten predefined percentage ranges: (1) 0–10%, (2) 11–20%, (3) 21–30%, (4) 31–40%, (5) 41–50%, (6) 51–60%, (7) 61–70%, (8) 71–80%, (9) 81–90%, and (10) 91–100%. A selection of 0% means that the student developed their competence entirely outside formal education, while 100% means they acquired the competence exclusively through formal education.

Participants

The study population consisted of final-year students enrolled in Slovenian wood science and technology education programs at different levels. A total of 453 students participated, representing approximately 82% of the total population. The sample was predominantly male (97.0%), reflecting the gender distribution in the industry. Participants

included students from a range of educational programs: upper secondary vocational education (3-year, ISCED 353) for carpenters (45.8%); upper secondary technical vocational education (4-year, ISCED 354) for technicians (17.2%); 2-year vocational technical education (ISCED 354), which enables graduates of upper secondary VET programs to obtain an upper secondary technical qualification (22.0%); short-cycle higher vocational education (2-year, ISCED 554) for engineers (5.5%); vocational and academic bachelor programs (3-year, ISCED 645 and 655) for Bachelor of Wood Engineering (7.0%); and the master program (2-year, ISCED 767) for Master of Wood Science and Technology (2.4%). Students in short upper secondary vocational programs and doctoral studies were excluded, as the structure and focus of their competence development are not directly comparable with those of the other programs analyzed.

Data Analysis

The data analysis was conducted using IBM SPSS Statistics Version 29 and AMOS Version 29. First, the distribution of the observed variables was examined using descriptive statistics. The internal consistency of the measurement scales was evaluated with Cronbach's alpha. Because the latent constructs proposed in the conceptual framework (see Fig. 1) could not be empirically validated, a series of Exploratory Factor Analyses (EFA) were carried out to assess the dimensionality of the items. The EFAs were conducted separately for each thematic group of competencies: generic digital competencies, generic sustainability competencies, and professional digital and sustainability competencies. For each group, three analyses were conducted: one for self-assessed competence levels, one for topic interest, and one for the share of competencies acquired in formal education. Within each thematic group, the factor structures obtained from the three perspectives were largely consistent, with minor deviations. When individual items had ambiguous or cross-loadings, they were classified according to their conceptual fit. This process resulted in a structure with three factors for generic digital competencies, one factor for generic sustainability competencies, and two factors for professional digital and sustainability competencies. Based on this classification, six latent constructs were defined, representing the main competence areas: DigC1 (fundamental generic digital competencies such as information literacy, communication, and collaboration), DigC2 (digital safety and online behavioral competencies, including safe digital practices, copyright awareness, and responsible online interaction), DigC3 (complex digital competencies such as digital content creation and problem solving), SusC (a unidimensional construct representing generic sustainability competencies), ProfC1 (technical professional digital and sustainability competencies), and ProfC2 (professional digital and sustainability competencies related to business operations). Although there was some overlap between the domains, the strong consistency of results across the different perspectives justified the use of these six dimensions in subsequent analyses, with awareness of potential issues related to multicollinearity. These dimensions were then used as the basis for confirmatory factor analysis (CFA) and for testing predictive relationships through regression analyses.

Based on these validated constructs, the hypothesized relationships between students' self-assessed competence levels, interest in topics, and the share of competencies acquired in formal education were tested by estimating a total of 12 linear regression models. Two sets of relationships were examined: (1) the effect of topic interest on self-perceived competence levels, and (2) the effect of topic interest on the share of competencies acquired in formal education. The assumptions of linear regression were tested: normality was assessed using Kolmogorov-Smirnov and Shapiro-Wilk tests.

Although the tests indicated deviations from normality for the distributions of topic interest and the share of competencies acquired in formal education, graphical inspections did not reveal substantial departures from normality in the residuals of the models. Homoscedasticity and linearity were confirmed by scatter plots, independence of errors was verified with a Durbin-Watson value close to 2, and Cook's distance indicated the absence of influential outliers.

RESULTS

The reliability and validity of the constructs were examined according to established guidelines for reflective measures (Bagozzi and Yi 1988). Item reliability was confirmed, with all standardized factor loadings above 0.50. Internal consistency (Table 2) was supported by Cronbach's alpha (α) and composite reliability (CR), with all constructs exceeding the 0.70 threshold. Convergent validity, assessed by average variance extracted (AVE), was satisfactory for most constructs (≥ 0.50), except for the topic interest constructs, which showed consistently lower AVE values. These constructs were nevertheless retained because they demonstrated adequate internal consistency and composite reliability. In addition, the factor structure was intentionally aligned across self-perceived competence, topic interest, and the share of competencies acquired in formal education to ensure conceptual comparability. In cases of ambiguous or cross-loadings, items were classified based on theoretical and conceptual fit rather than statistical optimization, which may have reduced AVE values for interest constructs. Discriminant validity was evaluated using the Fornell–Larcker criterion (Fornell and Larcker, 1981). Several inter-construct correlations exceeded the square roots of AVE, which aligns with expectations but suggests caution. As shown in Table 2, students reported the highest self-perceived digital safety and behavioral competencies (DigC2) (M = 4.88, SD = 1.39), followed by fundamental digital competencies (DigC1) (M = 4.77, SD = 1.24). Complex digital competencies (DigC3) were lowest among the generic digital domains (M = 4.32, SD = 1.30). Generic sustainability competencies (SusC) averaged M = 4.58 (SD = 1.25), comparable to professional technical competencies (ProfC1) (M = 4.50, SD = 1.27), whereas business-related competencies (ProfC2) had the lowest mean value (M = 4.01, SD = 1.30). On the scale used, these values correspond to proficiency around Levels 4 to 5, where at Level 4 students can work independently on well-defined, non-routine tasks, while at Level 5 they can handle different tasks and problems and guide others.

Across all six single-predictor models (Table 3), students' topic interest significantly and positively predicted their self-perceived competence in the corresponding domain ($p < .001$). Standardized effects ranged from $\beta = 0.35$ to 0.53 and explained variance (R^2) ranged from 0.12 to 0.28. The strongest association was observed for generic sustainability competencies ($\beta = 0.53$), indicating that a one-point increase in interest corresponded to nearly a one-level increase on the eight-level proficiency scale ($B = 0.93$), with the model explaining 28% of the variance. Substantial effects were also found for interest in complex generic digital competencies ($\beta = 0.43$), fundamental generic digital competencies ($\beta = 0.42$), and technical professional competencies ($\beta = 0.41$). The lowest effects were found for business-operations professional competencies ($\beta = 0.37$) and digital safety/online behavioral competencies ($\beta = 0.35$). For these two models, the explained variance was lower ($R^2 = 0.12$ and 0.14), yet a one-point increase in interest still corresponded to more than half a proficiency level ($B = 0.64$ and 0.65).

Table 2. Descriptive Statistics, Reliability, Validity, and Correlations of Latent Factors

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. DigC1	**.73**																	
2. ShareDigC1	.07	**.74**																
3. IntDigC1	.42**	.34**	**.65**															
4. DigC2	.72**	.08	.35**	**.71**														
5. ShareDigC2	-.01	.75**	.29**	.09*	**.75**													
6. IntDigC2	.21**	.27**	.63**	.35**	.35**	**.65**												
7. DigC3	.74**	.10*	.39**	.72**	.05	.24**	**.71**											
8. ShareDigC3	.04	.77**	.30**	.08	.77**	.27**	.18**	**.75**										
9. IntDigC3	.33**	.26**	.66**	.29**	.22**	.65**	.43**	.32**	**.63**									
10.SusC	.66**	.17**	.36**	.70**	.09	.28**	.71**	.20**	.35**	**.70**								
11.ShareSusC	.10*	.70**	.36**	.10*	.76**	.34**	.16**	.79**	.35**	.25**	**.74**							
12.IntSusC	.24**	.29**	.57**	.27**	.30**	.65**	.27**	.37**	.64**	.53**	.47**	**.63**						
13.ProfC1	.58**	.16**	.25**	.59**	.12**	.19**	.67**	.20**	.23**	.72**	.21**	.28**	**.72**					
14.ShareProfC1	.15**	.47**	.26**	.11*	.40**	.28**	.14**	.48**	.33**	.20**	.57**	.40**	.28**	**.73**				
15.IntProfC1	.21**	.22**	.45**	.21**	.22**	.48**	.18**	.25**	.51**	.32**	.33**	.64**	.41**	.49**	**.66**			
16.ProfC2	.52**	.17**	.32**	.52**	.13**	.24**	.65**	.21**	.27**	.64**	.22**	.29**	.79**	.14**	.24**	**.71**		
17.ShareProfC2	.08	.53**	.24**	.08	.52**	.26**	.12**	.60**	.28**	.17**	.64**	.37**	.23**	.76**	.37**	.28**	**.74**	
18.IntProfC2	.24**	.19**	.46**	.23**	.21**	.54**	.24**	.23**	.54**	.36**	.32**	.65**	.31**	.36**	.70**	.37**	.42**	**.65**
M	4.77	4.42	2.86	4.88	3.88	2.88	4.32	4.10	2.95	4.58	4.23	2.89	4.50	5.55	3.22	4.01	4.58	2.98
SD	1.24	1.83	.65	1.39	1.94	.75	1.30	1.88	.72	1.25	1.76	.71	1.27	1.86	.74	1.30	1.89	.75
α	.89	.89	.82	.87	.90	.83	.87	.90	.82	.92	.94	.89	.94	.95	.92	.90	.90	.85
CR	.89	.90	.83	.87	.90	.83	.88	.90	.82	.92	.94	.89	.94	.95	.92	.89	.90	.85
AVE	.54	.55	.42	.50	.56	.42	.51	.57	.39	.49	.55	.40	.51	.53	.43	.51	.54	.42

Note. M = Mean; SD = Standard Deviation; α = Cronbach's Alpha; CR = Composite Reliability; AVE = Average Variance Extracted. The lower triangle presents correlations among latent factors. Diagonal values in bold represent the square root of the AVE. * indicates that $p < 0.05$, ** indicates that $p < 0.01$

Table 3. Simple Linear Regression Analysis of Students' Interest in Topics of Competencies Predicting their Level of Competencies

Outcomes	Predictors	B	SE_B	β	t	p
Fundamental Generic Digital Competencies (DigC1)	Topic Interest in Fundamental Generic Digital Competencies (IntDigC1)	.80	.08	.42	9.74	<.001
Model 1: R^2 = .18; p < .001						
Digital Safety and Online Behavioral Generic Digital Competencies (DigC2)	Topic Interest in Digital Safety and Online Behavioral Generic Digital Competencies (IntDigC2)	.64	.08	.35	7.81	<.001
Model 2: R^2 = .12; p < .001						
Complex Generic Digital Competencies (DigC3)	Topic Interest in Complex Generic Digital Competencies (IntDigC3)	.78	.08	.43	10.14	<.001
Model 3: R^2 = .19; p < .001						
Generic Sustainability Competencies (SusC)	Topic Interest in Generic Sustainability Competencies (IntSusC)	.93	.07	.53	13.18	<.001
Model 4: R^2 = .28; p < .001						
Technical Professional Digital and Sustainability Competencies (ProfC1)	Topic Interest in Technical Professional Digital and Sustainability Competencies (IntProfC1)	.71	.07	.41	9.63	<.001
Model 5: R^2 = .17; p < .001						
Business Operations Professional Digital and Sustainability Competencies (ProfC2)	Topic Interest in Business Operations Professional Digital and Sustainability Competencies (IntProfC2)	.65	.08	.37	8.54	<.001
Model 6: R^2 = .14; p < .001						

B = unstandardized regression coefficient; SE_B = standard error of the unstandardized coefficient; β = standardized regression coefficient; t = t-value for the regression coefficient; p = significance level. R^2 indicates the proportion of variance in the outcome variable explained by the predictor.

For the six single-predictor models (see Table 4), which examined how students' topic interest predicted the share of competencies acquired in formal education, all associations were significant and positive ($p < .001$). Standardized effects ranged from β = 0.32 to 0.49. The variance explained by the models ranged from 10% to 24%. The strongest effects were found for technical professional competencies (β = 0.49; B = 1.23) and generic sustainability competencies (β = 0.47; *B* = 1.16). These results indicate that a one-point increase in topic interest corresponded to more than one step on the 10-point percentage scale of acquired competencies in formal education, with the models explaining 24% and 22% of the variance, respectively. A substantial effect also emerged for business-operations professional competencies (β = 0.42; B = 1.06), with 18% of the variance explained. The lowest, yet still meaningful, effects were observed for fundamental generic digital competencies (β = 0.34; B = 0.96), digital safety/online behavioral competencies (β = 0.35; B = 0.91), and complex generic digital competencies (β = 0.32; B = 0.82). These models accounted for between 10% and 12% of the variance.

Table 4. Simple Linear Regression Analysis of Students' Interest in Topics of Competencies Predicting Share of Acquired Competences in Formal Education

Outcomes	Predictors	B	SE_B	β	t	p
Share of Acquired Fundamental Generic Digital Competencies in Formal Education (ShareDigC1)	Topic Interest in Fundamental Generic Digital Competencies (IntDigC1)	.96	.13	.34	7.65	<.001
Model 7: R^2 = .12; p < .001						
Share of Acquired Digital Safety and Online Behavioral Generic Digital Competencies in Formal Education (ShareDigC2)	Topic Interest in Digital Safety and Online Behavioral Generic Digital Competencies (IntDigC2)	.91	.12	.35	7.88	<.001
Model 8: R^2 = .12; p < .001						
Share of Acquired Complex Generic Digital Competencies in Formal Education (ShareDigC3)	Topic Interest in Complex Generic Digital Competencies (IntDigC3)	.82	.12	.32	7.05	<.001
Model 9: R^2 = .10; p < .001						
Share of Acquired Generic Sustainability Competencies in Formal Education (ShareSusC)	Topic Interest in Generic Sustainability Competencies (IntSusC)	1.16	.10	.47	11.24	<.001
Model 10: R^2 = .22; p < .001						
Share of Acquired Technical Professional Digital and Sustainability Competencies in Formal Education (ShareProfC1)	Topic Interest in Technical Professional Digital and Sustainability Competencies (IntProfC1)	1.23	.10	.49	11.94	<.001
Model 11: R^2 = .24; p < .001						
Share of Acquired Business Operations Professional Digital and Sustainability Competencies in Formal Education (ShareProfC2)	Topic Interest in Business Operations Professional Digital and Sustainability Competencies (IntProfC2)	1.06	.11	.42	9.72	<.001
Model 12: R^2 = .18; p < .001						

B = unstandardized regression coefficient; SE_B = standard error of the unstandardized coefficient; β = standardized regression coefficient; t = t-value for the regression coefficient; p = significance level. R^2 indicates the proportion of variance in the outcome variable explained by the predictor.

Taken together, the results indicate that students' interest in topics of digital and sustainability competencies is associated with both higher self-perceived competencies and a greater share of competencies acquired through formal education. The diagram (Fig. 2) summarizes the validated relationships for both research questions (RQ). For RQ1, all six models showed significant positive effects, confirming the hypotheses (H1a–c). The strongest association was found for generic sustainability competencies. For RQ2, the findings did not support the original hypotheses (H2a–c), as interest was not linked to competencies acquired outside formal education. Instead, interest was positively related to the share of competencies students reported acquiring within formal education, with the strongest effects for technical professional and generic sustainability competencies.

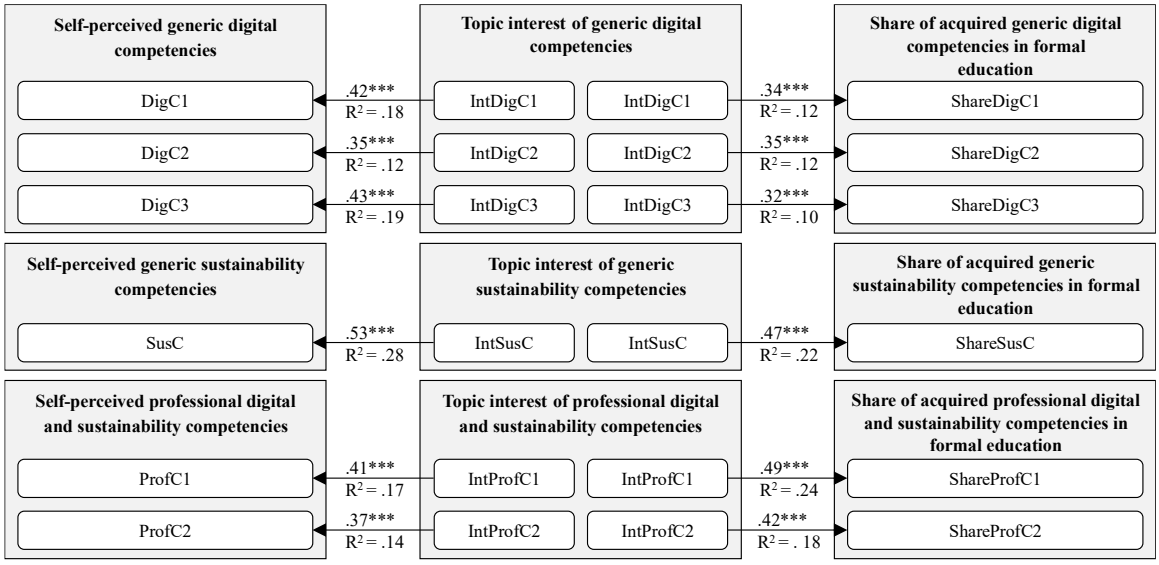

Fig. 2. Tested relationships. Numbers on arrows are standardized β; R^2 is shown for each model; all paths estimated using simple OLS; *** p < .001.

DISCUSSION

Interest is a powerful driver of learning, increasing engagement, sustaining attention, improving memory performance, and promoting persistence (Renninger and Hidi 2017). Building on this foundation, the present study examines whether and how students' interest in topics of digital and sustainability competencies affects their self-perceived proficiency in these areas and the context in which these competencies are developed (formal vs. non-formal settings), based on data collected at a single point in time, which should be interpreted as observed relationships rather than causal effects.

The results support Hypothesis 1, which states that students' topic interest significantly affects their self-perceived digital and sustainability competencies across both generic and professional competencies. Specifically, topic interest significantly and positively predicts students' self-perceived proficiency in all three areas of generic digital competencies (fundamental, safety-related, and more complex competencies), generic sustainability competencies, and both areas of professional digital and sustainability competencies (technical and business-operations professional competencies). Thus, the present results support the established role of interest in learning and knowledge development (Krapp *et al.* 1992) and align with other empirical research demonstrating its influence on perceived learning (Abrantes *et al.* 2007) and learning outcomes (Guo *et al.* 2020; Walkington 2013). Additionally, the findings extend this effect to the emerging domains of digital and sustainability competencies. The explained variance (R^2 = 12 to 28%) indicates that, although topic interest is not the only factor contributing to competence development, it accounts for a meaningful portion of the variance. This is consistent with typical findings in social science research, where many factors influence student outcomes and the focus is often on identifying significant predictors rather than maximizing predictive power, with R^2 values above 10% generally considered satisfactory (Ozili 2022). Notably, the strongest effect and explained variance were observed for generic sustainability competencies, suggesting that students' interest in sustainability

topics plays a particularly strong role in their self-perception of these competencies.

At the same time, the strong associations observed between generic sustainability competencies, generic digital competencies, and professional digital and sustainability competencies indicate that these domains are closely interconnected. Although digital and sustainability competencies are conceptually distinct, their overlap reflects the integrated nature of competence development typical of competence-based education, which underpins current educational reforms in Slovenia, including vocational education (Ahačič *et al.* 2024; Skubic Ermenc *et al.* 2024), higher vocational education (Mali *et al.* 2025), and higher education (Vlada Republike Slovenije 2022). In such contexts, competencies are developed holistically across subjects and modules (Makovec Radovan 2025), so digitalization- and sustainability-related competencies, which are among the priorities of current reforms, are often acquired simultaneously and tend to reinforce each other rather than develop in isolation.

In addition to self-perceived competence levels, the study examined the effect of students' topic interest on the share of competencies they reported acquiring through formal education. Although, on average, students attribute only 31 to 40% of their competencies to formal education, which might suggest a more advanced stage of interest, conclusions ought not to be based on this alone and caution should be exercised in making such interpretations. A more plausible explanation is contextual: at the time of data collection, digital and sustainability competencies were not yet widely included in national formal curricula, and official reforms incorporating these competencies had only just begun. Furthermore, contrary to the assumptions in Hypothesis 2, topic interest showed a positive effect on this share, indicating that students who are more interested in topics of digital and sustainability competencies attribute a larger share of their competence development to formal education rather than to informal educational settings. The explained variance (R^2 = 10 to 24%) was modest but typical for educational research and remains meaningful (Ozili 2022), as described above. This suggests that while most competence development is still believed to occur outside formal education, students with greater topic interest tend to recognize formal learning environments as more influential in their competence growth, especially for professional digital and sustainability and generic sustainability competencies, and slightly less, but still significantly, for generic digital competencies. According to Hidi and Renninger's (2006) four-phase model of interest development, cognitive processing and self-regulation become prominent only in the later phases of interest. This may indicate that students' interest in digital and sustainability topics is still at an earlier developmental stage, strong enough to enhance engagement within formal education, but not yet sufficiently established to drive voluntary and independent learning beyond it (Renninger and Pozos-Brewer 2015). Genuine interest is reflected in the time and effort invested (Ginsberg *et al.* 1951), and sustained participation helps learners discover the "hooks" that allow them to trigger and sustain their own engagement (Azevedo 2015), an opportunity that structured learning in formal education can provide. Besides personal factors, interest results primarily from a person's interaction with their environment (Krapp *et al.* 1992; Kunter *et al.* 2007), especially in the early stages of interest development. This may indicate that the current learning environment does not provide sufficient stimuli to deepen and sustain interest in digital and sustainability topics and has untapped potential.

The results of this study have important implications, particularly for pedagogical practice, as the findings indicate that students with greater interest in topics of digital and sustainability competencies perceive themselves as more competent. This underscores the

importance of students' interest in shaping their self-perceived competence in these areas. Because interest can be developed but requires external support (Renninger and Hidi 2017), such support can be provided in formal education, where educators play an important role (Pressick-Kilborn 2015), including in wood science and technology education programs, which formed the basis of this research. One way to increase interest is by developing competence itself, as supported by studies emphasizing the roles of students' self-efficacy and outcome expectations (Lopez *et al.* 1997), self-concept (Marsh *et al.* 2005), and perceived competence (Shin *et al.* 2022) in fostering interest. This may occur once current educational reforms introducing digital and sustainable competencies take effect.

Furthermore, recognizing students' earlier and later phases of interest is essential for identifying behavioral indicators that can be used to adapt classroom activities (Hidi and Renninger 2006). Cognitive factors alone may not be sufficient in the early phases of interest, as students' affect and the learning environment play a crucial role at this stage (Renninger and Shumar 2002). Because interest is not necessarily measured solely by asking whether students are interested or like a certain topic, the authors roughly estimated the stage of students' current interest phase by examining how their topic interest corresponded with the extent to which they attributed competence development to formal education or informal learning. In the present analysis, since students' topic interest was associated with attributing a greater share of their competence development to formal education, it can be assumed that their current interest in digital and sustainability topics is still in an earlier developmental phase. This again emphasizes the important role of learning environment, especially when working with less motivated students (Hidi and Harackiewicz 2000), as they can either support or hinder the development of students' interest.

Limitations and Future Research

This study was subject to some limitations that should be considered. First, the use of self-reporting may introduce bias. While these measures provide useful insight into students' understanding, they reflect only a single viewpoint. To strengthen the robustness of future studies, additional sources of evidence could be incorporated, including instructor assessments, analyses of curricular content, or objective performance-based measures such as practical assignments or examinations. Second, the use of cross-sectional data captures relationships at a single point in time and therefore does not allow conclusions about the causal direction between variables. Nevertheless, the observed associations are informative, and future longitudinal research designs would be valuable for examining causal mechanisms. Finally, the study sample was drawn from a male-dominated field, which limits the generalizability of the results. Although this reflects the actual gender distribution in the sector, future studies could consider sample with a more balanced gender distribution to increase representativeness.

CONCLUSIONS

1. Students' interest in topics of digital and sustainability competencies was shown to have a significant positive effect on their self-perceived competencies across all examined areas and sub-dimensions. These sub-dimensions, identified through factor analysis, include the three dimensions of generic digital competencies, namely fundamental, digital safety and online behavior, and more complex digital

competencies; one dimension of generic sustainability competencies; and two sub-dimensions of professional digital and sustainability competencies, namely technical and business operations oriented. The strongest effect of topic interest was observed for generic sustainability competencies, while the other areas showed similarly strong associations.

2. Students' topic interest explained a significant proportion of the variance (R^2 = 0.12 to 0.28) in self-perceived competence levels across all examined competence areas, highlighting the importance of students' topic interest for self-perception of their digital and sustainability competencies in wood science and technology education.
3. Students' topic interest also positively predicted the share of competencies that they attributed to formal education across all examined competence dimensions, including generic digital competencies, generic sustainability competencies, and professional digital and sustainability competencies. The strongest effects were observed for technical professional and generic sustainability competencies.
4. Students' topic interest also explained a significant proportion of the variance in the share of competencies that they attributed to formal education across all examined competence dimensions (R^2 = 0.10 to 0.24), confirming that topic interest affects not only self-perceived competence levels but also how students perceive the role of formal learning in developing digital and sustainability competencies in wood science and technology education.
5. Based on the present study, topic interest is an essential factor that cannot be overlooked when addressing digital and sustainability competencies. It significantly shapes how students perceive their competence levels, highlighting the importance of considering students' interest as a specific motivational factor, along with cognitive and contextual factors, in developing their digital and sustainability competencies in formal education.
6. The results suggest that students' interest in topics of digital and sustainability competencies in wood science and technology education is still in an early developmental phase. While this interest already enhances engagement in formal education, it may not yet be sufficiently developed to support autonomous learning beyond formal settings. This underscores the importance of continued pedagogical support within formal learning environments to foster the progression of interest from situational to individual phases.

ACKNOWLEDGMENTS

The authors are grateful for the support of the Slovenian Research and Innovation Agency under the research programs P4-0015 and P5-0174; and the Ministry of Higher Education, Science and Innovation and NextGenerationEU under the ULTRA project, which is part of the Recovery and Resilience Plan.

REFERENCES CITED

Abrantes, J. L., Seabra, C., and Lages, L. F. (2007). "Pedagogical affect, student interest,

and learning performance," *Journal of Business Research* 60(9), 960-964. https://doi.org/10.1016/j.jbusres.2006.10.026

Ahačič, K., Banjac, M., Baškarad, S., Belasić, I., Bergoč, Š., Bešter, J., Borota, B., Bratina, K., Brečko, B., Breznik, I., *et al*. (2024). "Skupni cilji in njihovo umeščanje v učne načrte in kataloge znanj," Zavod Republike Slovenije za šolstvo, www.zrss.si/pdf/skupni_cilji.pdf

Ainley, M., and Ainley, J. (2011). "Student engagement with science in early adolescence: The contribution of enjoyment to students' continuing interest in learning about science," *Contemporary Educational Psychology* 36(1), 4-12. https://doi.org/10.1016/j.cedpsych.2010.08.001

Ainley, M., Hidi, S., and Berndorff, D. (2002). "Interest, learning, and the psychological processes that mediate their relationship," *Journal of Educational Psychology* 94(3), 545-561. https://doi.org/10.1037/0022-0663.94.3.545

Azevedo, F. (2015). "Sustaining interest-based participation in science," in: *Interest in Mathematics and Science Learning*, K. A. Renninger, M. Nieswandt, and S. Hidi (Eds.), American Educational Research Association, Washington, DC, pp. 281-296. https://doi.org/10.3102/978-0-935302-42-4_16

Bagozzi, R. P., and Yi, Y. (1988). "On the evaluation of structural equation models," *Journal of the Academy of Marketing Science* 16(1), 74-94. https://doi.org/10.1007/BF02723327

Bathgate, M. E., Schunn, C. D., and Correnti, R. (2014). "Children's motivation toward science across contexts, manner of interaction, and topic," *Science Education* 98(2), 189-215. https://doi.org/10.1002/sce.21095

Berlyne, D. E. (1949). " 'Interest' as a psychological concept," *British Journal of Psychology* 39(4), 184-195. https://doi.org/10.1111/j.2044-8295.1949.tb00219.x

Bianchi, G., Pisiotis, U., and Cabrera Giraldez, M. (2022). "GreenComp: The European sustainability competence framework," *Publications Office of the European Union*, Luxembourg.

Breque, M., De Nul, L., and Petridis, A. (2021). *Industry 5.0 – Towards a Sustainable, Human-Centric and Resilient European Industry*, European Commission: Directorate-General for Research and Innovation, Publications Office of the European Union. https://doi.org/10.2777/308407

Carretero, S., Vuorikari, R., and Punie, Y. (2017). *DigComp 2.1 – The Digital Competence Framework for Citizens with Eight Proficiency Levels and Examples of Use*, EC Joint Research Centre, Publications Office of the European Union. https://doi.org/10.2760/38842

Chaudhary, P., and Singh, R. K. (2022). "A meta analysis of factors affecting teaching and student learning in higher education," *Frontiers in Education* 6, article 824504. https://doi.org/10.3389/feduc.2021.824504

Flowerday, T., and Shell, D. F. (2015). "Disentangling the effects of interest and choice on learning, engagement, and attitude," *Learning and Individual Differences* 40, 134-140. https://doi.org/10.1016/j.lindif.2015.05.003

Fornell, C., and Larcker, D. F. (1981). "Evaluating structural equation models with unobservable variables and measurement error," *Journal of Marketing Research* 18(1), 39-50. https://doi.org/10.2307/3151312

Ginsberg, E., Ginsburg, S. W., Axelrad, S., and Herma, J. L. (1951). *Occupational Choice: An Approach to a General Theory*, Columbia University Press, New York.

Goropečnik, L., Makovec Radovan, D., and Kropivšek, J. (2024). "Empowering

advancement of wood and furniture sector through key digital and sustainability competencies," *Drvna industrija* 75(3), 337-347. https://doi.org/10.5552/drvind.2024.0165

Goropečnik, L., Makovec Radovan, D., Grošelj, P., and Kropivšek, J. (2025). "Gaps between students' self-perceived digital and sustainability competencies and the expectations of the wood and furniture industry," *Forests* 16(7), articlee 1194. https://doi.org/10.3390/f16071194

Goropečnik, L., Kropivšek, J., Kristl, N., and Makovec Radovan, D. (2026). "The effect of students' academic motivation on their self-perceived digital and sustainability competencies in wood science and technology education," *BioResources* 21(1), 267-287. https://doi.org/10.15376/biores.21.1.267-287

Guo, Y. M., Klein, B. D., and Ro, Y. K. (2020). "On the effects of student interest, self-efficacy, and perceptions of the instructor on flow, satisfaction, and learning outcomes," *Studies in Higher Education* 45(7), 1413-1430. https://doi.org/10.1080/03075079.2019.1593348

Hidi, S. (1990). "Interest and its contribution as a mental resource for learning," *Review of Educational Research* 60(4), 549-571. https://doi.org/10.3102/00346543060004549

Hidi, S., and Harackiewicz, J. M. (2000). "Motivating the academically unmotivated: A critical issue for the 21st century," *Review of Educational Research* 70(2), 151-179. https://doi.org/10.3102/00346543070002151

Hidi, S., and Renninger, K. A. (2006). "The four-phase model of interest development," *Educational Psychologist* 41(2), 111-127. https://doi.org/10.1207/s15326985ep4102_4

Hyytinen, H., Laakso, S., Pietikäinen, J., Ratvio, R., Ruippo, L., Tuononen, T., and Vainio, A. (2023). "Perceived interest in learning sustainability competencies among higher education students," *International Journal of Sustainability in Higher Education* 24(9), 118-137. https://doi.org/10.1108/ijshe-06-2022-0198

Ilomäki, L., Paavola, S., Lakkala, M., and Kantosalo, A. (2016). »Digital competence – An emergent boundary concept for policy and educational research. *Education and Information Technologies* 21(3), 655-679. https://doi.org/10.1007/s10639-014-9346-4

Krapp, A., Hidi, S., and Renninger, K. A. (1992). "Interest, learning, and development," in: *The Role of Interest in Learning and Development*, K. A. Renninger, S. Hidi, A. Krapp, and A. Renninger (eds.), Psychology Press, pp. 3-25. https://doi.org/10.4324/9781315807430

Kropivšek, J. (2018). "Konceptualni model digitalizacije izobraževanja: Primer visokošolskega izobraževanja v lesarstvu v Sloveniji," *Les/Wood* 67(2), 63-74. https://doi.org/10.26614/les-wood.2018.v67n02a06

Kropivšek, J., and Grošelj, P. (2020). "Digital development of Slovenian wood industry," *Drvna industrija* 71(2), 139-148. https://doi.org/10.5552/drvind.2020.1961

Kunter, M., Baumert, J., and Köller, O. (2007). "Effective classroom management and the development of subject-related interest," *Learning and Instruction* 17(5), 494-509. https://doi.org/10.1016/j.learninstruc.2007.09.002

Lee, W., Lee, M.-J., and Bong, M. (2014). "Testing interest and self-efficacy as predictors of academic self-regulation and achievement," *Contemporary Educational Psychology* 39(2), 86-99. https://doi.org/10.1016/j.cedpsych.2014.02.002

Lopez, F., Lent, R., Brown, S., and Gore, P. (1997). "Role of social-cognitive expectations in high school students' mathematics-related interest and performance,"

Journal of Counseling Psychology 44(1), 44-52. https://doi.org/10.1037/0022-0167.44.1.44

Makovec Radovan, D. (2025). *Načrtovanje in izvajanje kompetenčno zasnovanih programov v poklicnem in strokovnem izobraževanju*, Institute of Vocational Education and Training, Ljubljana.

Mali, D., Hrast Debeljak, B., Bokal, D., Hergan, M., Dular, B., Dovžak, K., Jurman, T., Krajnc, B., Ličen, S., Makovec, N., Meden, J., Pipan, E., Razpet, A., Turk, M., and Žnidarič, H. (2025). "Izhodišča za pripravo višješolskih študijskih programov," Center RS za poklicno izobraževanje, https://cpi.si/wp-content/uploads/2024/08/A5_Izhodisca-za-pripravo-visjesolskih-studijskih-programov-2025.pdf

Marsh, H. W., Trautwein, U., Lüdtke, O., Köller, O., and Baumert, J. (2005). "Academic self-concept, interest, grades, and standardized test scores: Reciprocal effects models of causal ordering," *Child Development* 76(2), 397-416. https://doi.org/10.1111/j.1467-8624.2005.00853.x

Ministry of Economic Development and Technology, and Wood Industry Directorate. (2022). *Implementation Document for the Development of the Slovenian Wood Industry until 2030*.

Muench, S., Stoermer, E., Jensen, K., Asikainen, T., Salvi, M., and Scapolo, F. (2022). *Towards a Green and Digital Future – Key Requirements for Successful Twin Transitions in the European Union*, European Commission: Joint Research Centre, Publications Office of the European Union. https://doi.org/10.2760/977331

Núñez, M. E., Siddiqui, M. K., and Abbas, A. (2024). "Motivation, attitude, knowledge, and engagement towards the development of sustainability competencies among students of higher education: A predictive study," *Discov Sustain* 5, article 335. https://doi.org/10.1007/s43621-024-00556-0

Ozili, P. K. (2022). "The acceptable R-square in empirical modelling for social science research," *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4128165

Pressick-Kilborn, K. (2015). "Canalization and connectedness in the development of science interest," in: *Interest in Mathematics and Science Learning*, K. A. Renninger, M. Nieswandt, and S. Hidi (eds.), American Educational Research Association, Washington, DC, pp. 353-368. https://doi.org/10.3102/978-0-935302-42-4_20

Renninger, K. A., and Hidi, S. (2017). *The Power of Interest for Motivation and Engagement*, Routledge, London. https://doi.org/10.4324/9781315771045

Renninger, K. A., and Pozos-Brewer, R. K. (2015). "Interest, psychology of," in: *International Encyclopedia of the Social and Behavioral Sciences* (2nd Ed.), J. D. Wright (ed.), Elsevier, Amsterdam, pp. 378-385. https://doi.org/10.1016/B978-0-08-097086-8.26035-2

Renninger, K. A., and Shumar, W. (2002). "Community building with and for teachers at The Math Forum," in: *Building Virtual Communities*, Cambridge University Press, Cambridge, pp. 60-95. https://doi.org/10.1017/cbo9780511606373.008

Scarlat, N., Dallemand, J.-F., Monforti-Ferrario, F., and Nita, V. (2015). "The role of biomass and bioenergy in a future bioeconomy: Policies and facts," *Environmental Development* 15, 3-34. https://doi.org/10.1016/j.envdev.2015.03.006

Schiefele, U. (1992). "Topic interest and levels of text comprehension," in: *The Role of Interest in Learning and Development*, K. A. Renninger, S. Hidi, A. Krapp, and A. Renninger (eds.), Psychology Press, pp. 151-182. https://doi.org/10.4324/9781315807430

Shin, D. D., Kim, S.-I., Lee, M.-J., Jiang, Y., and Bong, M. (2022). "Role of perceived competence and task interest in learning from negative feedback," *Frontiers in Psychology* 13, article 830462. https://doi.org/10.3389/fpsyg.2022.830462

Skubic Ermenc, K., Makovec Radovan, D., Čop, J., Žnidarič, H., Pipan, E., Ahčin, A., Jug Skledar, M., Kovač Hace, S., Butinar Mužina, M., Mandeljc, M., Kočica, J., Robnik, V., Klopčič, P., Sambolić Beganović, A., Andrin, A., and Vidovič, M. (2024). "Izhodišča za prenovo katalogov znanj za splošnoizobraževalne predmete v poklicnem in strokovnem izobraževanju," Zavod Republike Slovenije za šolstvo, www.zrss.si/pdf/izhodisca_za_prenovo_KZ.pdf

Swarat, S. L. (2008). "What makes a topic interesting? A conceptual and methodological exploration of the underlying dimensions of topic interest," *The Electronic Journal of Science Education* 12(2), 1-26.

Tongco, M. D. C. (2007). "Purposive sampling as a tool for informant selection," *Ethnobotany Research and Applications* 5, 147-158.

Unsworth, N., and McMillan, B. D. (2013). "Mind wandering and reading comprehension: Examining the roles of working memory capacity, interest, motivation, and topic experience," *Journal of Experimental Psychology: Learning, Memory, and Cognition* 39(3), 832-842. https://doi.org/10.1037/a0029669

Vlada Republike Slovenije. (2022). *Resolucija o Nacionalnem Programu Visokega Šolstva do 2030 (ReNPVŠ30)*, *Uradni list Republike Slovenije*, 49/2022, https://pisrs.si/pregledPredpisa?id=RESO139

Vuorikari, R., Kluzer, S., and Punie, Y. (2022). "DigComp 2.2: The digital competence framework for citizens - with new examples of knowledge, skills and attitudes," *Publications Office of the European Union*, Luxembourg.

Zafeer, H.M.I., Maqbool, S., Rong, Y., and Maqbool, S. (2025). "Impact of digital learning tools on student's engagement and achievement in middle school science classes," *International Journal of Technology in Education and Science* (IJTES), 9(2), 177-196. https://doi.org/10.46328/ijtes.622

Walkington, C. A. (2013). "Using adaptive learning technologies to personalize instruction to student interests: The impact of relevant contexts on performance and learning outcomes," *Journal of Educational Psychology* 105(4), 932-945. https://doi.org/10.1037/a0031882

Article submitted: November 10, 2025; Peer review completed: December 20, 2025; Revised version received and accepted: December 24, 2025; Published: January 9, 2026.
DOI: 10.15376/biores.21.1.1706-1724