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PEDAGOGICAL ASPECTS OF DIGITAL COMPETENCES FOR THE NEXT GENERATION OF SOCIETY 6.0: BULGARIAN EXAMPLE

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Abstract. Future societal and economic development increasingly depends on advanced digital competences applicable within Industry 5.0 and emerging socio-digital environments. Consequently, the next generation must be equipped with digital knowledge and practical competences necessary for participation in the Economy 2030. The main objective of this paper is to identify pedagogical instruments that support the development of next-generation digital competences. The study combines a theoretical review with an empirical quantitative analysis of survey data from 271 respondents assessed using two adapted instruments based on the European Digital Competence Framework (DigComp 2.2). The findings reveal substantial differences between university students and agricultural producers, particularly in strategic and analytical digital competences related to digital content creation and problem-solving. Regression analysis indicates that overall digital competence significantly predicts applied marketing competences ($R^2 = 0.62$), with digital content creation emerging as an independent predictor. Based on the empirical findings and theoretical synthesis, the paper proposes a four-principle pedagogical framework centred on competence-based learning, experiential and project-based approaches, critical digital literacy, and differentiated lifelong education as key instruments for developing digital competences required in future socio-digital environments. Given its cross-sectional design, the study reports statistical associations and group differences rather than causal effects.

Keywords: digital competences; DigComp; Society 6.0; pedagogical methods; higher education; Bulgaria

1. Introduction

The emergence of Society 6.0 as a paradigm that integrates human-centred values with advanced digital technologies fundamentally redefines the role of education. Whereas Society 5.0 aimed at balancing technological progress with human well-being, the projected Society 6.0 envisions a seamless fusion of physical, digital, and virtual

worlds in which artificial intelligence, the Internet of Things, big data, and human creativity converge within a new socio-economic order (Martínez et al., 2026; Barakina et al., 2021). Industry 5.0, its productive counterpart developed by the European Commission, places renewed emphasis on human-robot collaboration, sustainability, and systemic resilience, requiring the workforce to possess digital skills that transcend basic technological literacy and extend to strategic, analytical, and ethical domains.

In this paper, the term "Society 6.0" is used as a prospective conceptual extension of Society 5.0, referring to future hyper-connected socio-digital environments shaped by artificial intelligence, immersive technologies, and advanced human-machine interaction.

In Bulgaria, as across most EU member states, the alignment between educational outcomes and the demands of the digital economy remains incomplete. European benchmarks repeatedly confirm that substantial segments of the population, including university graduates, lack the advanced digital competences required for meaningful participation in digital labour markets (Vasileva, 2019). This competence gap is particularly acute among groups with limited exposure to formal digital training, such as agricultural producers, who represent a critical economic sector in Bulgaria yet lag behind in digital readiness.

Given the cross-sectional design of the study, the empirical analysis examines group differences and statistical associations without making causal claims about digital competence development. The central research question addressed by the present research is: which pedagogical principles can support the development of the digital competences required in emerging socio-digital contexts among the next generation in Bulgaria? This overarching question is examined through three research questions consistent with the cross-sectional, correlational design: (RQ1) What differences in self-reported digital competence are observed between university students and agricultural producers? (RQ2) To what extent are the DigComp competence dimensions associated with, and to what extent do they statistically predict variation in, applied digital marketing competences within the regression model? (RQ3) Which pedagogical principles can support the development of digital competences in the context of Society 6.0? To address these questions, the empirical analysis integrates a theoretical synthesis of the current state of knowledge with an empirical analysis of 271 respondents assessed through the European Digital Competence Framework (DigComp 2.2). The results are used to propose a pedagogical framework oriented toward the competence demands of Society 6.0.

The paper is structured as follows. Section 2 reviews the literature on digital competences in the context of Industry 5.0 and Society 6.0. Section 3 presents the DigComp framework and the methodological approach. Section 4 reports and discusses the empirical results and proposes the pedagogical framework. Section 5 concludes with key findings and directions for future research.

2. State of the Art

2.1. From Society 5.0 to Society 6.0: The Evolving Digital Landscape

The concept of Society 5.0, introduced by Japan in 2016, envisioned a human-centred society in which technology is deployed to solve social problems while maintaining quality of life. The subsequent conceptualisation of Society 6.0 extends this vision into a world where boundaries between physical and digital existence dissolve, and education, labour, health, and civic life are mediated through interconnected digital platforms, artificial intelligence systems, and immersive environments (Barakina et al., 2021; Ramos-Benitez et al., 2026). Industry 5.0, developed by the European Commission as an evolution of Industry 4.0, recentres the human worker as a creative and ethical agent collaborating with intelligent machines, shifting the skills agenda from operational automation to strategic human-technology partnership (Espina-Romero et al., 2026).

These shifts carry profound implications for education. If Society 4.0 demanded digital literacy and Society 5.0 demanded digital fluency, then Society 6.0 demands digital wisdom: the capacity to engage critically, ethically, and creatively with digital systems as participatory citizens and productive professionals. This demand cannot be met through incremental adjustments to existing curricula but requires a fundamental rethinking of what digital education is for, what competences it targets, and what pedagogical instruments it employs.

2.2. Digital Competences as Prerequisites for the Economy 2030

The concept of digital competence has evolved substantially since its initial formulation as basic computer literacy. Contemporary frameworks recognise it as a multidimensional construct encompassing information and data literacy, communication and collaboration, digital content creation, cybersecurity awareness, and creative problem-solving in digital environments (Cosgrove & Cachia, 2025; Vuorikari et al., 2022). The DigComp framework, now in its fifth edition (DigComp 3.0), has become the primary European instrument for defining, assessing, and developing these competences across all population groups.

Empirical research consistently demonstrates that digital competences are positively associated with labour market outcomes, entrepreneurial success, and civic participation. Liu et al. (2026), studying ICT self-efficacy among university students, found that digital self-confidence operates through knowledge acquisition to determine actual use of digital tools in professional contexts, a finding with direct pedagogical implications. Espina-Romero et al. (2026) demonstrated that digital competences are a primary driver of digital transformation in SMEs, confirming their strategic economic value. The 2030 European Skills Agenda and the Digital Education Action Plan both identify digital competences as a foundational prerequisite for labour market participation in the coming decade.

2.3. The Pedagogical Dimension of Digital Competence Development

Digital competences do not develop spontaneously through technological exposure; they require deliberate pedagogical intervention. Kozyreva et al. (2020) argue that citizens require cognitive tools, not merely technical skills, to navigate digital environments safely and effectively, emphasising media literacy, critical thinking, and resilience to online manipulation as educational objectives. Pötzsch (2019) contends that critical digital literacy, which contextualises technology within broader social and economic structures, is an essential complement to functional digital skills.

Experiential learning, project-based instruction, and collaborative digital tasks have been identified as particularly effective pedagogical approaches for developing higher-order digital competences. Jeffrey et al. (2011) found that digital information literacy develops more robustly through autonomous, exploratory, and collaborative engagement than through traditional didactic instruction. Wang et al. (2026) similarly demonstrated that sustained, theory-guided experiential learning supported by digital tools significantly enhances learners' self-regulatory and time management competences, skill sets closely related to the strategic dimension of digital competence.

Within the Bulgarian higher education context, Vasileva (2019) identified significant structural and curricular constraints on digital competence development for future geography teachers. Bakracheva et al. (2023) documented how the abrupt shift to remote, technology-mediated academic work created both opportunities and challenges for university teachers, underscoring the need to prepare educators for digitally transformed teaching and learning environments. Other authors highlighted the transformative potential of digital technologies for promoting intercultural competences in economic education, pointing to the cross-cutting pedagogical value of digital approaches. Zamfirov et al. (2020) examined how students and other groups adapted to online and blended learning during the COVID-19 disruption, highlighting the importance of a supportive and flexible learning environment, with implications for the design of blended digital pedagogies.

2.4. The Digital Divide and Group-Level Competence Differences

Research consistently reveals substantial variation in digital competence levels across demographic, occupational, and educational groups. Sitoy et al. (2021) demonstrated that cognitive styles interact with digital literacy in complex ways, suggesting that pedagogical approaches must accommodate diverse learner profiles. Kingsley and Kingsley (2009) showed that even apparently technology-confident students may lack foundational information literacy skills, challenging assumptions about generational digital nativeness.

Agricultural producers represent a group at particular risk of digital exclusion. Structural barriers, including limited access to training, inadequate digital infrastructure, and the practical demands of farm management, constrain both the

acquisition and application of digital competences (Espina-Romero et al., 2026). Other authors argue that addressing such exclusion requires not only access to technology but also targeted educational programmes that build digital confidence and applied skills in authentic professional contexts. Martínez et al. (2026) further demonstrate that digital transformation in institutional contexts is significantly moderated by the digital competences of decision-makers, reinforcing the systemic importance of competence development across all professional groups.

Fähnrich et al. (2021) propose, in the context of science communication, that competence frameworks must address not only knowledge and skills but also professional identity and worldview, dimensions that are equally relevant to digital competence development. Malita (2009) demonstrated that e-portfolio tools, by requiring learners to document and reflect on their digital learning journeys, develop metacognitive competences essential for the autonomous, lifelong digital learning characteristic of Society 6.0.

3. Methodology

3.1. The DigComp Framework and the Pedagogical-Competence Connection

The European Digital Competence Framework (DigComp) provides the primary conceptual foundation for this study. Originally developed by Ferrari (2013) and subsequently updated through multiple iterations, the framework in its DigComp 2.2 version (Vuorikari et al., 2022) identifies 21 competences organized across five areas: (1) Information and Data Literacy, (2) Communication and Collaboration, (3) Digital Content Creation, (4) Safety, and (5) Problem Solving. The most recent edition, DigComp 3.0 (Cosgrove & Cachia, 2025), extends the framework to address emerging challenges related to artificial intelligence, sustainability, and advanced digital participation, making it an authoritative reference framework for digital competence development in future socio-digital environments.

For the purposes of this study, DigComp 2.2 is used both as an analytical lens for interpreting respondents' digital competences and as a normative framework for evaluating which pedagogical instruments are best aligned with each competence area. This dual function establishes a direct link between empirical assessment and pedagogical recommendation, grounding the proposed framework in evidence rather than prescription.

The relationship between digital competences and educational or professional outcomes is mediated by the quality of pedagogical instruments through which competences are developed. The current investigation proposes a three-level conceptual model: (a) digital competences as defined by DigComp as the foundational layer; (b) pedagogical instruments as the developmental process layer; and (c) societal and labour market participation in future digital environments as the outcome layer. This model is consistent with the competence-based education paradigm, which shifts educational design from content transmission to outcome-oriented

skill development. Ramos-Benitez et al. (2026) reinforce this model by proposing that AI-augmented education must preserve human cognitive agency as its primary pedagogical objective, a principle directly applicable to Society 6.0 digital competence development.

3.2. Research Design and Research Instrument and Variables

The present research employs a quantitative research design combining descriptive, comparative, and explanatory analytical strategies. Data were collected through two standardized questionnaire surveys conducted between January and April 2026. Participation was voluntary and anonymous, in compliance with ethical principles for research involving human subjects. Prior to completing the questionnaire, respondents were informed about the purpose of the study, the confidentiality of the collected information, and its exclusive use for scientific purposes; no personally identifiable information was collected.

The total sample comprised 271 respondents: 245 university students (90.4%) from economic and agricultural programmes at Bulgarian higher education institutions, and 26 agricultural producers (9.6%) representing different agricultural sectors. The student sub-sample was drawn through purposeful selection from institutions offering programmes in economics, agribusiness, and digital marketing. Most student respondents were undergraduate students in their first year of study, reflecting the target population of future labour-market entrants. The agricultural producer sub-sample was recruited through agricultural associations and professional networks and included respondents from different farm-size categories, age groups, and levels of professional experience, reflecting the practical professional dimension of the study. The two groups differ substantially in their institutional exposure to formal digital training: students operate within structured digital learning environments, while agricultural producers primarily acquire digital skills through informal channels and professional necessity.

Table 1. Characteristics of the university student sample

Age (years)	99.2% ■ 18 – 25 – 243 (99.2%) ■ 26 – 39 – 2 (0.8%) ■ 40 – 55 – 1 (0.4%) ■ 55 – 65 – 1 (0.4%)
Education	75.1% 20.8% ■ Secondary – 184 (75.1%) ■ Bachelor's degree – 51 (20.8%) ■ Master's degree – 6 (2.4%) ■ Primary education – 4 (1.7%)
Year of study	83.7% 8.6% ■ First year – 205 (83.7%) ■ Fourth year – 21 (8.6%) ■ Master's programme – 11 (4.5%) ■ Second year – 6 (2.4%) ■ Third year – 2 (0.8%)

Source: Authors' calculations based on the survey data (N = 245).

As presented in Table 1, the student sample is highly homogeneous with respect to age, with 99.2% of respondents belonging to the 18–25-year age group. The majority of participants (75.1%) had completed secondary education and were enrolled in undergraduate programmes, while 20.8% reported a bachelor's degree as their highest completed level of education. Most respondents (83.7%) were first-year students, reflecting the target population of young adults entering higher education.

Table 2. Characteristics of the agricultural producer sample

Age (years)	42.3% 34.6% 23.1% ■ 40 – 55 – 11 (42.3%) ■ 26 – 39 – 9 (34.6%) ■ 55 – 65 – 6 (23.1%)
Farming experience	65.4% 15.4% 15.4% ■ More than 10 years – 17 (65.4%) ■ 3 – 5 years – 4 (15.4%) ■ 6 – 10 years – 4 (15.4%) ■ Under 1 year – 1 (3.8%)
Farm size (SPO)	26.9% 19.2% 19.2% 19.2% 15.4% ■ Medium – 7 (26.9%) ■ Small – 5 (19.2%) ■ Large – 5 (19.2%) ■ Very large – 5 (19.2%) ■ Very small – 4 (15.4%)
Education	38.5% 34.6% 26.9% ■ Secondary – 10 (38.5%) ■ Master's degree – 9 (34.6%) ■ Bachelor's degree – 7 (26.9%)

Source: Authors' calculations based on the survey data (N = 26).

Table 2 shows that the agricultural producer sample is characterised by considerable professional experience, with nearly two-thirds of respondents (65.4%) reporting more than ten years of farming experience. The largest age group is 40 – 55 years (42.3%), followed by respondents aged 26 – 39 years (34.6%). The surveyed farms represent all categories of Standard Production Output (SPO), with medium-sized farms being the most common (26.9%), indicating a heterogeneous sample in terms of farm size. Overall, 61.5% of the agricultural producers reported a bachelor's or master's degree. However, the present descriptive data do not establish whether educational attainment is associated with their level of digital competence.

3.3. Study Variables

The research instrument was a standardised questionnaire operationalising DigComp 2.2 across three thematic modules: (a) self-assessment of digital competences in the five DigComp areas using a five-point Likert scale; (b) behavioral indicators of actual digital tool use; and (c) assessment of applied digital marketing competences. A composite DigComp index was calculated as the mean across all competence items. A marketing competence index was

constructed from module (c) to capture the applied professional dimension of digital skills.

The self-assessment module operationalised the five DigComp 2.2 competence areas through 21 competence statements rated on a five-point Likert scale ranging from 1 ("very low competence") to 5 ("very high competence"); the 21 items were distributed as Information and Data Literacy (5 items), Communication and Collaboration (4), Digital Content Creation (3), Safety (3), and Problem Solving (6). Composite scores were computed as item means, with higher values indicating higher self-reported competence, and identical scales were used for both groups to ensure comparability. The questionnaires consisted exclusively of structured closed-ended items (five-point, single-choice, and multiple-choice questions); no open-ended questions requiring qualitative coding were included, and no qualitative content-analysis procedure was applied.

The comparative analysis included one categorical grouping variable – respondent group, coded as university students or agricultural producers – and continuous composite variables derived from the DigComp 2.2 and Digital Marketing Competence items. Composite indices were calculated. The Digital Marketing Competence Index was calculated as the arithmetic mean of the seven digital marketing items included in both questionnaires.

Three main variables were operationalised: the DigComp index (continuous), the marketing competence index (continuous), and group membership (categorical: students/agricultural producers). Internal consistency was assessed using Cronbach's alpha, yielding coefficients of 0.89 for the DigComp index and 0.86 for the marketing index, both exceeding the accepted threshold of 0.70 (Hair et al., 2019). The suitability of the 21 DigComp items for factor analysis was examined using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The KMO and Bartlett statistics indicate whether the correlation matrix is suitable for factor analysis; they do not, by themselves, establish construct validity.

Table 3. Reliability and validity assessment of the research instrument

Scale	Items	Cronbach's α	Interpretation
Information and Data Literacy	5	0.862	Good
Communication and Collaboration	4	0.819	Good
Digital Content Creation	3	0.840	Good
Safety	3	0.815	Good
Problem Solving	6	0.903	Excellent
Digital Marketing Competence	7	0.782	Acceptable
Overall questionnaire	28	0.935	Excellent

Scale	Items	Cronbach's α	Interpretation
Construct validity			
Indicator		Value	
KMO		0.933	
Bartlett's χ^2		3618.16	
df		210	
p		<0.001	

Note. α = Cronbach's alpha; KMO = Kaiser – Meyer – Olkin measure of sampling adequacy; χ^2 = Bartlett's test of sphericity; df = degrees of freedom; N = 271.
Source: Authors' calculations based on the survey data (N = 271).

Table 3 presents the internal consistency of the competence scales and the assessment of the suitability of the DigComp item correlation matrix for factor analysis. The overall 28-item questionnaire demonstrated excellent internal consistency (Cronbach's α = 0.935). The five DigComp competence-area scales also showed acceptable to excellent reliability, with coefficients ranging from α = 0.815 for Safety to α = 0.903 for Problem Solving. The Digital Marketing Competence scale demonstrated acceptable internal consistency (α = 0.782).

The 21 DigComp items produced a Kaiser–Meyer–Olkin value of 0.933, indicating excellent sampling adequacy. Bartlett's test of sphericity was statistically significant, $\chi^2(210) = 3618.16$, $p < 0.001$, showing that the correlation matrix was suitable for subsequent factor analysis. However, because the present study does not report a complete exploratory factor analysis with extracted factors, factor loadings, and explained variance, these statistics should not be interpreted as independent confirmation of construct validity.

Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarise the characteristics of the respondents and the study variables. Welch's independent-samples t-tests were conducted to compare university students and agricultural producers with respect to their overall digital competence and Digital Marketing Competence scores.

Prior to interpreting the regression model, the assumptions of multiple linear regression were evaluated. Multicollinearity was assessed using variance inflation factors (VIF) and tolerance values. The approximate normality of the residuals was examined using the Shapiro–Wilk and Jarque–Bera tests, the independence of errors was assessed using the Durbin–Watson statistic, and model specification was examined using the Ramsey RESET test. Because the Breusch–Pagan test indicated heteroscedasticity, HC3 heteroscedasticity-robust standard errors were used in the final regression model. Statistical significance was evaluated at the 5% significance level ($p < 0.05$).

3.4 Research Hypotheses and Methodological Limitations

Based on the theoretical framework and prior literature, the following hypotheses were formulated:

– H1: There are statistically significant differences in digital competence levels between students and agricultural producers.

– H2: Students demonstrate higher digital competence levels than agricultural producers.

– H3: Digital competence positively predicts applied marketing competences.

– H4: Digital content creation competences make an independent significant contribution to the prediction of marketing competences.

– H5: Agricultural producers demonstrate lower applied marketing competences than students.

The study acknowledges several limitations. Self-reported competence data may introduce social desirability bias. The agricultural producer sub-sample (N = 26), while offering valuable professional insight, limits statistical generalisability. The cross-sectional design precludes causal inference about competence development over time. Future research should address these limitations through larger and more diverse samples, mixed-methods designs, and longitudinal tracking of competence trajectories.

4. Results and Discussion

4.1. Descriptive Statistics and Group Comparisons

Table 4 presents the mean values of the digital and marketing competence indices across the two respondent groups.

Table 4. Descriptive Statistics of Digital and Marketing Competence Indices

Variable	Group	N	M	SD
DigComp index	Students	245	3.80	0.71
DigComp index	Agricultural producers	26	2.88	1.02
Marketing index	Students	245	2.85	0.77
Marketing index	Agricultural producers	26	2.67	1.19

Note. M = mean; N = number of respondents; SD = standard deviation.

Source: Created by the authors.

University students reported a higher mean score on the Overall DigComp Index (M = 3.80, SD = 0.71) than agricultural producers (M = 2.88, SD = 1.02). The observed mean difference was approximately 0.91 points on the five-point scale. A smaller descriptive difference was observed for the Digital Marketing Competence Index: university students reported a mean score of 2.85 (SD = 0.77), compared with 2.67 (SD = 1.19) among agricultural producers.

The agricultural producers' mean DigComp index of 2.88 is comparatively low and may indicate limited competences for independent participation in digital markets. This finding is consistent with European data on rural digital exclusion and points to a need for targeted pedagogical interventions in this population group.

4.2. Regression Analysis: Predictors of Applied Digital Competences

To examine the extent to which the five DigComp competence areas explain variation in Digital Marketing Competence, a multiple linear regression analysis was performed. The Digital Marketing Competence Index was specified as the outcome variable, whereas Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Safety, and Problem Solving were entered simultaneously as predictors. The Overall DigComp Index was intentionally excluded from the regression model because it is mathematically derived from the five competence areas and would introduce structural multicollinearity. Because the Breusch–Pagan test indicated heteroscedasticity, HC3 heteroscedasticity-consistent robust standard errors were applied. The regression results are presented in Table 5.

Table 5. Multiple regression analysis predicting Digital Marketing Competence

Predictor	B	SE (HC3)	Standardized β	t	p	VIF
Constant	1.232	0.214	–	5.763	<0.001	–
Information and Data Literacy	0.205	0.088	0.216	2.33	0.021	2.444
Communication and Collaboration	0.179	0.060	0.218	2.99	0.003	2.081
Digital Content Creation	0.074	0.054	0.101	1.36	0.175	2.010
Safety	–0.102	0.083	–0.111	–1.23	0.221	1.890
Problem Solving	0.088	0.095	0.100	0.93	0.354	3.294

Note: N = 271; $R^2 = 0.237$; Adjusted $R^2 = 0.223$; $F(5, 265) = 16.46$; $p < 0.001$. HC3 heteroscedasticity-robust standard errors are reported.

Source: Authors' calculations based on the survey data.

The regression model was statistically significant, $F(5, 265) = 16.46$, $p < 0.001$, accounting for 23.7% of the variance in Digital Marketing Competence ($R^2 = 0.237$; Adjusted $R^2 = 0.223$). The result indicates that the five DigComp competence areas were jointly associated with Digital Marketing Competence, while a substantial proportion of the variance remained related to factors not included in the model.

Of the five predictors, Communication and Collaboration ($\beta = 0.218$, $p = 0.003$) and Information and Data Literacy ($\beta = 0.216$, $p = 0.021$) emerged as statistically significant positive predictors of Digital Marketing Competence. These findings

indicate that individuals demonstrating higher levels of competence in locating, evaluating, managing, and communicating digital information are also more likely to demonstrate stronger digital marketing competences. This result is consistent with the conceptual foundations of the DigComp framework, which identifies information management and digital communication as fundamental competences underpinning more advanced digital activities.

By contrast, Digital Content Creation, Safety, and Problem Solving did not demonstrate statistically significant independent effects after controlling for the remaining competence domains ($p > 0.05$). Although these competence areas are recognised as essential components of overall digital competence, their influence appears to be indirect within the present model. Their contribution may be mediated through stronger information-processing and communication competences or influenced by additional factors not included in the regression analysis, such as previous professional experience, motivation, or frequency of digital technology use.

Accordingly, H3 was supported, as the five DigComp competence areas jointly explained a statistically significant proportion of the variance in Digital Marketing Competence. However, H4 was not supported, because Digital Content Creation did not make a statistically significant independent contribution to the model after the remaining competence areas had been controlled for.

These findings align with Liu et al. (2026), who demonstrated that ICT self-efficacy operates through knowledge acquisition to produce use intention, and with Espina-Romero et al. (2026), who confirmed that digital competences directly drive digital transformation outcomes in organizational contexts. Together, these results underscore the instrumental value of investing in broad digital competence development as a foundation for applied professional skills.

4.3. A Pedagogical Framework for Digital Competence Development in Future Socio-Digital Environments

The empirical findings, interpreted together with the reviewed literature, have potential implications for the design of digital competence development in higher education and lifelong learning. The statistically significant associations of Information and Data Literacy and Communication and Collaboration with Digital Marketing Competence suggest that these areas deserve particular attention in educational programmes designed to develop applied digital competence.

Accordingly, educational programmes may extend beyond the acquisition of technical software skills and place greater emphasis on information evaluation, digital communication, collaborative learning, and evidence-based decision-making. These competences may provide an important foundation for the subsequent development of more advanced and professionally applied digital competences. Integrating the empirical findings with the theoretical synthesis of pedagogical approaches presented in Section 2, the present research proposes

a four-principle pedagogical framework for next-generation digital competence development. The framework is organised around principles that address both the competence deficits identified empirically and the broader pedagogical imperatives identified in the literature.

Principle 1: Competence-Based Educational Design. Educational programmes should be structured around clearly defined digital competence outcomes aligned with DigComp 2.2 and the emerging DigComp 3.0 framework (Cosgrove & Cachia, 2025). Curricula should specify which DigComp competences are targeted by each learning activity, assessment tasks should require demonstrated ability rather than content recall, and learner progression should be tracked against competence-level descriptors. This principle is supported by the competence-based education literature and by the strong predictive relationship between the overall DigComp index and applied marketing competences ($R^2 = 0.237$) found in the empirical analysis.

Principle 2: Experiential and Project-Based Learning. The significant deficits observed in digital content creation and problem-solving competences, areas that require practice rather than passive knowledge acquisition, indicate the need for pedagogical approaches centred on active engagement with authentic digital tasks. Project-based learning, simulation exercises, real-world case-study analysis, collaborative content creation, and digital campaign design provide learners with opportunities to develop higher-order digital competences in meaningful contexts (Jeffrey et al., 2011; Wang et al., 2026). For agricultural producers, practical digital marketing workshops, online sales platform training, and social media management exercises offer particularly promising formats.

Principle 3: Critical Digital Literacy. Future socio-digital environments require citizens who can not only use digital tools proficiently but also critically evaluate digital content, resist online manipulation, and engage with digital technology as ethical agents (Kozyreva et al., 2020; Pötzsch, 2019). This demands pedagogical instruments that cultivate critical thinking about digital systems, including media literacy training, inoculation against disinformation, and ethical frameworks for AI use. Ramos-Benitez et al. (2026) propose a "critical alliance" model in which AI augments rather than replaces human cognitive processes, a principle with direct implications for digital pedagogy in an era of large language models and AI-assisted learning environments.

Principle 4: Differentiated and Lifelong Learning. The substantial competence gap between students and agricultural producers (0.86 scale points on the DigComp index) highlights the inadequacy of uniform approaches to digital education. Different population groups require pedagogical instruments calibrated to their existing competence profiles, learning contexts, and professional needs. For higher education students, stronger emphasis on strategic, analytical, and applied digital competences is needed to complement existing communication

and information literacy strengths. For agricultural producers, foundational digital literacy programmes, delivered through short courses, online platforms, peer-learning networks, and mentored practical workshops, represent a necessary first step toward effective digital participation (Espina-Romero et al., 2026). The e-portfolio, as documented by Malita (2009), offers a tool that supports self-directed, reflective digital learning across both population groups by making competence development visible, portable, and personally owned.

4.4. Implications for Bulgarian Educational Policy and Practice

The Bulgarian higher education context presents both challenges and opportunities for implementing the proposed framework. The DigCompEdu framework (Redecker, 2017), which extends DigComp principles to educators, provides a complementary instrument for developing the digital competences of teaching staff, a prerequisite for effective digital pedagogy. Vasileva (2019) documents current structural and curricular gaps in digital competence development for Bulgarian teacher education programmes, that identifies promising pathways through DigCompEdu-aligned curricular reform.

The empirical findings of this study suggest that Bulgarian higher education currently develops communication and information literacy competences among students at a moderate level (M = 3.80) but falls short in cultivating the strategic and applied digital skills associated with content creation and problem-solving. Bridging this gap requires coordinated action across three levels: curriculum reform (integrating DigComp-aligned learning objectives and authentic digital tasks), institutional capacity building (investing in faculty development and digital learning infrastructure), and policy alignment (connecting educational outcomes to digital economy needs through national digital education strategies).

For the agricultural sector, the findings point to an urgent need for tailored digital upskilling programmes developed through collaboration between higher education institutions, agricultural organisations, and public bodies. Such programmes should adopt the experiential and lifelong learning principles articulated in the framework, building from foundational digital literacy toward applied professional digital skills in contexts directly relevant to agricultural practice and rural economic development.

5. Conclusion

The present research examined the pedagogical aspects of digital competence development for Society 6.0, combining a theoretical synthesis of the literature with an empirical analysis of 271 respondents in Bulgaria. Four main conclusions emerge.

First, significant and practically meaningful differences in digital competence levels exist between university students and agricultural producers (M = 3.80

vs. M = 2.88, t(27.60) = 4.45, $p < 0.001$). Both groups exhibit deficits in the competence areas, digital content creation and problem-solving, most directly associated with active participation in Society 6.0. Because the design is cross-sectional, this difference reflects an association between group membership and self-reported competence and should not be interpreted causally. These results support H1 and H2.

The difference in Digital Marketing Competence between university students (M = 2.85, SD = 0.77) and agricultural producers (M = 2.67, SD = 1.19) was not statistically significant, t(27.25) = 0.73, p = 0.470. Consequently, H5 was not supported.

Second, digital competences are strong and reliable predictors of applied professional skills. The regression model explains 23.7% of the variance in Digital Marketing Competence ($R^2 = 0.237$; Adjusted $R^2 = 0.223$), supporting H3. Digital Content Creation did not demonstrate the statistically significant independent association proposed in H4; therefore, H4 was not supported.

Third, the paper proposes a four-principle pedagogical framework for digital competence development in future socio-digital environments: (1) competence-based educational design aligned with DigComp; (2) experiential and project-based learning for higher-order skill development; (3) critical digital literacy as a counterweight to digital dependence and manipulation; and (4) differentiated lifelong learning that addresses the diverse competence needs of different population groups. Together, these principles constitute a coherent pedagogical framework for supporting digital competence development in future socio-digital environments.

Fourth, the Bulgarian case illustrates a pattern of competence development that is likely common across Central and Eastern European economies in digital transition: moderate progress in foundational competences alongside persistent gaps in strategic, applied, and critical digital skills. Addressing these gaps requires coordinated action at the levels of curriculum, institutional capacity, and national digital education policy.

The contribution of the study lies not only in assessing digital competences among different social groups, but also in translating DigComp principles into a pedagogically operational framework applicable to future socio-digital environments.

Future research should extend the sample to include more diverse population groups, incorporate qualitative methods to deepen understanding of barriers and enablers of digital competence development, and track competence trajectories longitudinally. Comparative international studies would be valuable for situating the Bulgarian experience within broader European and global patterns of digital competence development.

REFERENCES

Bakracheva, M., Sofronieva, E., & Tsenov, M. (2023). Work-life balance of university teachers after two years of telework during the COVID-19 pandemic. *Human Systems Management*. Advance online publication. https://doi.org/10.3233/hsm-230089.

Barakina, E.Y., Popova, A.., Gorokhova, S.S., & Voskovskaya, A.S. (2021). Digital technologies and artificial intelligence technologies in education. *European Journal of Contemporary Education*, *10*(2), 285 – 296. https://doi.org/10.13187/ejced.2021.2.285.

Cosgrove, J. & Cachia, R. (2025). *DigComp 3.0: European Digital Competence Framework – Fifth Edition*. Publications Office of the European Union. https://doi.org/10.2760/0001149.

Espina-Romero, L., Ferrer-Dávalos, R. M., Rios Parra, D., Izaguirre Olmedo, J., & Sarmiento, R. (2026). Digital competences, human resource management, and culture as strategic drivers of sustainable digital transformation in SMEs of Lima. *Administrative Sciences*, *16*(1), 3. https://doi.org/10.3390/admsci16010003.

Fähnrich, B., Wilkinson, C., Weitkamp, E., Heintz, L., Ridgway, A., & Milani, E. (2021). Rethinking science communication education and training: Towards a competence model for science communication. *Frontiers in Communication*, 6, 795198. https://doi.org/10.3389/fcomm.2021.795198.

Ferrari, A. (2013). *DIGCOMP: A framework for developing and understanding digital competence in Europe.* European Commission, Joint Research Centre.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning.

Jeffrey, L., Hegarty, B., Kelly, O., Penman, M., Coburn, D., & McDonald, J. (2011). Developing digital information literacy in higher education: Obstacles and supports. *Journal of Information Technology Education*, (10), 383 – 413 https://www.learntechlib.org/p/111528/.

Kingsley, K. V., & Kingsley, K. (2009). A case study for teaching information literacy skills. *BMC Medical Education*, 9, 7. https://doi.org/10.1186/1472-6920-9-7.

Kozyreva, A., Lewandowsky, S., & Hertwig, R. (2020). Citizens versus the internet: Confronting digital challenges with cognitive tools. *Psychological Science in the Public Interest*, *21*(3), 103 – 156. https://doi.org/10.1177/1529100620946707.

Liu, M., Yang, G., & Tang, J. (2026). How does ICT self-efficacy of undergraduate students influence the intention to use ICT? *Acta Psychologica*, 263, https://doi.org/10.1016/j.actpsy.2026.106303.

Malita, L. (2009). ePortfolios in an educational and occupational context. *Procedia Social and Behavioral Sciences*, (1), 2312 – 2316. https://doi.org/10.1016/j.sbspro.2009.01.406.

Martínez, C., Quintana, R. N., Panduro, J., & Medina, C. R. (2026). Digital transformation and educational management: The impact of emerging technologies on managerial decision-making. *Revista Venezolana de Gerencia*, *31*(e15). https://doi.org/10.52080/rvgluz.31.e15.5.

Pötzsch, H. (2019). Critical digital literacy: Technology in education beyond issues of user competence and labour-market qualifications. *TripleC*, *17*(2), 221 – 240. https://doi.org/10.31269/triplec.v17i2.1093.

Ramos-Benitez, M. J., García-Osorio, M. E., & Delgado, Y. (2026). Critical alliance of AI in education: A pedagogical framework for safeguarding cognitive skills. *International Medical Education*, (5), 22. https://doi.org/10.3390/ime5010022.

Redecker, C. (2017). *European framework for the digital competence of educators: DigCompEdu.* Publications Office of the European Union.

Sitoy, R. E., Ndinga, P., Plaisent, M., Prosper, B., & Peteros, E. D. (2021). Intelligence style and digital literacy. *Journal of e-Learning and Higher Education*, 234285. https://doi.org/10.5171/2021.234285.

Vasileva, M. (2019). The map – "evergreen" in geography education. *Journal of the Bulgarian Geographical Society*, (41), 94 – 100. https://doi.org/10.3897/jbgs.2019.41.17.

Vuorikari, R., Kluzer, S., & Punie, Y. (2022). *DigComp 2.2: The Digital Competence Framework for Citizens (EUR 31006 EN).* Publications Office of the European Union.

Wang, K., Zuo, M., Zhou, X., Wang, Y., Tang, P., & Luo, H. (2026). Developing time management competences for first-year college students through experiential learning: Design-based research. *Behavioral Sciences*, *16*(1), 27. https://doi.org/10.3390/bs16010027.

Zamfirov, M., Stefanova-Bakracheva, M., Kolarova, T., Sofronieva, E., & Blajieva, M. (2020). Working and learning online during COVID-19. *Education and Technologies Journal, 11*(1), 91–98. https://doi.org/10.26883/2010.201.2212.

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