Proficiency of teachers' digital content creation

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Purpose: This paper examines the digital competence proficiency of approximately 1,400 Slovenian teachers from 70 primary and secondary schools. The central research question addresses the extent of teachers' proficiency in digital content creation and explores the differences that emerge across various projects.

Study design/methodology/approach: A quantitative survey was conducted to evaluate teachers' competence in digital content creation. The collected data served as the basis for descriptive statistics and comparative analysis. The originality of this approach lies in connecting current state of practice in schools with the measurable indicators defined by the DigComp 2.2 competence framework.

Findings: The findings reveal that teachers generally demonstrate fundamental to intermediate proficiency that varies across specific sub-competencies. Programming is by far the least developed sub-competence by Slovenian teachers. The results highlight the ongoing need for targeted teachers' professional development of digital competencies in order for students to benefit in classrooms. The analysis provides evidence-based insights that support the design of future interventions, tailored more precisely to teachers' needs in digital content creation, thereby contributing to the overall digital readiness of the education system.

Originality/value: The paper builds on a comparative analysis of project activities with the aim of assessing both their impact and the current state of teachers' competencies in creating digital content. The evaluation was carried out in alignment with the DigComp 2.2 framework, which provides a structured perspective on digital competence across different dimensions. By mapping teachers' knowledge and practices to this framework, the study not only highlights the strengths and weaknesses revealed through project implementation but also identifies concrete gaps in digital content creation skills.

Keywords: digital competencies, teachers, Digital content creation, DigComp 2.2., Innovative pedagogy 5.0, DigFit, I-school

Introduction

The European Union developed The Digital Competence Framework for Citizens (DigComp 2.2.) (Vuorikari, Kluser and Punie, 2022) to provide conceptual clarity and to help improve citizens' digital competencies. DigComp 2.2 offers a broad perspective on digital skills applicable to all individuals, including teachers. Following this framework (Vuorikari et al., 2022), we distinguish between 5 key areas comprising all together 21 digital competencies: Information and data literacy, Communication and collaboration, Digital content creation, Safety and Problem solving.

Teachers have to first sufficiently develop their own digital competencies to be able to successfully develop students' digital competencies (Nikolova et al., 2024; Ghomi and Redecker, 2019). Teachers' digital competence influences the extent to which students are prepared to enter the digital world (Kiryakova and Kozhuharova, 2024). Only teachers with highly developed digital competencies can successfully integrate digital tools and technologies into their teaching (Kiryakova and Kozhuharova, 2024) and use digital technologies to transform classroom teaching into innovative forms of learning (Ghomi and Redecker, 2019). Teachers' digital competencies are therefore a key aspect.

The purpose of this paper was to investigate the average levels of teachers' knowledge about digital competencies in the area of Digital content creation, which consists of creating and editing digital content and improving and integrating information and content into existing body of knowledge while understanding how copyright and licenses are applied. Our main research question was: *How proficient are teachers in the area of Digital content creation and what differences are there between the three projects?*

We focused on presenting results of needs analysis of 70 primary and secondary schools in Slovenia, that was carried out in three different international projects, namely *Innovative pedagogy 5.0* (IP5.0) (2023-2026), *Development of digital competencies to support learning and life* (I-school) (2023-2026) and *DigFit* (2024-2026). All three projects aim to develop digital competencies of students.

IP5.0 project is focused on building not only results, experiences and guidelines in the field of digital competencies of students and teachers but also focuses on improving the computer science and informatics knowledge of students (Inovativna pedagogika, n.d.). I-school project aims to raise learners' digital competencies in a holistic way through innovative and modern approaches. The project is aimed at developing new and building on existing and proven didactic approaches, pedagogical strategies and good teaching practices in modern digital learning environments (I-school, n. d.). DigFit project aims to help teachers improve their digital competencies, enabling interactive and personalized teaching and increasing student engagement (Šolski center Kranj, 2024).

The goals of this paper are to:

- Provide a literature review on Digital content creation as one of the areas of digital competencies.
- Present the results of digital competencies of teachers (Digital content creation) based on quantitative methodology.
- Compare the results between three projects.
- State further recommendations for school management.

First, we address the research problem with a literature review, then we describe the research methods and data collection, followed by results of our research. Finally, we discuss the findings and their implications.

Literature Review on Digital Content Creation

Nikolova and colleagues (2024) performed a systematic literature review about good practices linked to the development of students' digital competencies in educational settings. They reported different learning approaches that led to the development of digital competencies. These approaches included Game-based learning, Learning by programming, Game development through programming, Competitions, Problem-based learning, Inquiry-based learning, Heuristic strategies, Computer simulations and modelling. The approaches mentioned were linked to the development of different areas of digital competencies (Vuorikari et al., 2022), including competencies on the area of Digital content creation. What these approaches have in common is that they are all student-centered active learning methods that promote critical thinking and creativity (Nikolova et al., 2024). Connected to this, digital competencies can be developed through various activities focused on digital competencies. For example, a study by Tretinjak and Anđelić (2016) describes a range of activities from the DIGICOMP portal that are aimed at implementing digital competencies in the classroom (ibid). Digital competencies are also being developed by being integrated into curriculums, most commonly in the form of ICT classes. It is important to note that curriculum design for the development of digital competencies should be interdisciplinary, which means that digital competencies should be embedded across all subjects and fields (Fedorova and Nikiforova, 2022). Integrating digital competencies into curricula requires a shift from merely delivering content material in digital form to developing students' digital skills through student-centered learning, interdisciplinary approaches, and project-based learning (Čampelj and Jereb, 2023; Tudor, 2016).

Within the DigComp 2.2. framework, digital content creation is defined as the ability to develop, produce, and disseminate digital resources in diverse formats, ensuring adherence to copyright and licensing requirements, and leveraging appropriate authoring tools and software. It highlights the intersection of technical proficiency, creative design, and ethical considerations in crafting digital learning materials (Vuorikari et al., 2022). Digital content creation is composed of the following sub-competences:

3.1 Developing digital content: encompasses planning and structuring content logically, selecting suitable formats and tools for target audiences.

3.2 Integrating and re-elaborating digital content: involves the ability to modify, adapt, and creatively combine existing digital content into new, coherent, and contextually relevant materials.

3.3 Copyright and licenses: involves understanding and applying copyright regulations and licenses when using, modifying, and distributing digital content. It emphasizes recognizing ownership rights, properly attributing sources, and adhering to licensing terms (e.g., Creative Commons).

3.4 Programming: refers to the ability to plan, design, write, test, and refine digital solutions using programming tools, languages, or platforms. It involves understanding the fundamental principles of coding and computational thinking, including logical reasoning, problem-solving, and algorithmic thinking (ibid.).

Teachers' Proficiency in Digital Competencies

A systematic literature review by Basilotta-Gómez-Pablos and colleagues (2022) demonstrated that teachers' digital competencies range between low to medium-low. The review indicated that teachers have particularly low levels of digital competencies related to the evaluation of educational practice (ibid.). Another systematic review of studies on teachers' digital

competencies highlighted that digital competencies remain a key challenge for teachers. The authors identified a deficit in teacher training and a lack of training in the use of Information and Communication Technology (ICT) (Fernández-Batanero et al., 2022).

Existing studies demonstrate that the level of teachers' knowledge of digital competencies varies across different areas of digital competencies. Multiple studies have shown that teachers on average show a lower level of proficiency in the area of digital content creation (Garzón-Artacho et al., 2021; Zhao et al., 2021; Hinojo-Lucena et al., 2019). Studies that have focused on pre-service teachers reported similar findings (Çebi and Reisoğlu, 2020, Napal Fraile, Peñalva-Vélez & Mendióroz Lacambra, 2018). For example, Spanish teachers in the Lifelong Learning stage had an extremely low level of competence on the area of Digital content creation (Garzón-Artacho et al., 2021). Furthermore, among a sample of Chinese teachers, less than half of them perceived themselves as good at creating websites for students, reusing digital content from virtual communities and modifying the advanced functions of digital tools for the purpose of their work (Zhao et al., 2021). These findings could be considered as problematic, since digital content creation competencies are connected to the work of teachers and to the introduction of ICT tools in learning and teaching (Napal Fraile et al., 2018).

Factors Influencing Digital Competencies Development

Multiple factors have been found to correlate with teachers' digital competence. Age and teaching experience often show negative associations, with younger teachers displaying higher digital skills (Palacios-Rodríguez et al., 2025; Zhao et al., 2021, Lucas et al., 2021). Teachers' gender has emerged as a significant predictor of digital competence, with male teachers reporting higher levels of proficiency in various digital competences, including digital content creation (Palacios-Rodríguez et al., 2025; Zhao et al., 2021). Moreover, subject area differences emerge: STEM teachers typically exhibit higher digital competencies compared to humanities teachers, potentially due to greater familiarity with digital tools in STEM fields (Vieira et al., 2023; Ghomi and Redecker, 2019). Similarly, teachers' attitude towards technology significantly predicts their level of digital competence (Cattaneo, Antonietti & Rauseo, 2022; Ghomi and Redecker, 2019). Institutional support, including access to resources and ongoing professional development, also significantly influences digital competence. For example, a study by Garzón-Artacho and colleagues (2020) showed that teachers who previously received ICT training had a higher level of competence on the area of creating digital content.

Methodology

The current paper compares the results from the needs analysis of three internationally funded projects (IP5.0, I-School and DigFit) focusing on the development of digital competencies of teachers and students. The projects are funded by the Ministry of Education of the Republic of Slovenia and by Recovery and Resilience European Union Fund. Needs analysis was conducted during the first months of the projects by the evaluation group. It was formed on a quantitative methodology, via an online survey questionnaire. The questionnaire was originally developed within the IP5.0 project and was then adapted to the needs of the other projects.

Table 1: Number of participating schools and responses by projects

Project	Number of schools	Number of valid responses	Gender of teachers	
			Male (%)	Female (%)
IP5.0	40	891	16 %	84 %
I-school	22	418	19 %	81 %
DigFit	8	167	22 %	78 %
Total	70	1,476		

Source: Inovativna pedagogika, n.d.; I-šola, n.d., Šolski center Kranj, 2024.

Sample and Data Collection

For each project, the needs analysis was done before project activities even started. Therefore, the results showed the current state of teacher's proficiency in digital competencies before the project intervention. The questionnaire of needs analysis for IP5.0 was conducted in October 2023, and we received a total of 891 valid responses from participating teachers. The samples are not representative of the entire population of Slovenian teachers, but of the partner schools involved in the three projects. Altogether, there are more that 25,000 teachers in primary and secondary schools (SORS, 2025), which means that we covered around 3,5 % of all teacher population. The questionnaire was completed by teachers from 35 primary schools and 5 secondary schools. The gender distribution was in favor of female teachers. The average age of the respondents was 39.9 years and the average length of service in education 17.5 years.

The questionnaire of needs analysis for I-school was conducted in December 2023, with a total of 418 valid responses. The questionnaire was completed by teachers from 20 primary schools, 2 secondary schools. The gender distribution was also in favor of female teachers. The average age of the respondents was 39.4 years and the average length of service in education was 17.6 years.

The questionnaire of needs analysis for DigFit was conducted in December 2024, with a total of 167 valid responses. The questionnaire was completed by teachers from 6 primary schools and 2 secondary schools. The questionnaire was completed by 22% of male teachers and 78 % of female teachers. Their average age was 38.3 years and the average length of service in education 16.4 years.

Figure 1 presents the locations of Slovenian schools participating in each of the three projects. We find that the majority of East Slovenia collaborated in the experimental projects.
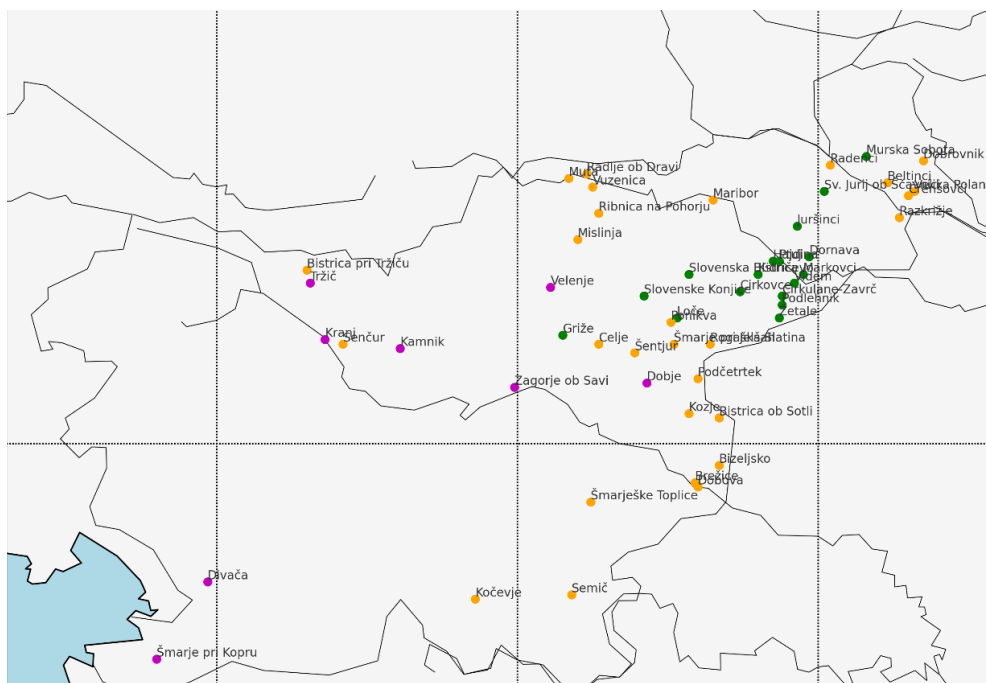
Figure 1: Map of Slovenia with locations of schools by projects

Note: Orange dots = IP5.0 partner schools; green dots = I-school partner schools; purple dots = DigFit partner schools

Source: Inovativna pedagogika, n.d.; I-šola, n.d., Šolski center Kranj, 2024.

Measurement

The questionnaire for the needs analysis was developed in line with a literature review and based on existing questionnaires such as the Talis surveys focusing on aspects of school teaching (*TALIS 2018 Results (Volume I)*, n.d.), SELFIE for Schools (European Commission, n. d.), Selfie for teachers (European Commission, n. d.), DigComp 2.2 framework (Vuorikari et al., 2022) and the ICT EU survey (European Commission et al., 2013) focusing on an overview of ICT activities from the perspectives of principals, teachers, students and parents.

Digital content creation was measured based on its conceptualization in DigComp 2.2. framework. The level of digital competence of teachers was measured on a 4-point scale with answers ranging from 1 = Foundational level, 2 = Intermediate level, 3 = Advanced level to 4 = Highly specialized level. Teachers self-assessed their level of proficiency by choosing either Foundational level, Intermediate level, Advanced level or Highly specialized level for each of the sub-competencies. It is important to note that their reported values may be higher than the actual level of teachers' knowledge as the instrument used was a self-evaluation. Teachers may rate their competencies higher than their actual level of proficiency for various reasons, e.g. overrating their own digital competencies (Muszyński et al., 2023, Maderick et al., 2016), which can lead to validy problems. The subjectivity of our measurement instrument presents the main obstacle of this instrument.

Statistical analysis

Statistical analysis was performed by using descriptive statistics (frequency distribution, measures of central tendencies and measures of dispersion) to compare teachers' digital competencies across three different projects.

Results

Following our research question: *How proficient are teachers in the area of digital content creation and what differences are there between projects?,* we focused on levels of teachers' digital competence proficiency.

Table 2 presents the mean values and standard deviations for four digital content creation sub-competencies across three educational projects: IP5.0, DigFit, and I-school. The scores are based on a scale where higher values indicate greater self-reported competence. On average, developing digital content and integrating, re-elaborating digital content was at intermediate level, while copyright and licenses was between foundational and intermediate level. Teachers from DigFit reported the highest competence in developing digital content, slightly above teachers from IP5.0 and I-school project. Furthermore, DigFit teachers demonstrated a slightly higher mean level of Integrating and re-elaborating digital content, compared to teachers from IP5.0 and I-school project. Teachers from DigFit project on average also demonstrated a higher level of knowledge about copyright and licenses, compared to teachers from IP5.0 and I-school. Competence in programming was the lowest (at foundational level) across all projects. Still differences between projects are minimal and the programming competence can be regarded as similar.

Table 2: Mean values of teachers' competence on the area of Digital content creation

Competence	Project	M	SD	N
3.1 Developing digital content	IP5.0	2	0.8	891
	DigFit	2.2	0.9	167
	I-school	1.9	0.8	418
3.2 Integrating and re-elaborating digital content	IP5.0	1.9	0.8	883
	DigFit	2.1	0.8	163
	I-school	1,9	0.8	412
3.3 Copyright and licenses	IP5.0	1.7	0.8	847
	DigFit	2	0.9	160
	I-school	1.7	0.8	392
3.4 Programming	IP5.0	1.4	0.7	776
	DigFit	1.6	0.8	157
	I-school	1.4	0.7	362

Note: M = Mean, SD = Standard deviation, N = number of responses. Values are based on a 4-point scale where: 1 = Foundational level, 2 = Intermediate level, 3 = Advanced level and 4 = Highly specialized level.

Developing digital content

Teachers from IP5.0 mostly fall within intermediate levels, with fewer reaching higher proficiency. There's room for targeted training to elevate those at the foundational level. Teachers from DigFit stand out for having on average a higher level of advanced knowledge about developing digital content. I-school project has the most teachers at the foundational level, suggesting a need for capacity-building in this area. The majority of teachers from all three projects have an intermediate level of knowledge, indicating that teachers across different contexts can develop and work with digital content to some extent. Teachers within DigFit project show the most promise for fostering advanced skills and expertise. Project partners from I-school may need more foundational support to build the competence of digital content creation. Teachers within IP5.0 project lie somewhere in between (Figure 2).
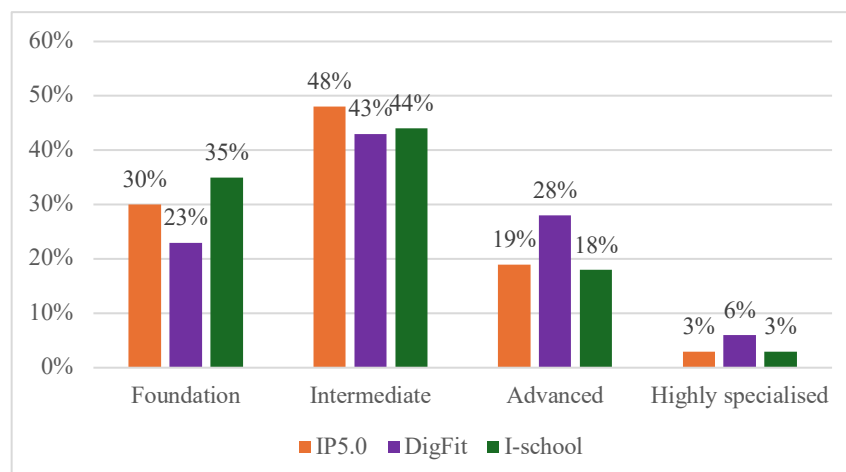
Figure 2: The level of teachers' proficiency in competence 3.1 Developing digital content

Integrating and re-elaborating digital content

A solid share of teachers from IP5.0 project show an intermediate level of knowledge and a third of teachers from this project have only foundational level of knowledge. Teachers from DigFit project have the highest level of proficiency in this competence, with fewer teachers at the foundation level and more at advanced and highly specialized level. Similarly to IP5.0 project, a large share of teachers from I-school project demonstrates an intermediate level of proficiency, but approximately a third of teachers only have foundational knowledge. The lower percentage of I-school teachers with advanced or highly specialized knowledge indicates room for growth. Teachers with an intermediate level of knowledge dominate across all three projects (45–46%). Both IP5.0 project and I-school project have a larger proportion of teachers at the foundation level, suggesting a need for further support and training. The relatively small percentage of teachers with highly specialized knowledge across all projects indicates that expert-level competence in this area remains rare (Figure 3).
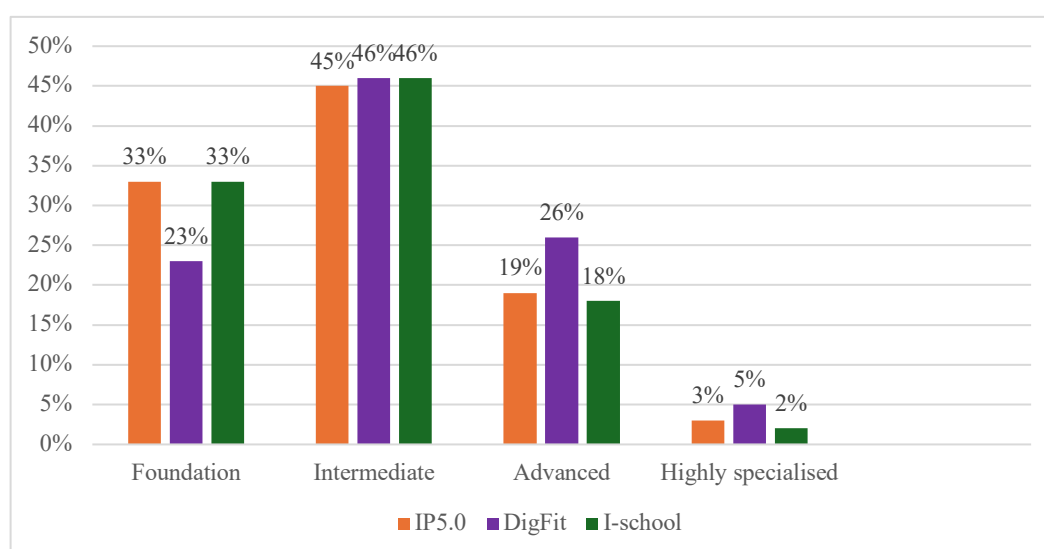

Figure 3: The level of teachers' proficiency in competence 3.2 Integrating and re-elaborating digital content

Copyright and licenses

Most teachers from IP5.0 project report a basic or intermediate level of knowledge, with relatively few having advanced or expert-level competence in copyright and licensing. Teachers from DigFit project appear the most knowledgeable overall when it comes to copyright and licenses. There is a higher share of teachers from DigFit project with advanced and highly specialized level of knowledge, and fewer are at the foundational level, suggesting better training or institutional focus on ethical digital use. Teachers from I-school project show a similar pattern to IP5.0 teachers, with the highest percentage of teachers having a basic level of knowledge. A very small share of teachers from I-school project shows advanced or highly specialized level of knowledge. All the projects have a high share of teachers with a foundational level of knowledge (31–45%), which indicates that many teachers lack solid understanding of copyright and licensing. At the same time, the share of teachers with an intermediate level of knowledge is strong (40–43%) across all three projects. The percentages of teachers with advanced or highly specialized levels of proficiency are relatively small in all three projects, showing a need for targeted professional development in this area (Figure 4).
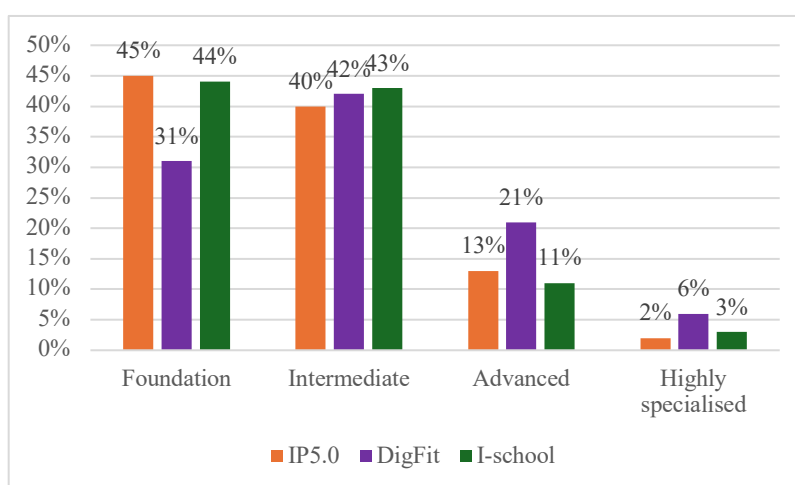

Figure 4: The level of teachers' proficiency in competence 3.3 Copyright and licenses

Programming

The vast majority of teachers from IP5.0 project have only foundational knowledge of programming, with a smaller share of teachers having a higher level of proficiency. DigFit project stands out for having the largest share of teachers with intermediate and advanced level of knowledge, which makes it the strongest project in terms of programming competence. Similarly, to IP5.0 project, a dominant share of teachers within I-school project have only a basic level of knowledge about programming. The results show that the majority of teachers have limited programming experience. Foundation-level knowledge dominates in all three projects (57–71%), confirming that programming remains one of the least developed digital competences among teachers. Overall, there is a very small percentage of teachers with advanced and highly specialized levels of programming knowledge, which shows that there exists a strong need to improve teachers' competence in this area.
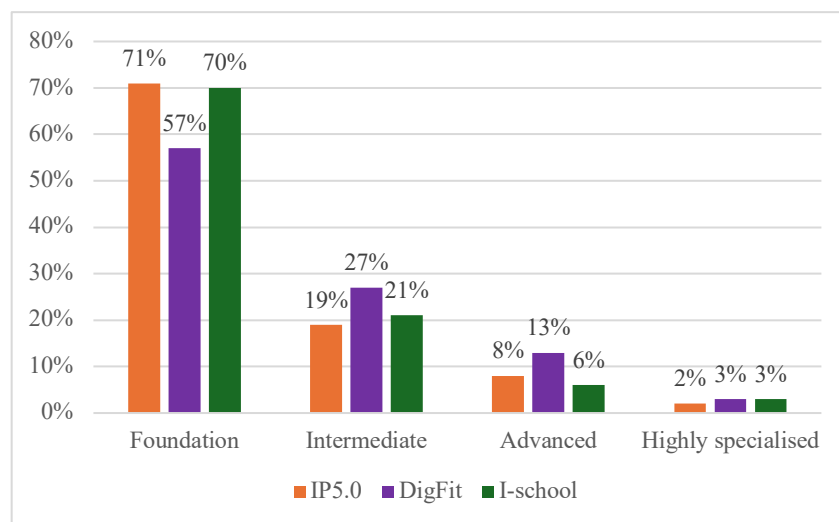
Figure 5: The level of teachers' proficiency in competence 3.4 Programming

Discussion

The results of this research suggest that the self-assessment of the teachers participating in all three projects reveal minor differences. Teachers from DigFit demonstrate the highest levels of digital proficiency in the area of Digital content creation, but on average the level of proficiency is similar in all three projects. Also, in all projects proficiency in programming remains notably low, indicating a clear gap in more technical aspects of this Digital content creation competence. Most teachers assessed themselves at either the foundational or intermediate level, depending on the specific sub-competency. This suggests a heterogeneous distribution of digital skills, where certain areas are more developed than others, reflecting the current structure and focus of teacher training programs.

In line with existing studies (Čampelj and Jereb, 2023; Basilotta-Gómez-Pablos et al., 2022; Fernández-Batanero et al., 2022; Sánchez-Cruzado, Santiago Campión and Sánchez-Compaña, 2021), these findings highlight the ongoing need for targeted professional development in the field of digital competencies among teachers. There is a particular need to strengthen skills related to programming, data literacy, and the use of digital tools for creative and collaborative teaching. Our results are mostly in line with the research of Basilotta-Gómez-Pablos and others (2022) that found that teachers' self-assessment of digital competencies was on a low or medium-low level of proficiency. Moreover, the current paper confirms previous studies that reported about a significant underdevelopment of teachers' programming competencies (Sánchez-Rivas, Ruiz-Roso Vázquez and Ruiz-Palmero, 2024). Our findings also support the fact that future studies should focus on the research gap between teachers' self-perceptions and their actual digital competence (Zhao et al., 2021).

In addition, our findings are in line with results an European survey (European Commission. Directorate General for Communications Networks, Content and Technology. et al., 2019) teachers are least confident in the area of digital content creation. Content creation was evaluated on average at 2.6 (between a little and somewhat) on a scale from 1 (not all) to 4 (a lot).

To support the future development of teachers' digital competencies, we propose several strategies: (1) implementing structured training programs tailored to develop digital content creating, (2) integrating digital skills into both initial teacher education and continuous professional development, and (3) encouraging peer learning and knowledge sharing among teachers in professional learning communities (Vičič Krabonja et al., 2024).

A limitation of our research is that our measurement instrument for assessing teachers' digital competencies is based on teachers' self-assessment of their own knowledge. As mentioned in some of the previous studies (Muszyński et al., 2023, Maderick et al., 2016), teachers may have overestimated their own proficiency of digital competencies.

Conclusion

Developing and evaluating teachers' digital competences is crucial for reforming the educational process in line with the needs of today's digital age (Kiryakova and Kozhuharova, 2024). The results of our study show that the digital competencies of most teachers remain at a foundational to intermediate level of proficiency. A special focus should be given to the development of competencies related to programming, data literacy, and the use of digital tools for creative and collaborative teaching. Our findings thus point to the need for future investment in teacher training on the area of digital competencies. All these needs are and will be addressed in the presented experimental projects. The results of the paper support the fact that teachers' education and training need to include the upgrade of knowledge (core knowledge of computer science, computational thinking and comprehensive pedagogical digital competencies) as this will enable the transformation of Slovenian education into modern smart education (Čampelj and Jereb, 2023).

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