

DIGITAL MATURITY ASSESSMENT IN SECONDARY EDUCATION

Analysis of, and Recommendations for, Public Policies on Digital Transformation of Secondary Schools



September 2023



© 2023 International Bank for Reconstruction
and Development / The World Bank
1818 H Street NW
Washington DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org

This work is a product of the staff of The World Bank with external contributions. The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of The World Bank, its Board of Executive Directors, or the governments they represent.

The World Bank does not guarantee the accuracy of the data included in this work. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of The World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

Rights and Permissions

The material in this work is subject to copyright. Because The World Bank encourages dissemination of its knowledge, this work may be reproduced, in whole or in part, for noncommercial purposes as long as full attribution to this work is given.

Any queries on rights and licenses, including subsidiary rights, should be addressed to World Bank Publications, The World Bank Group, 1818 H Street NW, Washington, DC 20433, USA; fax: 202-522-2625; e-mail: pubrights@worldbank.org.

ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
BBSK	Banskobystrický Samosprávny Kraj (Banská Bystrica Self-governing Region)
BL	Blended Learning
Cedefop	European Centre for the Development of Vocational Training (Centre Européen pour le Développement de la Formation Professionnelle)
CuRI	Catching-up Regions Initiative
DESI	Digital Economy and Society Index
DG	Directorate-General (of the European Commission)
EC/EU	European Commission / European Union
FE	Further Education
HL	Hybrid Learning
IoT	Internet of Things
IT	Information Technology
ICT	Information and Communications Technology
KSK	Košický Samosprávny Kraj (Košice Self-governing Region)
LLD	Lifelong Training and Development
MOOC	Massive Open Online Course
NRI	Network Readiness Index
OECD	Organisation for Economic Co-operation and Development
OER	Open Educational Resources
PIAAC	Program for the International Assessment of Adult Competencies
PSK	Prešovský Samosprávny Kraj (Prešov Self-governing Region)
RACI	Roles and Responsibilities Matrix (Responsible, Accountable, Consulted, and Informed)
SaaS	Software as a Service
STEM	Science, Technology, Engineering, and Mathematics
TALIS	(OECD) Teaching and Learning International Survey
TEL	Technology-enhanced Learning
TVET	Technology-oriented Vocational Education and Training
VET	Vocational Education and Training
VLE	Virtual Learning Environment
VR/AR	Virtual Reality / Augmented Reality
WB	World Bank Group and its associates

Contents

1	Acknowledgements	7
2	Executive Summary	8
3	Introduction	18
3.1	Overview of the Catching-up Regions Initiative 4: The Slovak Republic	19
3.2	Relationship to European Union Themes and Priorities	21
4	Objectives of the Survey and the Departure Point of the Analysis	23
4.1	Assessment Methods and Assumptions	23
4.2	Survey Sample and Target Population Overview	25
4.3	Data Gathering Approach	26
5	Basic Demographics of the Surveyed Population	27
6	Digital Maturity Assessment	29
6.1	What is Digital Maturity?	29
6.2	Calculating digital maturity	29
6.3	Digital maturity outcomes	33
6.4	Digital Maturity Interpretations	38
7	Cross-validation with Third-party Digital Competence Analyses	44
7.1	Country Position in Comparative Indices of Digital Performance	45
7.2	National Index of Digital Readiness—IT Fitness Test	50
7.3	Conclusions from Cross-validation	50
8	Deep Dive Analysis of Identified Challenge Clusters	53
8.1	Operational Age of Educational Infrastructures	55
8.2	Availability of Infrastructure for Hybrid Teaching and Learning	56
8.3	Superficial Usage of Digital Learning Tools and Platforms	57
8.4	Utilization of Digital Aspects in STEM and Vocational Context	58
8.5	Strategy—Systematic Versus Opportunistic Approach to Modernization	59
8.6	The role of a Digital Coordinator in Supporting the Transformation	60
8.7	Awareness and Availability of (Co-)Created Digital Content	61
8.8	Talent with Attitudes of Sharing, Collaborating, and Co-creating	63
9	Responses to Core Challenges and Their Prioritization	65
9.1	Validation of Observations in Focus Groups	66
9.2	Recommended Priorities for Schools, Regions, and the System	74
10	Public Policy Implications and Way Forward	78
11.1	Investment Area 1: Smart and Hybrid Learning Environments	79
11.2	Investment Area 2: Support Centers for Professional Development, Virtual Teams and Digital Content Co-creation	82
11.3	Investment Area 3: Platforms for Virtual Cooperation, Career Development, and Networking of Stakeholders	85
11.4	Investment Area 4: Building a Smart Education Data Foundation	87
11.5	Investment Area 5: Seeding of School-industry Platforms of Digital Excellence to Bridge Schools and Practice More Effectively	90
11.6	Summary of the Proposed Structural Changes	93
12	References	97
13	Appendix 1. Research and Survey Instrument	99
15.1	Assessment Methods and Assumptions	99
15.2	Target Population / Focus Group Definition	102
15.3	Evaluation of Data Gathered via the Survey	103
15.4	Roles and Responsibilities	103

15.5 Assessment Execution Timeline _____	105
15.6 Recommendations for Facilitating the Assessment _____	106

List of Tables

Table 1. Third Party Analyses of Digital Performance Featuring the Slovak Republic _____	44
Table 2. Overview of DESI Performance—the Slovak Republic versus EU averages _____	46
Table 3. The Slovak Republic in the Portulans Institute’s Network Readiness Index 2022 _____	47
Table 4. IT Fitness Test Average Success Rates—2022 Edition _____	50
Table 5. Estimation of Cost/Investment Baseline for Centers of Digital Excellence _____	93
Table 6. Definition of Key Roles in Assessing Digital Maturity in the CuRI Context _____	104
Table 7. RACI Matrix for the Implementation of the Digital Maturity Assessment _____	104
Table 8. Recommended Timeline for Executing the Digital Maturity Assessment _____	106
Table 9. Minimum Percentage Participation Rates for School Leaders, Teachers, and Students per Survey _____	108

List of Figures

Figure 1. Distribution of Surveyed Institutions _____	8
Figure 2. An Average Digital Maturity Map Across All Regions and Schools _____	9
Figure 3. Comparison of ‘Best-in-class’ and ‘Weakest-in-class’ Digital Maturity _____	10
Figure 4. DigCompEdu Framework Overview _____	19
Figure 5. Distribution of Surveyed Institutions _____	25
Figure 6. Distribution of Surveyed Teachers: a) By School Type, b) By Specialization _____	27
Figure 7. Distribution of Surveyed Teachers: a) By Age, b) By Years of Experience _____	27
Figure 8. Totals Affected in the Surveyed Schools: a) Students, b) Teachers _____	28
Figure 9. Distribution of Teachers—Specialists (Vocational versus IT) _____	28
Figure 10. Average Digital Maturity Map Across All Three Regions and All Schools _____	29
Figure 11. Interactive Explorer of Digital Maturity Charts (slicers on the left) _____	31
Figure 12. Comparison of Recorded (a), and Adjusted (b), Digital Maturity Maps Across All Three Regions and Schools _____	31
Figure 13. DigCompEdu Progressive Competence Levels _____	32
Figure 14. Comparison of Digital Maturity per Region _____	33
Figure 15. Comparison of Digital Maturity: a) Grammar Schools, b) COV IT _____	34
Figure 16. Comparison of Digital Maturity: a) SPŠ, b) SOŠ Technical _____	35
Figure 17. Comparison of Digital Maturity: a) SOŠ Services, b) SOŠ Mixed _____	36
Figure 18. Comparison of Unadjusted Attitudes and Adjusted Indexes (a radar map shown for grammar schools as a sample) _____	39
Figure 19. Comparison of “Best-in-class” and “Weakest-in-class” Digital Maturity _____	40
Figure 20. DigCompEdu Common Evaluation Framework Interpretation (Banská Bystrica Region) _____	40
Figure 21. DigCompEdu Common Evaluation Framework Interpretation (Košice Region) _____	41
Figure 22. DigCompEdu Common Evaluation Framework Interpretation (Prešov Region) _____	42
Figure 23. Share of Poor- and Top-Performing Teachers in Problem-Solving in Technology-rich Environments by Country _____	48
Figure 24. Share of Teachers Using ICT for Students’ Projects or Class Work _____	49
Figure 25. Teachers’ Need for ICT Training by Country _____	49
Figure 26. Expected Application of Various Digital Skills, Technologies, and Methods to Jobs Across the Whole EU Economy _____	51
Figure 27. Visual Summary of the DESI Index for the Slovak Republic Against the EU Average _____	52
Figure 28. Four Layers of Digital Modernization in Organizations _____	53
Figure 29. Situation with Essential Digital Infrastructure: (a) Availability and Perceived Sufficiency, (b) Operational Age and Fitness _____	55
Figure 30. Availability of Infrastructure for (a) Hybrid Learning and Teaching, and (b) Exploring Advanced Digital Use Cases _____	56

Figure 31. (a) Utilization of (Administrative) School Information Systems, contrasted	57
Figure 32. (a) General Knowledge of Learning Support Systems and Tools, versus (b) Usage of Digital Learning Tools in STEM Subjects	58
Figure 33. (a) Digital Transformation Strategy and Action Plan Situation, versus (b) Evaluation of Digital Readiness and Progress	59
Figure 34. Creation of Dedicated Roles (a) For ICT Infrastructure Support, and (b) For Digital Coordination and Advisory Service at School	61
Figure 35. (a) Awareness of Third-party Digital Content, versus (b) Personal Willingness to Co-create Digital Content	62
Figure 36. Perception of Obstacles: (a) Talent and Expert Availability, (b) Regional and Sectoral Support for School Transformation	63
Figure 37. Map of Areas Where Secondary Schools Apply Digital Aspects	65
Figure 38. Focus Group—Introduction of Preliminary Outcomes	67
Figure 39. Focus Group—Presentation of National and Sectoral Initiatives	68
Figure 40. Focus Group—Presentation of Focus Group Conclusions	70
Figure 41. Focus Group—Expert Panel Discussion	74
Figure 42. Focus Group—Next Steps and Concluding Remarks	77
Figure 43. Overall Model and Categories of a Modern Education 4.0 Toolkit [32]	95
Figure 44. Contribution of Recommended Investment Packages to the Education 4.0 Architecture and Vision (extending [32])	96
Figure 45. Three-stage Process for the Assessment of Digital Maturity	99

List of Boxes

Box 1. Successful Implementation Example: TVET Platform for Professional Development at BIBB	82
Box 2. Successful Implementation Example: TVET Platform for Professional Development at GIZ	84
Box 3. Successful Implementation Example: IT Academy Program for Digital Coordinators	86
Box 4. Successful Implementation Example: Ed-Fi Alliance and Technology Suite	87
Box 5. Successful Implementation Example: Sample Educational Data Solutions	89
Box 6. Successful Implementation Example: EXAM 4.0 Project	91

1 Acknowledgements

This report was prepared by a core team led by Husein Abdul-Hamid, Task Team Leader of the Vocational Education and Training (VET) component of the CuRI Slovak Republic Project. The team included Martin Džbor (Digitalization Expert), Juraj Ťapák (Digitalization Expert), Štefan Chudoba (Employment and Policy Expert), Andrea Hagovská (EU Programs and Vocational Expert), Helena Virčíková (Regional Development and Business Associations Expert), and Anna Polačková (Education Practitioner and Lecturer). The team would like to thank Vladimír Benč (Project Manager) and Veronika Zimanová (Program Assistant) for their support and guidance for the work on the VET component during the initiative implementation.

The team is also indebted to the education departments of the Banská Bystrica Self-governing Region, the Košice Self-governing Region, and the Prešov Self-governing Region. This report is a product of their support, collaboration, and passion for advancing digital maturity in the regional educational institutions.

The team is grateful for the leadership and guidance of the European Commission CuRI team, especially, Pascal Boijmans, Eva Wenigová, Katarína Prokopič, and Andrej Mikyska, as well as the members of the Ministry of Investment, Regional Development and Informatization of the Slovak Republic team. Special thanks to Peter Balík (Minister of Investment, Regional Development and Informatization), Dominika Forgáčová, Ján Stano, and Karol Schmuck, for their contributions to the process, their comments and feedback pertaining to the report, and the conclusions they provided therein.

The team also would like to thank the following institutions and individuals for participating in the focus groups workshop: Branislav Hadár (director, State Institute for Vocational Education and Training), František Jakab (chair, Sectoral Council for Information and Communication Technologies and director, University Science Park Technicom), Miloslav Karaffa (vice-chair, Slovak Chamber of Industry and Commerce, and owner, ELCOM, s.r.o), Veronika Hubiňaková (coordinator of professional education, Lifelong Learning Center, Pavol Josef Šafárik University), Ján Holub (head, combined secondary school Ľ. Podjavorinskej in Prešov), Štefan Balogh (head, secondary vocational school for ICT in Banská Bystrica), as well as the representatives of Grammar School Konštantínova 2 in Prešov, the secondary vocation school for ICT in Košice, the secondary vocational school for electrotechnics in Prešov, and the secondary vocational schools in Snina, Poprad, Bardejov, and other locales. Their insights and recommendations were valuable to shape the analyses and recommendations summarized in this report.

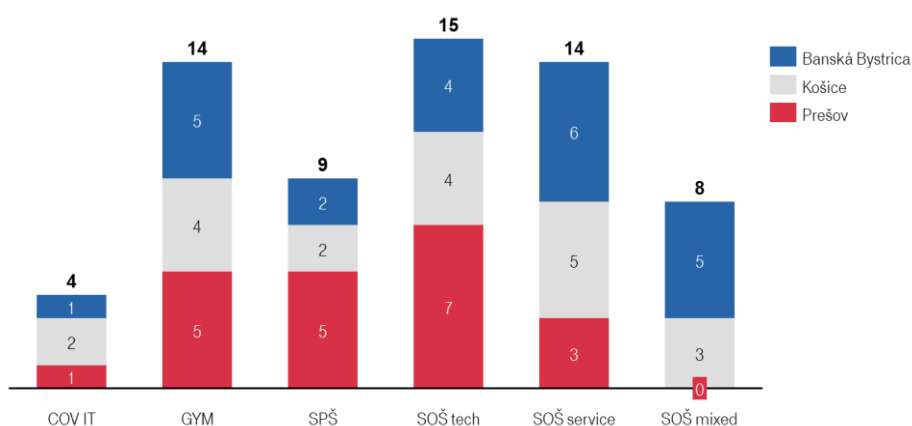
2 Executive Summary

Digitalization requires organizations to do more than just acquire technology or enterprise systems. Educational institutions and their information technology (IT) leaders need to guide the institutional modernization by partnering with businesses and curriculum experts and demonstrating the value that digital technology can deliver to produce competencies, performance targets, and to achieve a successful change. The purpose of this report is to summarize the outcomes of, and the implications for, the policies of the survey assessing digital maturity of regional secondary schools with a focus on vocational education and training (VET). The research has been done in the context of the Catching-up Regions Initiative (CuRI) 4 and applies to three regions in the Slovak Republic—Prešovský, Košický, and Banská Bystrica.

Digitalization of learning and teaching bears a potential to improve learning outcomes, enhance equity, and improve the efficiency of the associated processes. Digital education is most effective and sustainable when supported by the right pedagogical technologies (for example, computers, tablets, and other technologies), embraced by teachers, and embedded in clear teaching goals and sound pedagogies. To know where a particular regional school stands in terms of digital maturity, the World Bank CuRI team has researched the current level of digital maturity and readiness at selected secondary educational institutions. First, a perceptual quick self-assessment of individual educators was carried out. It was followed up by a quantifiable ‘deep dive’ with school management. Surveys covered a range of dimensions, including the following:

- Communication and collaboration using digital tools
- Professional self-development in digital upskilling
- Working with digital resources in learning and teaching
- Applying digitally enabling learning and teaching techniques
- The role of digital tools for learner assessment
- Empowerment of learners in applying and exploring digital resources, tools, and so on
- Developing digital competencies among the learners
- Perceiving data privacy and data protection in educational processes

Figure 1. Distribution of Surveyed Institutions



Source: Authors, 2023.

A mixture of schools was selected for the research, as shown in Figure 1: secondary vocational schools, secondary technical schools, secondary nontechnical (or services) schools, centers

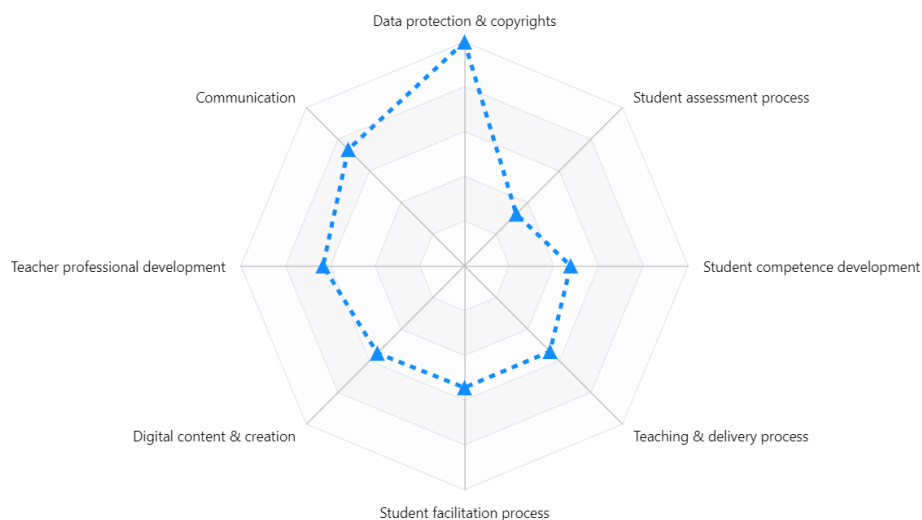
specialized in IT education, secondary combined schools, and grammar schools. Data was gathered by electronic means (online questionnaire). The data were not analyzed at the level of an individual—they were consolidated “per school”, “per region”, and “per school type”, while other “demographic” variables served to cross-check the representativeness. The data gathering process started in the last week in January 2023 and continued through mid-April 2023. Data analysis was carried out during April and May 2023. The focus group that helped validate and complement the gathered data was held during the first week of May 2023. The report was prepared during May and June 2023.

Altogether, the research obtained data from 1,568 educators across different specialization areas, experience, and age groups. The ‘typical’ teacher/trainer surveyed is between 40 and 50 years old, with up to 25 years of professional practice and experience. The numbers show a significant shift toward older teachers, with a substantial lack of the younger generation. In total, the surveyed institutions employ over 2,150 teachers and vocational trainers (thus, a response rate of close to 75% was attained) and provide services to a population of nearly 22,700 students.

For the purpose of this report, digital maturity was seen as a measure of an institution’s capability to consume and create value through digital. Organizations with high levels of digital maturity have an obvious competitive advantage along multiple performance indicators and this, in turn, would impact their performance indicators. On the other hand, organizations with lower levels of digital maturity are more likely to struggle to achieve their strategic ambitions and desired performance. The World Bank team designed an easily comprehensible digital maturity model and visualized it with the help of a radar chart. The dimensions of the survey are shown as labels surrounding the radar field. The radar landscape is divided into five ‘levels’ that correspond to the five-level Likert scale used in answers. An ideal radar expressing full maturity would correspond to a dashed curve spanning the outer edge of the radar field—that is, all dimensions would be assessed at ‘level 5’. The more the curve resembles a circle, the more digitally mature an organization is.

Figure 10 shows an average digital maturity across all surveyed institutions. The charts are based on basic attitudinal data from the survey, which was adjusted by a panel of experts judging the depth and quality of open-ended questions from the survey. The adjustments were applied to the subjective scores, transposed, and used to visualize the digital maturity radar maps.

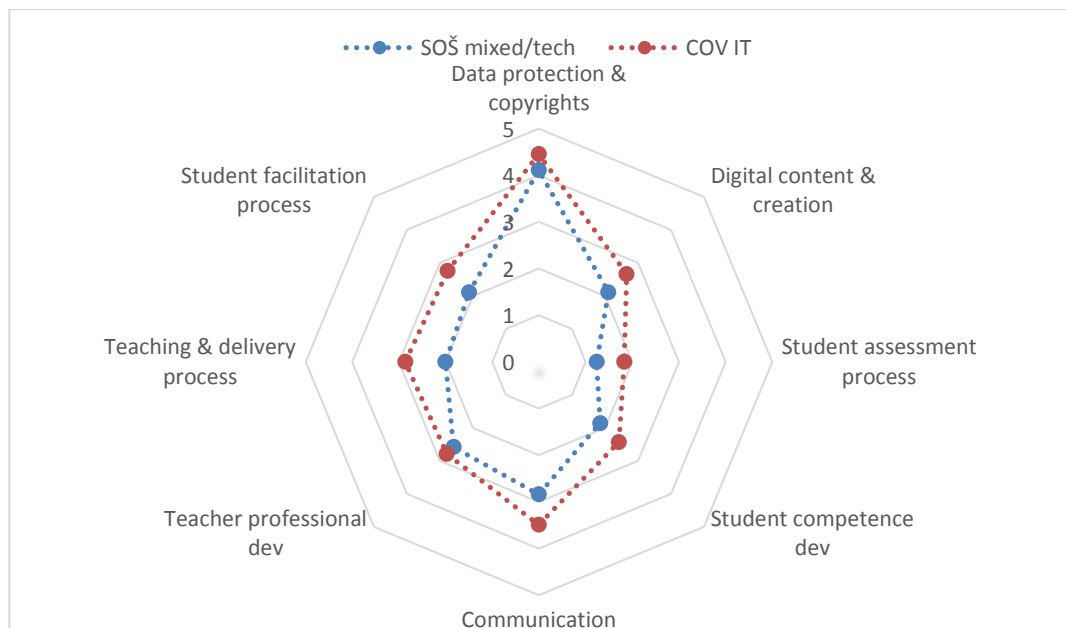
Figure 2. An Average Digital Maturity Map Across All Regions and Schools



Source: Authors, 2023.

The performance of the three regions on digital maturity did not show any substantial differences. When we compared different types of schools, the differences were more visible, with specialized centers for professional development (COV) and grammar schools showing higher maturity than vocational schools across all regions. Generally, the best performance was found in the dimension “data privacy and copyrights”. The lowest levels of performance were generally found in the “student assessment” and “student facilitation” dimensions. The differential between the best and worst performing institution is shown in Figure 3 below.

Figure 3. Comparison of ‘Best-in-class’ and ‘Weakest-in-class’ Digital Maturity



Source: Authors, 2023.

In terms of “communication”, 85% of teachers communicate digitally with their students and colleagues. Fewer teachers collaborate with their internal, in-school ecosystem using virtual methods (58%). Even less collaboration takes place if we bring into context peers and partner communities beyond one’s own schools—here less than 25% of teachers regularly engage in collaborative activities with a partner from outside of their ‘inner bubble’. In the “digital content creation” dimension, 71% of teachers regularly turn to the virtual world to find, evaluate, and download digital content. Only 43% work with this third-party content actively—that is, adapt it, extend it, modify it, or personalize it. Barely one-third of teachers co-created their digital content, that is, cooperate on it with their colleagues at school.

In “teaching and delivery process”, almost half of teachers (44%) claim regular usage of digital tools in their teaching. Yet only 15% of teachers offer their students digital tools for self-learning, self-monitoring of progress, and self-organization of learning experience. Rather surprisingly, only 40% of teachers use digital tools to interconnect theory with practice—to illustrate, exemplify, and engage students in a hands-on way with the theoretical aspects taught. Even fewer (29%) choose digital tools to simulate, demonstrate, or visualize the real-life experience of the concepts and theories taught within the teaching processes.

In “teacher professional development”, 74% of teachers perceive themselves as active in self-driven exploration and the acquisition of digital skills. On a less positive side, only 10% of all surveyed teachers regularly take part in actual digital skill development events, courses (including self-paced) that expose them to digital tools, methods, and/or techniques. Another positive driver in this dimension concerns the readiness to learn from observing more experienced colleagues or through

coaching; over 70% of teachers are open to this method of upskilling. Within the dimension “student facilitation processes”, 34% of teachers actively use digital technologies to engage and include their students in learning experiences, and about the same number (30%) rely on digital tools and methods to help their students self-organize their own learning process and experience. Less than a quarter (24%) apply digital tools to offer personalized and varied learning experiences to their students.

In terms of “student digital competence development”, schools tend to acknowledge the digital know-how of their students (80% give positive marks to the students’ use of digital technology for communication, and 68% acknowledge their skills in using the digital tools for cooperating in study groups). Less than 25% of teachers coach their students in the critical evaluation of online data and information, although as many as 85% expect digital technology to impact critical reading and critical thinking most positively. Only 18% of teachers actively assign tasks expecting students to create something using digital means, although over 90% see digital as a great way to improve students’ creativity and problem-solving competencies. Only 21% of teachers design problem situations to encourage and boost creativity in their classes.

In terms of the DigCompEdu competence framework, the researched schools achieved positions in an interval between levels A2 (“explorer”) and B2 (“expert”)—none has achieved the highest possible levels C1 or C2. The majority of schools achieved level B1 (“integrator”)—36 schools. Level B2 was achieved by 15 schools; they are distributed evenly across all regions. We looked at what might make an institution score at higher levels of maturity. What are the typically correlated behaviors, processes, or activities arising from our survey and how do they compare to the original expectations of the DigCompEdu model? All frontrunners are characterized by high scores in a conjunction of three dimensions: “communication” AND “digital content and creation” AND “teaching and delivery process”. A combination of all three dimensions was rare, but when it happened, the respective school was among the frontrunners. These dimensions were lifted to more positive values by a strong performance on sharing digital content with a school community (“communication”), good capability in reusing, repurposing, adapting, and evolving digital content acquired from third parties (“digital content and creation”).

An important feature was associated with the willingness of teachers to do mutual coaching and observation, as well as to make use of small microcourses and personalized self-development (“teacher professional development”). The factors recognized here as supporting higher levels of maturity all related to something we would label as cultural aspects of the respective institution—the capability to share, to train (especially, to coach and allow observing more experienced colleagues), and to work with content more actively—and these are all signs of digital leadership. In their implementation of digital input into the teaching processes, the frontrunners go well beyond supporting merely communication via digital means. They show a stronger capability to use the tools to collaborate in virtual teams and/or student groups, to more often apply digital tools for simulating and exemplifying abstract concepts, and to leave their students to self-organize and self-monitor their comprehension of both conceptual and practical know-how (“teaching and delivery process”). Indeed, the mere strong commitment to, application of, and focus on ‘deeper aspects’ of digital seems to be synonymous with collaboration, interactive simulation, self-monitoring, and self-organization of student teams; hence, this appears to be a sufficiently reliable indicator of frontrunning.

A third cluster of sufficiently informing behaviors includes those that facilitate a student’s development of competencies, creativity, critical thinking, and other positive skills. The frontrunners show greater than average belief (and application to practice) in the personalization of tasks through digital channels, the adaptation of tasks to facilitate creativity, and above all, the active coaching of

the students or student groups in using and exploring the digital tools, methods, or platforms (the “student facilitation process” and “student competence development” dimensions). This seems to be supporting another important feature of the digital culture—the shift from documenting (writing up notes) to creating products, developing functioning prototypes, experimenting, and testing practical scenarios.

Assessing digital maturity and expressing it either as a map or competence level is useful for digital transformation strategy creation. However, it might be a too coarse perspective if we want to identify and address specific challenges, shortcomings, and pain points. In the digital context, we prefer talking about a full-scale, systemic modernization of an organization. Modernization is a strategy, not only a simple replacement of one organizational function or tool with a new one. Therefore, we analyzed modernization capabilities on four levels: technological, processes, data and capabilities, and people and skills. Among the key observations that were made were the following:

- **Technologies**

- Our survey shows a discrepancy in managing the technological foundation in many secondary schools. While two-thirds of surveyed schools report very good, good, or a satisfactory number of computational devices, more than 80% rely on *infrastructures older than five years*, and are hardly able to support modern application suites, software, or platforms.
- Our survey shows the schools are relatively well equipped for more traditional learning (frontal delivery, in a physical location, to a larger group of students) with enough interactive or projection boards in 71% of schools. However, more than three-quarters are *lacking equipment for hybrid* and interactive teaching/learning. Furthermore, close to 90% of surveyed schools cannot *provide dedicated equipment to their teachers*—be it for preparation, self-development and exploration of new methods, tools, or for other digital pursuits.

- **Processes**

- Our survey shows a rather *superficial usage of digital tools* and methods in teaching processes. While almost 85% of schools use digital means to communicate with teachers and students, active usage of digital tools for active collaboration and product creation is seen in just 61% of surveyed schools. The number of schools capable of digitally evaluating their students and giving them formative feedback falls to only 35%.
- About half of schools perceive their teachers as active users of digital tools in their respective curricular domains. However, only 35% of schools can say that student activity in using digital tools for learning is satisfactory. Furthermore, digital aspects get *relatively rarely applied in teaching science, technology, engineering, and mathematics (the STEM subjects)*—only 16% of schools do it regularly, and about 25%, occasionally.

- **Data, Content and Capabilities**

- In terms of strategic (or systemic) usage of data, the population splits into ‘twin peaks’— about half of schools do measure and evaluate their digital readiness versus a half not gathering such data. About one-third compile a dedicated digital transformation and modernization strategy (that is, a plan) versus about half who *react to external changes opportunistically*.
- While close to three-quarters of teachers are willing to learn by observing their peers (or being coached by them), less than 40% of schools established the role of a digital coordinator/champion. In fact, more than half of the schools face different *obstacles in*

implementing such a supportive, transformation role (despite the formal legislative requirement for a digital coordinator).

- It is relatively positive that in two-thirds of the schools, the skills and confidence of their teachers in using digital tools is sufficiently supportive (as opposed to being an obstacle). However, we see the ‘twin peaks’ outcome again when it comes to *awareness and availability of third-party digital content* and materials (about half of schools consider the lack of information on this topic a major obstacle). Similarly, almost half of schools feel they lack information on professional development in digital skills and competencies.

- **People and Skills**

- Three-quarters of surveyed schools see a key added value to digital possibilities in supporting teacher cooperation and interaction. Yet only a quarter of teachers regularly share digital content and materials with peers beyond one’s own school. About one-third co-create digital content with their colleagues at school, and less than a fifth of them *cooperate at least occasionally with a partner* from another school, or an employer, or a university.
- About two-thirds of schools find it difficult to attract and retain skilled teachers, and one-third believe they *cannot contribute to a regional or local digital transformation agenda* (planning, prioritizing, implementing).
- A partly hidden message coming from our survey relates to a cultural aspect visible in many schools—*‘lone fighting’*—whereby it is up to an individual teacher to find and prepare teaching materials, deliver them, test, and assess students, and to keep improving the curriculum. Lone fighting leads to repeatedly investing in the same effort and significantly reduces time potentially available to exploring and learning new technologies, methods, and so on. This aspect helps to prop up an *organizational culture that is not attractive to a younger generation* of enthusiasts and experts; in surveyed schools, the ratio of teachers aged below 40 versus above 50 reached 1:2. If we take below and above 40, the ratio falls to 1:3 (that is, one ‘younger’ teacher to three ‘senior’ peers).

From the replies to the survey, it becomes apparent that a lot of seeming digital effort goes essentially into maintaining the traditional, existing educational models. This ‘old’ business model emphasizes one teacher to a classroom full of students, usually frontal, a physical delivery of content, and a relatively passive role for the student. On the opposite side are various digitally native methods, tools and technologies encouraging collaboration, creativity, and other qualities and skills. Our findings are that the majority of schools fall into the category of using an ‘old’ approach. These are the institutions, where digital aspects are seen in the shape of projectors with interactive whiteboards as image displays, and that have fast connectivity, but are restricted to one or two specialized informatics laboratories (labs), and other similar restricted situations.

A smaller number of schools started using digital during pandemic times in the form of various Zoom or Teams or Kahoot tools and now keep using it. More or less, such tools only act as new channels for traditional processes and content delivery; instead of a physical teacher, a teacher appears on screen—in a better case, a remote expert addresses the classroom. About the same number of schools started using the digital portfolio more creatively. They introduced various creative sets, simulators, digitally supported student team collaboration, advanced tools on top of the standard office suite (like, for example, 3D modelers and viewers, collaboration canvas boards, agile methods, and so on). Only a tiny majority went all the way to designing and exploring completely new models

of teaching and learning enabled by the digital. These include the following examples: the massive open online courses (MOOCs)/Moodle style software; virtual reality (VR)-/augmented reality (AR)-equipped classrooms to offer embedded experience; the creative exploration of science through games like Minecraft; robotics like Lego Mindstorm; or internet of things (IoT) sensory sets like Microbits.

In order to prioritize the findings and core recommendations, we involved a range of experts from among different stakeholders, who helped us during a focus group workshop. Several representatives from different stakeholders were invited to the workshop to give feedback and help us prioritize recommendations arising from the survey. In total we had 32 participants, and the following categories of stakeholders were represented in the focus groups:

- Regional government representatives
- Representatives of the departments of education from Prešov, Košice, and Banská Bystrica
- Members of school management teams from secondary schools in the regions
- Teachers and digital coordinators from the regional secondary schools
- A representative of the National Institute for Vocational Education on behalf of the Ministry of Education
- Representatives of small, medium, as well as large regional employers
- Representatives of regional chambers and employer associations
- Representatives of the Digital Coalition—The National Coalition for Digital Skills and Jobs of the Slovak Republic, as well as national projects and initiatives working in the field of digitalizing education

We concluded that the following set of major digital ‘anti-patterns’—behavioral and procedural blockers—can be considered as the root causes for the relatively low level of digital maturity among surveyed schools:

1. The majority of secondary schools focus on one-time education

- However, one-time education at the age between roughly 15 and 20 years old, is a sort of ‘old business model’. It is demographically very sensitive, and the schools see it in the declining numbers of new entrants. Declining numbers lead to many schools serving only 150–250 students, which gives little space for efficiency. Compare that to larger school campuses in countries like Spain or Germany, but also in our regions; size gives economic advantage.

2. Our secondary schools rely on close to 100% in-person schooling

- One lecturer serves one class in one course, at any given point in time. While this made sense in the old days, with the opportunities offered by the digital ecosystem, these are sources of inefficiency. One expert teacher is tied to one classroom only, and his or her expertise cannot be reused elsewhere. If we were able to share the workload based on core capabilities, we could get teams preparing content, teams delivering it, and teams assessing students—albeit with overlaps, but not expecting everyone to ‘fight alone’.

3. Schools face a major barrier in ‘space-time’ lock

- In this locked situation, everything happens at a set time and place. While the concept of set classes gives a sense of order, it also contributes to silo thinking (of both teachers and students). Thus, in physics class we learn physics and do not consider how data

analytics, visual skills, programming, essay writing, and other skills may relate to the challenge. Digitally more successful schools explore project-based learning, modular blocks, and more explicitly interacting school subjects. In addition, they consider combining self-learning with group work, looking for connections rather than boundaries.

4. Schools prefer short-term resilience

- They tend to opt for digitalizing their resources (hardware) rather than capabilities (know-how) and value propositions. In the survey, it became clear that a lot of effort went into modernizing the infrastructure (networks, wi-fi, labs, visualizing equipment, smart phones, and tablets). Far less investment went into helping the teachers truly grasp those new technologies—many were ‘left to their own devices’ and had to learn ‘on-the-go’. Support versus neglect for these soft aspects of transformation is the dividing line between digital frontrunners on the one hand, and digital laggards on the other one.

Among many issues, challenges, and pain points, we argue that the following clusters present a viable set of priorities for the schools in the surveyed regions:

1. **Digital transformation needs an alliance of stakeholders. In general, regions and school managements need to address the lack of motivated, enthusiastic, and digitally equipped experts at schools. In particular, new approaches need to be designed to attract such experts to the roles of digital coordinators, champions, advisors, drivers, coaches, and others.**
 - The core challenges for these champions include the persuasion of their peers to use digital technologies more actively for exploration, co-creation, and collaboration, rather than passively as a replacement for traditional blackboards.
 - Digital coordinators need a supportive ecosystem, a platform, and also a clear expectation that they should be acting as role models—not only in using digital content, but in its creation, cooperative and shared development, as well as in strengthening the culture of coaching, observing, and exploring.
2. **The ‘lone fighters’ and the cultural expectation for a teacher being able to cover the entire process end-to-end, while simultaneously innovating and simultaneously caring for the mental well-being of students is out of bounds in today’s volatile, rapidly changing, and complex world.**
 - Digitalization must not stay on the surface; it must not end with shifting traditional processes to be in front of a camera and broadcasting the lecture through virtual media.
 - Technological platforms and social networks need to be explored and supported at the regional and sectoral levels, leading to creating large (albeit virtual) teams of experts whose expertise may go beyond their ‘home’ school.
 - The resistance to mutual interaction with peers, to co-creating digital content, to reusing digital materials and good practices needs to be addressed, for example, via dedicated centers for digital excellence that pursue closer ties to industrial partners, as well as academic partners from universities.
3. **The whole approach to digital transformation needs to shift from dominantly opportunistic and ad hoc to be more systemic, strategic, and structured. Digital transformation is a chance to stop rolling the legacy ballast in front of us and start working**

systematically on ballast removal and replace it with value-added activities, processes, tools, and so on.

- The system needs to transform to be more data-oriented, and schools need to acquire competencies in regularly assessing their capabilities, progress on their strategic plans, and increase their fitness for the changing markets.
 - New forms, possibly virtual or hybrid, need to be explored by the regional authorities to ‘take the game to a new level’—including supporting hybrid digital leadership showrooms and campuses, where schools (teachers and students) meet their industrial partners (be it in the role of business counterpart or future employer).
 - Schools would benefit from designing and sharing good practices on how the digital might be applied to the following: classroom setups; school infrastructure designs; maintenance and upgrading; novel lab equipment; the hybridization of learning and teaching processes; and the introduction of analytic as well as automated processes in the system.
 - New forms of ‘virtual digital campuses’ impact also the role (and the novel capabilities) of regional education authorities, who also undergo transformation from their current ‘ownership’ role to facilitatory, advisory, coordinating competencies, which might strengthen the bond between the the regional ecosystems.
- 4. Digital transformation is not a matter of a single project or exercise. Schools need to learn to continuously adapt their currently prevailing analog model of teaching, not only to new resources and technologies, but especially to new capabilities, new consumers of learning content, and to offer multiple different value propositions to them.**
- The strategic journey toward a digital school is modular. Schools and regions need to approach digital transformation planning as a repetitive process. It is the dots that are seemingly random, but together make up a bigger picture.
 - School management and regional authorities need to master the art of cultural change management. There is no point in devising strategies that are unachievable and put too many expectations on stakeholders.
 - The cultural transformation happens in steps—it starts with the digital enablement of the existing process, then the digital optimization and partial redesign, and onward up to the desired, full-fledged digital transformation of the underlying educational model (and indeed, business model) of the regional institutions.

In the conclusion to the report, we shaped the main areas of recommendations and elaborated on them in the following sections:

1. Area: Digital infrastructure—smart, hybrid

- Digitalization as a concept has to go far beyond merely enabling (fast) access to online educational resources.
- Limited public investment is a key barrier to systemic infrastructure lifecycle management and subsequently, to digital transformation.
- Systemic, foreseeable, and digitally friendly methods of infrastructure lifecycle management need to be pushed forward and supported.

- 2. Area: Education professionals' support structures—cooperation, co-creation, networking—while reducing the growth of the digital divide among both schools and users (teachers/students)**
 - A more systematic approach would be beneficial to develop digital competencies and content—continuously, collaboratively, and interactively.
 - The role of digital coordinator (motivator, advisor, coach) needs to be supported as a part of 'business-as-usual' (systematically), rather than being purely project-based.
 - A technological and methodological set of measures need to be put in place to stop and eventually remove the risk of an inherent digital divide, through the facilitation of greater inclusion, support, and guidance.
- 3. Area: Novel educational process—learning platforms, hybridization, self-learning, and the creation of the means for reducing the digital divide among schools, regions, and the participants in the educational system (teachers, students)**
 - Secondary institutions would benefit from a more regionally centralized provision and maintenance of digital content, software, and services.
 - A methodological set of practices, recommendations, and specific measures facilitating the reduction (removal) of the digital divide as well as an increase in inclusive education methods and techniques
- 4. Area: Strategic partnerships and digital leadership platforms—digital excellence**
 - A cultural change should be introduced to the Slovak regions, to link the educators more closely to their peers from other schools, and, especially, to industrial partners, so that the digital is not only an abstract vision but applies to a specific business reality.

3 Introduction

The purpose of this report is to summarize the outcomes and implications to the policies of the survey assessing digital maturity of regional secondary schools with a focus on VET within the context of the CuRI Initiative focusing on underdeveloped regions in the Slovak Republic. The assessment applies to three regions in the Slovak Republic—Prešovský, Košický, and Banská Bystrica. The Initiative provides a tailored support to lagging regions, with a focus on boosting the impact of EU investments in the region. The World Bank was asked to help coordinate the activities by the Directorate-General for Regional and Urban Policy (DG REGIO) of the European Commission.

Digitalization requires organizations to do more than just acquire technology or enterprise systems. Educational institutions and their information technology (IT) leaders need to guide the institutional modernization by partnering with businesses and curriculum experts, and by demonstrating the value that digital technology can deliver to produce competencies and performance targets, and to achieve a successful change. The value is not derived from just buying hardware or software and then deploying it to schools and classrooms. Digitalization is part of a modernization agenda that grows from the adoption of new and/or improved ways of delivering education and training, to achieve the successful skilling of people, and to improve the effectiveness and efficiency of processes, through data and technology [1].

For leaders to reach higher levels of digitalization, technology, and process optimization and modernization, they need to carefully plan a roadmap for such transformation. The first important step, according to analysts from Gartner[2], as well as the European Commission, is to establish a baseline for the digital strategy by outlining the current state of the digital technology environment and defining future state digital objectives, using the strategic roadmap for the system and for the respective institutions. Such an initial assessment not only reveals status in different competence areas, but also enables benchmarking the digital priorities, operating model and technology platforms, and achieving consensus regarding digital direction across institutions [3].

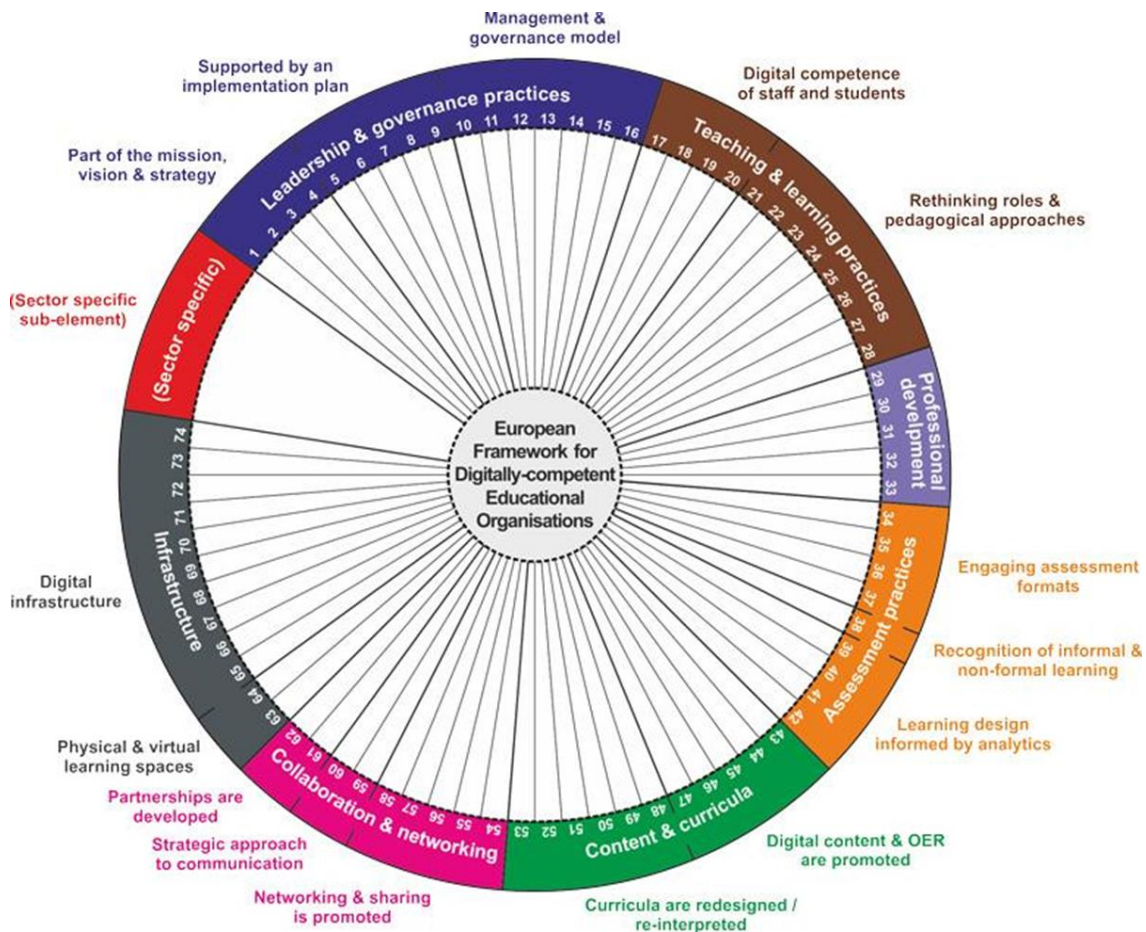
The intention of the data gathering is not to “vote” on ad-hoc ideas what one should and could do as a part of digital transformation, but rather receive as much important feedback and insight as possible from the core stakeholders (teachers, school leaders, digital coordinators) before finalization of the strategy plan and commitments by the school’s executive team and region’s educational department in the role of “superintendent”. –Kelly Calhoun Williams, Gartner [2]

In the context of digital maturity survey, the DigCompEdu framework¹ was chosen as a suitable means to introduce the overall picture of digitalization with its multiple dimensions, factors, and their purpose. DigCompEdu was published in 2017 by the Joint Research Centre of the European Union (JRC) [13]. Its main objective is to align the European educational policies with such a reference framework. It is a synthesis of scientific studies at the local, national, European, and international level [14]. DigCompEdu is a digital competence model with six differentiated competence areas (see Figure 4) . Each area has a series of competencies that “teachers must have to promote effective, inclusive, and innovative learning strategies, using digital tools.

¹ See https://joint-research-centre.ec.europa.eu/digcompedu_en.

The DigCompEdu framework reflects multidimensional aspects of the process of systematically integrating digital learning in educational institutions. For example, it enables self-assessment as schools are implementing their digital learning and transformations. It also enables policy makers to design, implement, and appraise programs, projects, and interventions for the integration of digital learning technologies [7]:

Figure 4. DigCompEdu Framework Overview



Source: Digital Competence Framework for Educators (DigCompEdu). EU Science Hub [7]

3.1 Overview of the Catching-up Regions Initiative 4: The Slovak Republic

Partners implementing the Slovak Republic Catching-up Regions Initiative 4 (CuRI) include the following entities: the European Commission (EC)/Directorate-General for Regional and Urban Policy (DG REGIO), and other DGs that cooperate on demand as well (mainly, the Directorate-General for Employment, Social Affairs & Inclusion [DG EMPLOYMENT], the Directorate-General for Justice and Consumers [DG JUST], and the Directorate-General for Internal Market, Industry, Entrepreneurship, and SMEs [DG GROW]; the Ministry of Investments, Regional Development and Informatization of the Slovak Republic (MIRDI), and other Slovak ministries cooperate and support SK CuRI as well; the Banská Bystrica Self-governing Region Office (BBSK); the Košice Self-governing Region Office (KSK); the Prešov Self-governing Region Office (PSK), and the World Bank.

The Slovak Republic has officially launched the European Commission’s Lagging Regions Initiative in January 2018 with the Prešov Region as part of the Catching-up Regions Initiative (CuRI). The Initiative provides a tailored support to lagging regions, with a focus on boosting the impact of EU

investments in the region. The World Bank was asked to help coordinate the activities, and an Administration Agreement was signed in May 2018 between DG REGIO and the Bank.

For the first phase of CuRI in the Slovak Republic, the activities were selected using an action plan prepared by the Prešov Self-governing Region, targeting big themes identified in the Slovak Republic Country Report 2018 and the Slovak Republic Country Specific Recommendations², namely: improve the quality of education, increase energy efficiency, enhance employment opportunities, and reduce the number of people living in poverty or social exclusion.

For the second year of activities in both regions, the BBSK and the PSK, a similar approach was taken where both regions prepared their actions plans. However, in the PSK's case it was the continuation of work already undertaken in CuRI Year 1, and partially it was the targeting of new themes identified in the 2019 National Reform Programme and 2019 European Semester: Country Specific Recommendation/Commission Recommendation— Slovakia³. These new themes are the following: improving the quality and inclusiveness of education; tackling corruption; improving the effectiveness of the justice system; and reducing the fragmentation of the public research system and stimulating business and innovation. A similar approach was taken for the third year of the SK Curi implementation, and all three lagging regions prepared their action plans. Košice Self-governing Region could choose to replicate positive outcomes of components already implemented in the Prešov and Banská Bystrica regions.

All three regions were engaged early on, to determine what concrete actions to focus on. It was important to identify activities with potential tangible impacts, which could be realistically implemented within the one-year duration. After the list of actions was completed, a number of meetings were organized with all SK CuRI partners to prioritize the actions' list and identify the distinct actions the SK CuRI would focus on. Once these key actions were identified, further discussions helped identify detailed subactions and the final scope of the work, outputs, milestones, and so on. Subsequently, all three lagging regions prepared detailed action plans and analytical sheets⁴.

Thus, the Slovak Republic Catching-up Regions Initiative covered a wide gamut of development challenges. Building upon experience from the Catching-up Regions Initiative in Poland, it was determined that without both strong on the ground and overall technical coordination, it would be difficult to bring such a diverse developmental program to a successful finish. For that reason, a strong coordination team on the World Bank side was maintained to ensure the delivery of technical

² European Commission 2018: <https://ec.europa.eu/info/sites/info/files/2018-european-semester-country-report-slovakia-en.pdf>

³ European Commission, 2019: <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1560258773480&uri=CELEX%3A52019DC0525>, and https://ec.europa.eu/info/sites/info/files/file_import/2019-european-semester-country-report-slovakia_en.pdf

⁴ Available at their websites: PSK - <https://www.po-kraj.sk/sk/samosprava/kompetencie-psk/regionalny-rozvoj/catching-up/>; BBSK - <https://www.bbsk.sk/%C3%A9Arad/Organiza%C4%8Dn%C3%A9jednotky%C3%A9AraduBBSK/OddelenieCatching-UpRegions/Oiniciat%C3%ADveCatching-upRegions.aspx>; and KSK - <https://web.vucke.sk/sk/kompetencie/regionalny-rozvoj/catching-up-regions/>

outputs, the management of communication with stakeholders, and the administrative support for the SK CuRI program. Arrangements were made for frequent interactions with local and regional stakeholders on the ground. Within year three of the Initiative, eight autonomous teams were established by the Bank for each defined component, with the technical work coordinated by an activity leader and a team of experts. For each activity, the team was present in the field on a regular basis (until the COVID-19 pandemic turned in-person meetings into virtual space meetings), with frequent (often weekly) communication with key stakeholders, to ensure an efficient two-way information flow, as well as stakeholders' engagement, and to properly respond to the needs and requests of stakeholders. Thanks to this hands-on approach, progress was steadily made on the defined actions; however, some activities (for example, training, on-site-visits, study visits, and so on) had to be postponed due to the pandemic.

As in the case of the Prešov and Banská Bystrica regions, the Bank team prepared a background study (Overview report—Key development dynamics) to highlight economic and regional development dynamics and challenges in both regions. The report analytically underpins individual components of the SK CuRI work.

Year four of the Initiative is being implemented from May 2022 until December 2023. A detailed analysis of obstacles and opportunities within all three regions are included in the action plan specific for each region. The regions, together with the Bank teams have agreed on implementing and continuing the work in the following components:

- Improving the integration of the groups at risk of poverty or social exclusion/improving the integration of marginalized Roma in all three SK CuRI regions
- Social enterprises in the BBSK
- Development of tourism and strengthening the attractiveness of the Poloniny Trail in the PSK and supporting sustainable tourism development in the Gemer Region of the KSK
- **Improving the quality of secondary vocational schools that meet the requirements of the labor market and improving the quality of VET schools in all three regions**
- Creating an environment for technology transfer and greater research and development (R&D) collaboration between research and industry in the BBSK and KSK; setting up the Košice Regional Innovation Centre and its products
- Integration of social and health care services, the support of scarce health services in the KSK and improvement of the availability and effectivity of healthcare provision in the BBSK Region
- Geo-infrastructure of spatial data—extension and improvement of quality in the KSK
- Piloting the design and construction of basic environmental infrastructure in the Snina District in the PSK

3.2 Relationship to European Union Themes and Priorities

The activities executed in the context of the CuRI Initiative, its VET component in general, and in the context of the digital maturity survey, in particular, are closely linked to two major themes at the

level of the European Union (EU). First, the Digital Education Action Plan⁵ (2021–2027) is a renewed EU policy initiative that sets out a common vision of high-quality, inclusive, and accessible digital education in Europe, and aims to support the adaptation of the education and training systems of Member States to the digital age. One of its two main strategic priorities is directed at the development of a high-quality digital education ecosystem with a list of next aspects:

- The necessary technical infrastructure to support more education and training practices going online, and improvements in connectivity and availability of digital equipment
- Digital skills among teachers, educators, and training staff
- Effective digital capacity building, including the improvement in organizational digital capabilities
- The availability of high-quality learning content and secure, private, and ethical standards for online platforms and tools

The other important theme closely linked to digitalization is the European Green Deal⁶. This is a set of policy initiatives by the European Commission with the overarching aim of making Europe climate-neutral by 2050. The Green Deal includes a number of initiatives aimed at reducing greenhouse gas emissions and increasing the use of renewable energy sources. One of the key pillars of the Green Deal is digitalization. The global green skills report presents the demand for so-called green skills; appearing in both new and updated occupations, it is accompanied with a portfolio of digital skills too⁷.

⁵ Digital Education Action Plan (<https://education.ec.europa.eu/focus-topics/digital-education/action-plan>)

⁶ Green digital sector (<https://digital-strategy.ec.europa.eu/en/policies/green-digital>)

⁷ LinkedIn, Global Green Skills Report (<https://economicgraph.linkedin.com/research/global-green-skills-report>)

4 Objectives of the Survey and the Departure Point of the Analysis

Digitalization of learning and teaching has a great potential to significantly improve learning outcomes, enhance equity, and improve the efficiency of the associated processes. Digital education is most effective and sustainable when supported by the right pedagogical technologies (for example, computers, tablets, and other technologies), as well as embraced by teachers and embedded in clear teaching goals and sound pedagogies. To know where a particular regional school stands in terms of digital maturity, the Bank CuRI team prepared a survey and supporting materials to guide their leaders through the assessment process as seamlessly as possible. The survey itself was motivated by SELFIE⁸ (Self-reflection on Effective Learning by Fostering the use of Innovative Educational technologies), which is a tool designed to help schools embed digital technologies into teaching, learning, and assessment.

The **primary motivating question for the conducted survey** is:

What are the secondary school-specific needs, obstacles, and priorities that shall be addressed for that institution and its stakeholders (such as teachers, managers, or students), if it wants to design a viable and implementable strategy of a digital transformation?

The **secondary supporting question** elaborates the context of the primary one:

How can a secondary educational institution in the targeted region select its priorities from among competing actions contributing to a digital transformation strategy—in a systematic and transparent way?

The **third supporting question** is the following:

What is the current level of digital maturity and readiness at selected secondary educational institutions, and what organizational and/or cultural signs provide evidence for it?

4.1 Assessment Methods and Assumptions

The individual stages of the survey process are defined as follows:

1) **Perceptual quick self-assessment of individual educators**

Focusing on the level of the educational institution, with multiple dimensions and a snapshot outcome, enabling the quick comparison with cohorts, the identification of hot points, and the basic *orientation* in the topic of digital maturity

2) **DigCompEdu-motivated quantifiable 'deep-dive' with school management**

Focusing on the level of the institution, with multiple dimensions; however, unlike stage 1, bringing in quantification of extent (depth and scope) to which assessed capabilities, resources, skills, and so on, are available at the respective educational institution, thus serving as a baseline for further planning and transformation strategy formulation

⁸ See <https://education.ec.europa.eu/selfie>.

Regarding **stage 1**, an *assessment of attitudes and beliefs* was achieved by means of a *questionnaire* for teachers, pedagogical specialists, and ICT coordinators. The questionnaire was structured into *eight dimensions*; altogether, there were *35 questions*. They were formulated to allow the application of the 5+1-level Likert scale. The respondent recorded his or her perception (or *attitude*) to a questioned capability, activity, process, or its aspect in terms of “strong disagreement”, “disagreement”, “partial agreement”, “agreement”, or “strong agreement”. The five scaled answers were complemented by the sixth option allowing the respondent to state “non-applicability” of a particular aspect to his or her school (again, based on her perception). The respondent was not expected to justify their perception, elaborate it, or provide any evidence. However, the questionnaire permitted *optional notes* to explain, illustrate, or complement the attitude. The questionnaire was given using Slovak localization.

The qualitative questionnaire comprised the following dimensions, along which the data was evaluated. Each factor represents an area of strategic focus, transformational change, or action:

- Communication and collaboration using digital tools
- Professional self-development in digital upskilling
- Working with digital resources in learning and teaching
- Applying digitally enabling learning and teaching techniques
- The role of digital tools for learner assessment
- Empowerment of learners in applying and exploring digital resources, tools, and others
- Developing digital competencies among the learners
- Perceiving data privacy and data protection in educational processes
- Category selection for organizational demographic and classification data to identify the institution type and enable data collection/consolidation

Regarding **stage 2**, the *quantifiable assessment* for school administrators and managers was done by means of a dedicated *questionnaire*, too. It was structured into *eight factors*; altogether there were *57 questions* to answer. Part of the questionnaire was based on the Likert scale, asking the respondent to choose from four levels of agreement—“strong disagreement”, “disagreement”, “agreement”, or “strong agreement”, complemented by the sixth option allowing the respondent to state “non-applicability” of a particular aspect. Some questions explored the degree of focus on the aspects questioned—“major focus”, “partial focus”, “limited focus”, and “no focus”. The scale avoided the middle ground to help the respondent take a position rather than remaining indecisive.

This questionnaire comprised the following factors, along which the data was evaluated. Each factor covers a category or area of potential strategic focus, transformational change, or action:

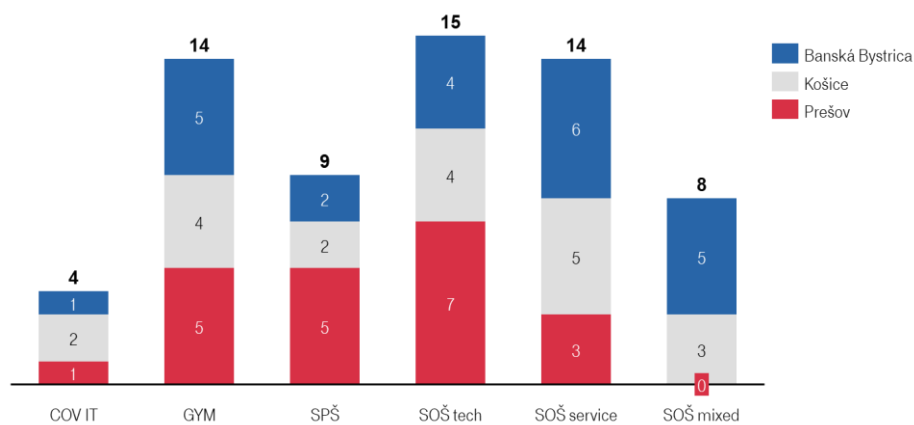
- Ownership of basic IT infrastructure and tools in school
- Digital know-how and skills in the school
- Evaluating the progress of digitalization at school
- Ranked prioritization of perceived obstacles and challenges to effective use of digital tools for learning and teaching
- Degree of focus on procuring different items of digital infrastructure, tools, and equipment
- Degree of focus on utilizing digital tools and methods in the educational process to achieve different outcomes

- Degree of focus on different aspects of curricular content and their impact
- Degree of focus on different processes affected by digitalization
- Category selection for organizational demographic and classification data to identify the institution type and enable data collection/consolidation

While the responses about “agreement” were subjective and attitudinal, responses to the “degree of focus” were interpreted by the facilitators in the following ways:

- *Major focus*: The questioned aspect applied to more than 75% of relevant situations, contexts, or decisions.
- *Partial focus*: The questioned aspect applied to more than 50%, and up to 75% of relevant situations, contexts, or decisions.
- *Limited focus*: The questioned aspect applied to more than 25%, and up to 50% of relevant situations, contexts, or decisions.
- *No focus*: The questioned aspect applied to fewer than 25% of relevant situations, contexts, or decisions.

Figure 5. Distribution of Surveyed Institutions



Source: Authors, 2023.

4.2 Survey Sample and Target Population Overview

The baseline of the digital maturity assessment targeted two distinct populations of respondents. However, before detailing the specific target groups of respondents, let us first define the focus of the measurement. For the digital maturity assessment, the CuRI VET project team, in cooperation with the representatives from the regional educational authorities, selected the following *mix of school types*: secondary vocational schools, secondary technical schools, secondary nontechnical (or services) schools, centers specialized in IT education, and grammar schools:

- *For the Prešov Region*: 16 VET schools from across the region + 5 grammar schools across the region = altogether 21 institutions
- *For Košice Region*: 16 VET schools from across the region + 4 grammar schools across the region = altogether 20 institutions
- *For Banská Bystrica Region*: 13 VET schools from across the region + 5 grammar schools across the region = altogether 18 institutions

The *qualitative attitudinal questionnaire aimed at educators* in the VET or non-VET institutions. We observed the following ‘rules’ to ensure its validity:

- *Diversity of perspectives:* We surveyed the teaching staff from all curricular domains at the given school, that is, not only the teachers of IT or STEM subjects, languages, or mathematics.
- *Representation:* We aimed to invite at least 50% of the teaching staff in the respective school and curricular area.
- *Independence:* Each member of the staff invited to the questionnaire answered on his or her own behalf. Technically, each respondent had access to a dedicated computer with an online survey.
- *Statistical validity:* We aimed to invite at least half (50%) of teachers and educators at each invited institution to achieve valid outcomes. We achieved participation of above 70% of all available teachers at surveyed schools (1,560 out of 2,150 schools).

4.3 Data Gathering Approach

Data were gathered by electronic means (online questionnaire) and they were stored in a local database for further processing by analytical tools and reporting. The data gathered using the methods described above did not contain any personal data of the individual participants. For the purpose of analyzing the data, the survey contained a “demographic” (or organo-graphic) section, where statistical data about the school were collected, including the name and type of school, the school region, the overall number of teachers at the school, the numbers of teaching staff in high-level curricular areas, and other similar components. The data was not analyzed at the level of an individual—they were consolidated “per school”, “per region”, and “per school type”, while other demographic variables were used to cross-check the representativeness.

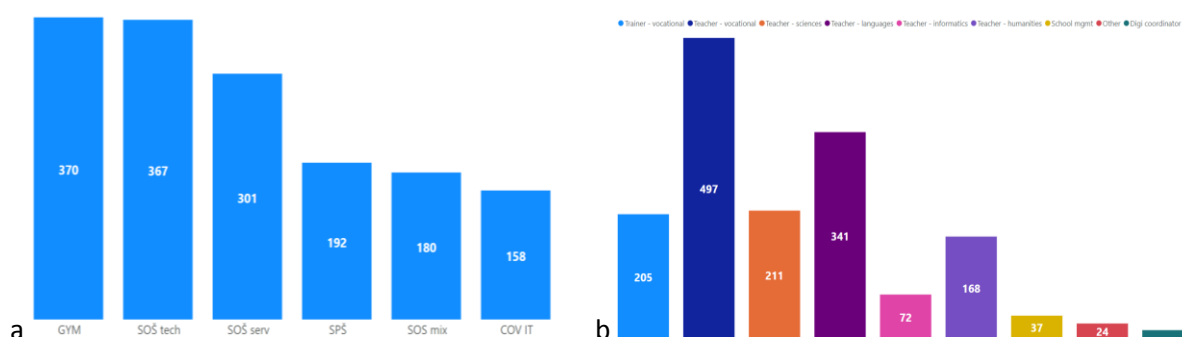
Participating schools and their leaders will receive outcomes on a “per school” basis that includes the consolidated results arising from their responses. In addition, the “per school” data of a particular institution will be evaluated (compared) with the “per region” consolidated, average answers to offer the school leadership context and the relative position of “me versus others similar to me”. The data gathering process started in the last week of January 2023 and continued through mid-April 2023. Data analysis was carried out during April and May 2023. The focus group that helped validate and complement the gathered data was held during the first week of May 2023. The report was prepared during May and June 2023.

5 Basic Demographics of the Surveyed Population

Figure 6a sums up the distribution of teachers/trainers across different types of secondary educational institutions. At 370 teachers, grammar schools had the highest representation, whereas specialized IT schools had the lowest coverage at 158. Grammar schools accounted for 23.60%, technological vocational schools with 717 teachers altogether accounted for 45.72%, the rest being service-oriented, nontechnological and mixed type schools with 481 teachers or 30.67%.

As shown in Figure 6b, at 497 the teachers of vocational subjects had the highest representation, followed by 341 language teachers and around 200 vocational trainers and sciences teachers. Vocational teachers accounted for 31.70% of participants, while informatics teachers formed only 4.60% of the respondents. We also succeeded in attracting 168 general subject teachers to the survey. Hence, we satisfied our requirement of cross-curricular area representation.

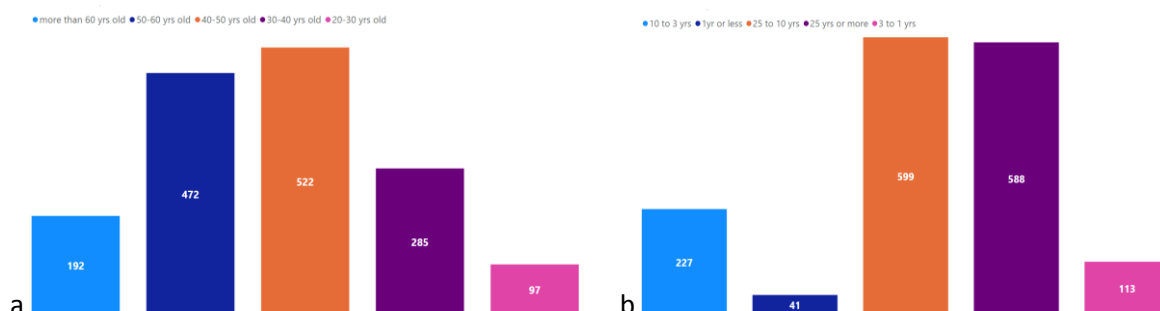
Figure 6. Distribution of Surveyed Teachers: a) By School Type, b) By Specialization



Source: Authors, 2023.

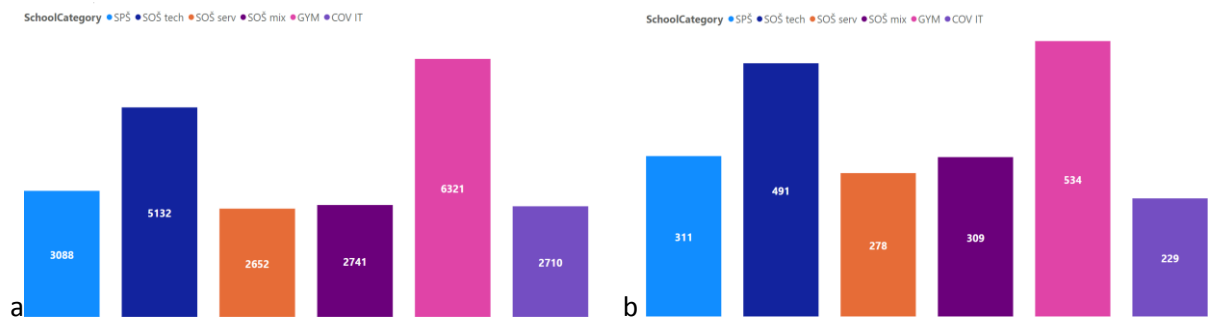
In terms of maturity, Figure 7a shows the age groups of surveyed teachers/trainers, whereas Figure 7b emphasizes the years of practical educational experience. What is clear is the fact that our teaching population falls into higher age brackets, where 664 teachers (or 42.34%) are above 50 years old and only 97 (or 6.20%) were below age 30. About a third of teachers (588) deliver more than 25 years of pedagogic experience to the game, and another third (599) has experience between 10 and 25 years. Thus, a 'typical' teacher/trainer surveyed is between 40 and 50 years old, with up to 25 years of professional practice and experience. The numbers show a significant shift toward older teachers, with a substantial lack of the younger generation. This may pose a serious problem to many schools when the dominant population starts retiring in the next five to ten years.

Figure 7. Distribution of Surveyed Teachers: a) By Age, b) By Years of Experience



Source: Authors, 2023.

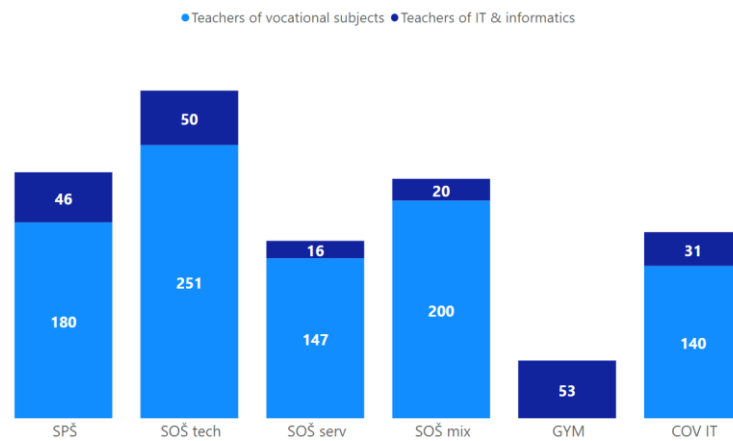
Figure 8. Totals Affected in the Surveyed Schools: a) Students, b) Teachers



Source: Authors, 2023.

In total, the surveyed institutions employ over 2,150 teachers and vocational trainers (Figure 8b) and provide services to a population of nearly 22,700 students (Figure 8a). As shown then in Figure 9, the participating institutions collectively employ as many as 918 vocational teachers, that is, specialists, but substantially fewer teachers of IT and informatics—215. The biggest challenge to have access to informatics teachers can be observed in service-, humanities-oriented and mixed type schools.

Figure 9. Distribution of Teachers—Specialists (Vocational versus IT)



Source: Authors, 2023.

6 Digital Maturity Assessment

In this chapter, we look at one of the core questions that motivated the data gathering process, namely: What is the current level of digital maturity and readiness at selected educational institutions, and what organizational and/or cultural signs provide evidence for it?

6.1 What is Digital Maturity?

According to the Boston Consulting Group (BCG), digital maturity is a measure of an institution's capability to consume and create value through digital means [15]. It is a key predictor of how likely the institution is to succeed if it launches a digital transformation project or initiative. Organizations with high levels of digital maturity have an obvious competitive advantage along multiple performance indicators or dimensions. These, in turn, impact their economic performance, including revenue growth and cost efficiency, as well as competitive performance, which includes the product or service quality, and customer or stakeholder satisfaction [15].

On the other hand, organizations with lower levels of digital maturity are more likely to struggle to achieve their strategic ambitions and desired performance. According to BCG, given digital's continued contribution to an organizational performance, the gap between digital leaders (or front runners) and laggards will likely grow [15]. Our survey is a powerful tool focusing on the educational ecosystem that lets educational institutions conduct a digital capability assessment at a relatively low cost but high informational value and interpretative power. It also allows the institutions to compare their digital performance with peers and the regional or national averages, to make best-in-class comparisons, and much more.

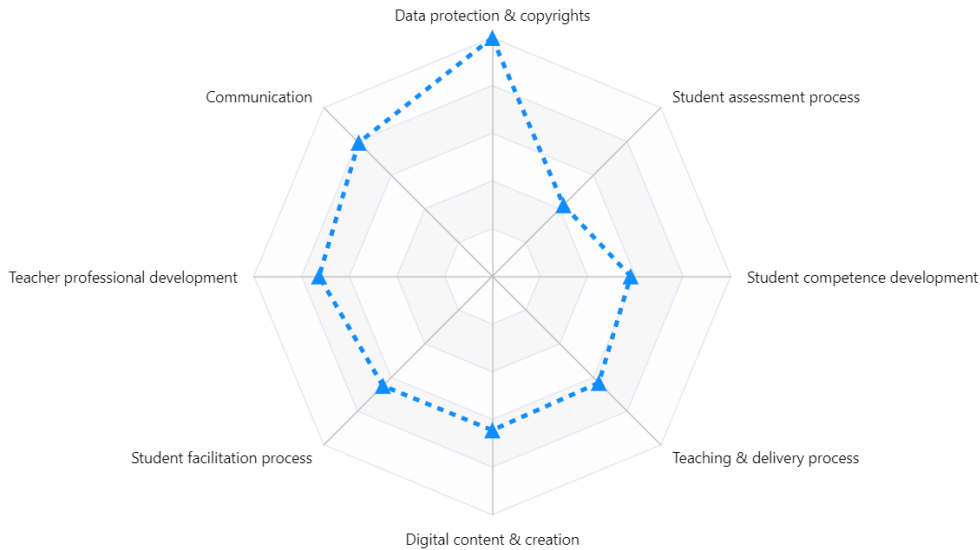
Other authors offer their perspectives on digital maturity. For example, in [16] we see the viewpoint emphasizing an ability of a given organization to take advantage of technological developments—that is, how well an organization has adopted digital tools and processes and is capitalizing on those new tools available to it and to its employees. When looking at digital maturity, one will often come across a related term—'digital transformation'. A digital transformation is a shift in the technological fabric used to run activities in a particular organization [16].

6.2 Calculating digital maturity

Based on the structure of our survey and data acquired through the survey from the teachers and educators, we designed an easily comprehensible digital maturity model and visualized it with the help of a radar chart or map. The radar expressing digital maturity in the educational context is shown in Figure 10. Although this figure shows a generalized view over all three regions and all schools, it has the same structure as a radar for a single institution. Such an institutional radar comprises eight axes that correspond to the dimensions of the survey defined in Section 0. These are shown as labels surrounding the radar field. The radar landscape is divided into five 'levels' that essentially correspond to the five-level Likert scale (formally, one more level was added to express the "don't know" stance) used in the responses. These are the white and grey strips, and their main purpose is to simplify the interpretation of the resulting curve.

An ideal radar expressing full maturity would correspond to a dashed curve spanning the outer edge of the radar field—that is, all dimensions would be assessed at 'level 5'. The real maturity curve is shown in Figure 10 as a blue dashed curve connected eight data points, each expressing the achievement in a specific axis (dimension). The more the curve resembles a circle, the more digitally mature an organization is.

Figure 10. Average Digital Maturity Map Across All Three Regions and All Schools

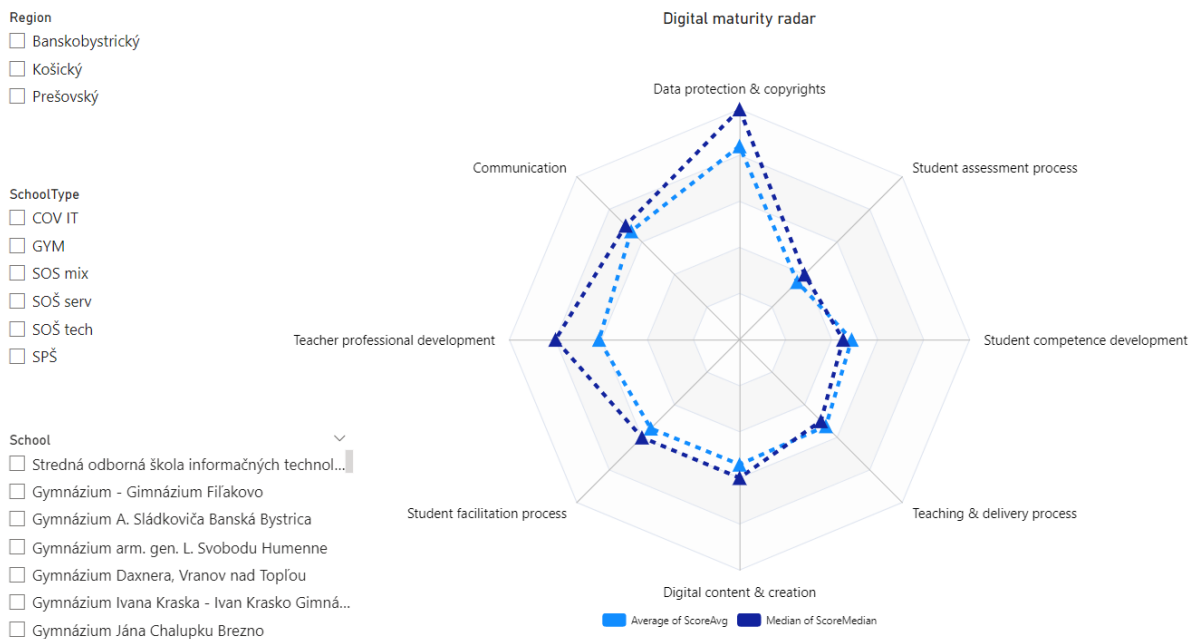


Source: Authors, 2023.

The individual data points are calculated in several steps. First, all the answers of one respondent are clustered into respective categories. There are multiple questions in each category, ranging from three, up to nine. Hence, different categories have a greater weight, as they are explored more in depth, in more detail. Responses to multiple questions within each category are averaged for each respondent—here we calculated both the arithmetic mean as well as the median of the teacher’s answers. All answers within a single category had an equal weight in our model. Once we had medians and means available for each teacher (respondent), we created a summative table of averages for all eight dimensions for each school. This table thus contained a record (row) describing one school, its categorization data (type, region, and so on) and eight columns of a dimension’s means, a dimension’s medians, and a dimension’s extremes (maximum and minimum). This table was subsequently transposed so that we calculated a structure that can be readily visualized using the radar chart, as in Figure 10. To enable filtering and visualizing the chart, a simple selector was implemented to pick one or more regions, one or more school types, and/or one or more specific school(s). The slicers (shown in Figure 11 on the left) are mutually interconnected, so one can use them to quickly ‘zoom in’ to the specific school or school type.

Thus, the process described so far accounts for purely attitudinal data from the survey. Next, that viewpoint was subject to calculated adjustment. The adjustment was carried out with the help of a respondent’s answers to the open questions that were incorporated into each category. These open answers were examined in a consolidated form by a panel of experts, on a per school basis. Thus, the simplified Delphi method asked the experts to express their confidence in the recorded attitude of a respondent based on the existence, quality, and depth of their open answer. The Delphi panel could suggest a corrector to a given category within interval “-1” to “+1”. The negative part of the correction meant that the respondent overvalued to a greater or lesser extent their subjective attitude; the positive correction meant that the respondent undervalued themselves in their subjective attitude. The adjustments were applied to the subjective scores, transposed, and used to visualize the digital maturity radar maps. As can be seen in Figure 12, the adjusted map is closer to the center of the radar field.

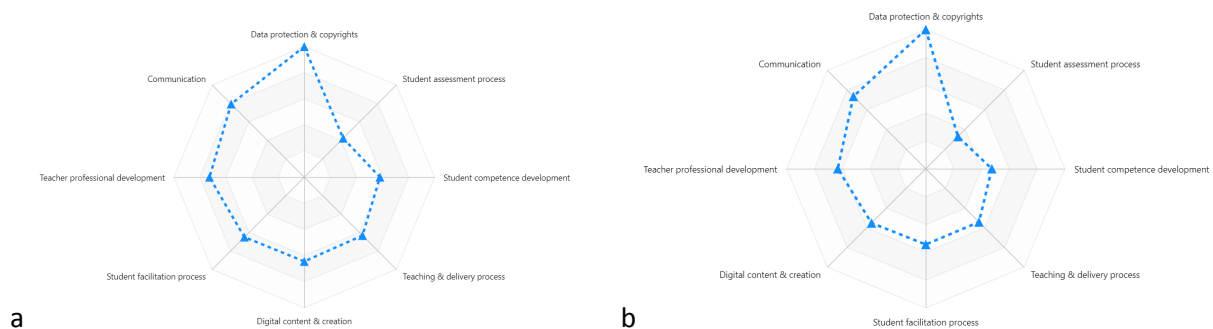
Figure 11. Interactive Explorer of Digital Maturity Charts (slicers on the left)



Source: Authors, 2023.

To answer our original research question, we looked at several radars. First, we compared the three regions and their average maturity. We also looked at the individual school types and compared average digital maturity in different types of schools. And finally, we looked at the individual schools, where we were interested in identifying the leaders and laggards, and in exploring the potential correlations, for example, to a school type, curricular specialization, or region. Finally, we translated the eight-dimensional maturity vector to a digital maturity index.

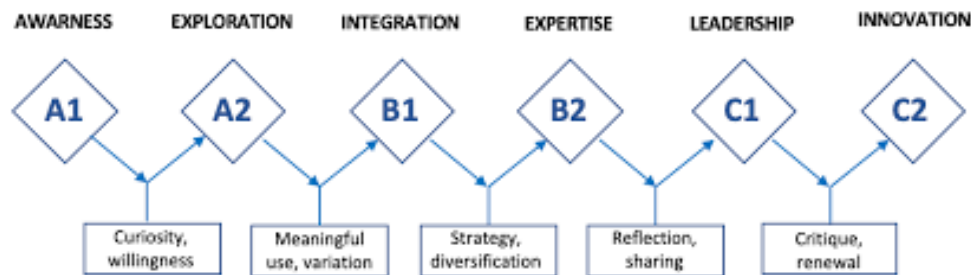
Figure 12. Comparison of Recorded (a), and Adjusted (b), Digital Maturity Maps Across All Three Regions and Schools



Source: Authors, 2023.

The DigCompEdu framework, introduced earlier as the foundational model underpinning the analysis, defines six progressive digital competence or maturity levels (see Figure 13). In this way, the digital competence level of an institution ranges from the "newcomer" level (A1), or those organizations with very little experience and contact with digital educational technology, to the "pioneer" level (C2), or those organizations who regularly and competently innovate through ICT and digital technologies.

Figure 13. DigCompEdu Progressive Competence Levels



Source: Digital Competence Framework for Educators (DigCompEdu). EU Science Hub [7]

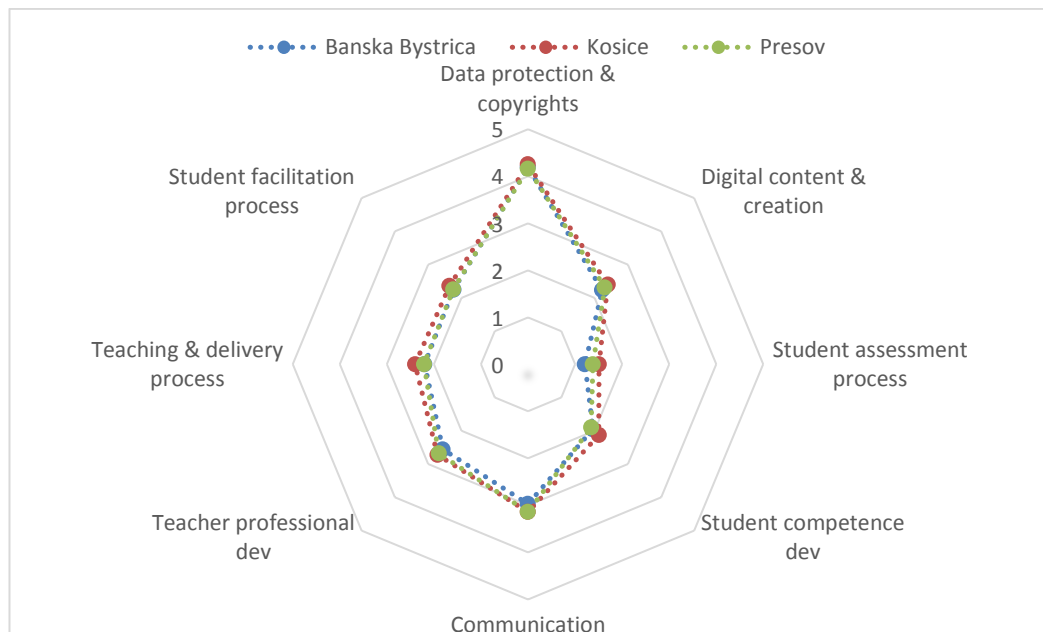
The mapping between our radar and the DigCompEdu levels is relatively straightforward. Each ‘strip’ in our radar landscape corresponds to one specific level, whereby level C2 corresponds to the outermost strip and level A2 to the innermost strip. Level A1 matches the center of the radar circle, that is, the zero referential point. The translation system follows a simple rule—an organization has a level of digital maturity that corresponds to the strip where the majority of data points can be located. Hence, if we take an example radar in Figure 10, we have four datapoints at level C1, two datapoints at level C2 and two at level B’. Thus, the digital maturity expressed in that radar can be summarized as “C1—leader”.

Let us offer a more systemic translation of the eight-dimensional digital maturity maps into the DigCompEdu common evaluation framework. As the framework comprises six levels (A1, A2, B1, B2, C1, and C2), we divided our interval from 1 to 5 to these six levels. To make the mapping more meaningful for the purpose of formulating strategies, priorities, and improvement objectives, we introduced two ‘sublevels’—being inspired by the investment ratings. Thus, to get from eight dimensions down to a single label, we introduced the following steps in our interpretation:

- Weights were introduced for the individual maturity map dimensions as follows:
 - 10% weight: “Teacher professional development”, “communication” and “student assessment processes”
 - 15% weight: “Teaching and delivery processes”, “digital content and creation”, “student facilitation processes” and “student competence development”
- The weighted average of scores in the eight dimensions was calculated for each school in the sample.
- The common evaluation framework was mapped onto numeric values of our analysis —if the weighted average fell into interval:
 - $\langle 0, 1.2 \rangle$... level **A1 = Newcomer**
 - $\langle 0, 1.0 \rangle$... level A1 = Full Newcomer
 - $\langle 1, 0, 1.2 \rangle$... level A1+ = Upper Newcomer
 - $\langle 1.2, 1.9 \rangle$... level **A2 = Explorer**
 - $\langle 1.2, 1.5 \rangle$... level A2– = Lower Exploration Level
 - $\langle 1.5, 1.75 \rangle$... level A2– = Full Exploration Level
 - $\langle 1.75, 1.9 \rangle$... level A2+ = Upper Exploration Level
 - $\langle 1.9, 2.55 \rangle$... level **B1 = Integrator**
 - $\langle 1.9, 2.1 \rangle$... level B1– = Lower Integration Level

- <2.1, 2.35) ... level B1 = Full Integration Level
- <2.35, 2.55) ... level B1+ = Upper Integration Level
- <2.55, 3.3) ... level **B2 = Expert**
 - <2.55, 2.75) ... level B2– = Lower Expertise Level
 - <2.75, 2.95) ... level B2 = Full Expertise Level
 - <2.95, 3.3) ... level B2+ = Upper Expertise Level
- <3.3, 4.2) ... level **C1 = Leader**
 - <3.3, 3.6) ... level C1– = Lower Leadership Level
 - <3.6, 4.0) ... level C1 = Full Leadership Level
 - <4.0, 4.2) ... level C1+ = Upper Leadership Level
- <4.2, 5.0) ... level **C2 = Pioneer**
 - <4.2, 4.4) ... level C2– = Lower Pioneering Level
 - <4.4, 4.75) ... level C2 = Full Pioneering Level
 - <4.75, 5.0) ... level C2+ = Upper Pioneering Level

Figure 14. Comparison of Digital Maturity per Region



Source: Authors, 2023.

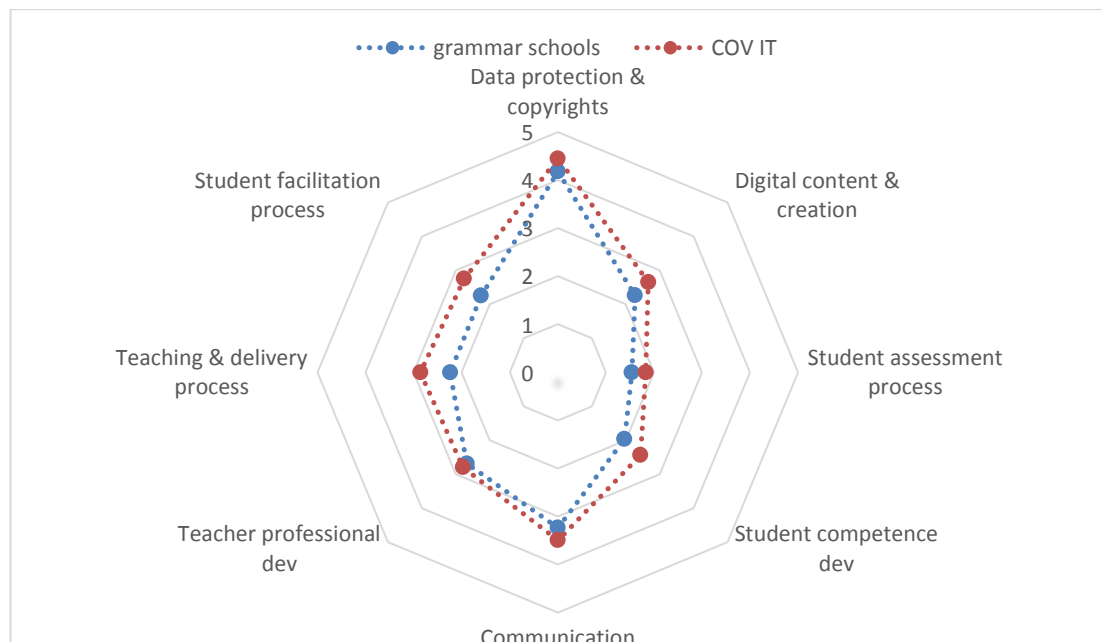
6.3 Digital maturity outcomes

Let us explore the digital maturity levels in our surveyed population from different angles. First, let us consider the three regions. When no other filters were applied to the data set, the performance of our three regions did not show any substantial differences. In other words, the average maturity looked very similar, with only minute differences in some dimensions. As shown in Figure 14, the three corresponding radars look very much the same. In our opinion, the reason for that outcome is

that there is a very similar composition of selected schools in each region where there was representation from every category. This observation to some extent challenged an often-heard statement that Košice Region is the one that most benefits from its intimate connection to both the ICT industry located there and the Košice IT Valley cluster. Three shapes in Figure 14 show a similar performance, with Košice (orange) being only marginally better.

Second, let us have a look at different school types. Here, the region can be disregarded, as that is not a differentiating factor anyway. One by one we visualized the digital maturity radar for the different school types: a) grammar schools (*gymnázium* in the Slovak system), b) secondary vocational academies (SPŠ in the Slovak system), c) specialized centers of professional studies in ICT (*centrum odborného vzdelávania pre IT*, or COV IT, in the Slovak system), d) secondary vocational schools with a technological focus (*SOŠ technická* in Slovak system), e) secondary vocational school with a service focus (*SOŠ služieb* in the Slovak system), and finally, f) secondary combined schools (*spojená stredná škola* in the Slovak system).

Figure 15. Comparison of Digital Maturity: a) Grammar Schools, b) COV IT



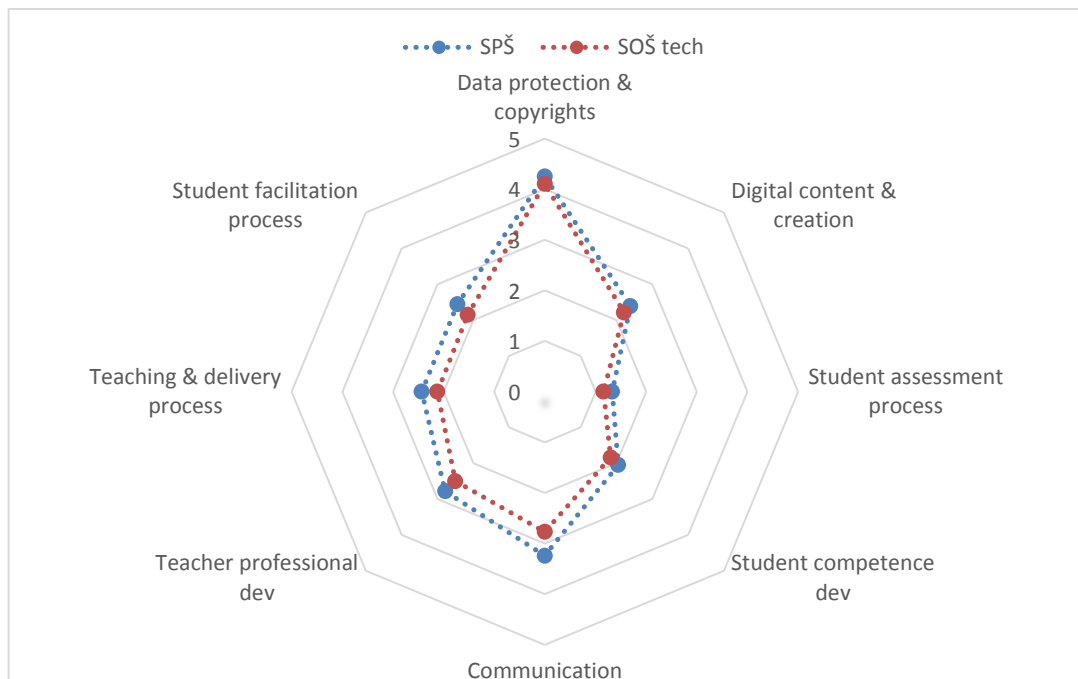
Source: Authors, 2023.

As shown in Figure 15 through Figure 17, the shape of digital maturity diagrams is similar across different types of educational institutions. When we look at details, we see the highest degree of maturity (unsurprisingly) with dedicated centers of professional development in ICT (COV IT). Slightly below COV IT, there are grammar schools and SPŠ vocational academies. On the opposite end, a lower degree of maturity is exhibited by the SOŠ with a mixed portfolio.

Generally, the highest maturity can be observed in the dimension “**data protection and copyrights**”, where the range of median values spans from 4.45 (COV IT) to 4.11 (SO SOŠ mix). This is the most mature element—this is most likely due to both the well-defined legislative framework and the significant effort invested into training the personnel in this area when it was introduced. The lowest degree of maturity can be observed in the dimension “**student assessment process**”, where the range spans from 2.21 (COV IT) to 1.62 (SOŠ technical). This is the least mature element—the teachers very rarely use digital tools and methods to give their students feedback or to assess their performance and achievements. While we return to this observation later on in the analysis, it is a key finding that points to the situation that digital tools are in place, but they are used relatively

superficially, with only a focus on basic communication (emailing) and administration (record keeping).

Figure 16. Comparison of Digital Maturity: a) SPŠ, b) SOŠ Technical



Source: Authors, 2023.

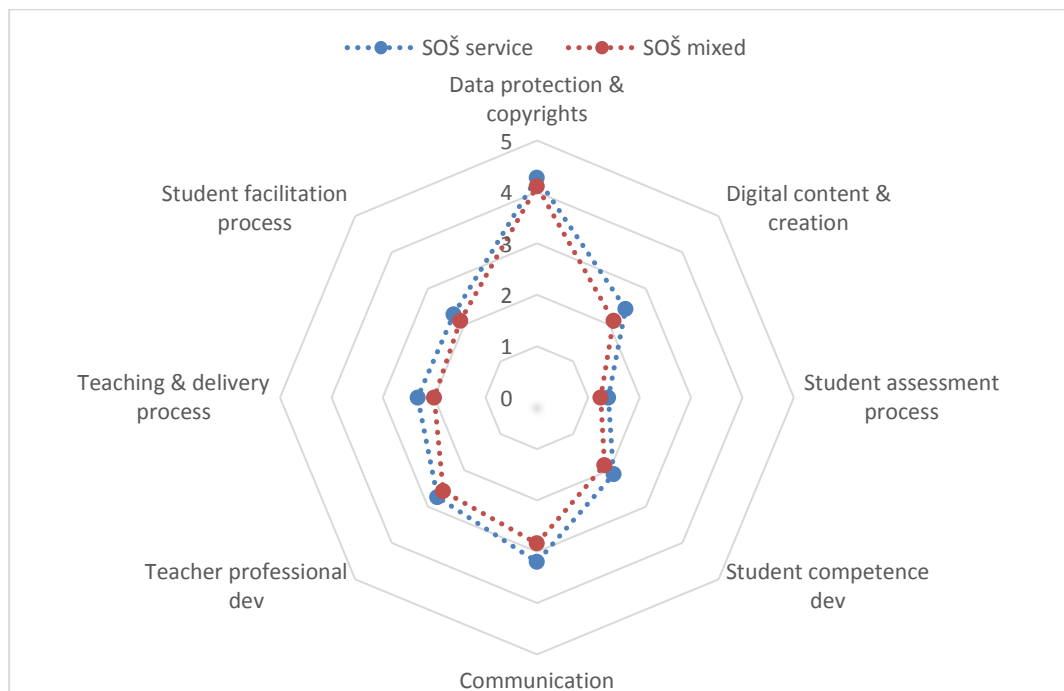
Looking at the dimension “**communication**” we observe a range spanning from 3.72 (COV IT) to 3.05 (SOŠ technical). This dimension covered the use of digital tools, technologies, and methods for communication and collaboration. A clear majority of teachers communicate digitally with their students and colleagues—85% do it regularly. However, significantly fewer teachers collaborate with their internal, in-school ecosystem using virtual methods—only 58% do so on a regular basis, which is a drop of almost 30%. This is even more pronounced if we include peers and partner communities beyond one’s own schools; barely a quarter of teachers regularly engage in collaborative activities with a partner from outside of their ‘inner bubble’. In our opinion, this is a major challenge in the observed ecosystem, and we analyze this further in later parts of this report.

Let us move on to the dimension “**digital content usage and creation**”, where we see a range from 3.08 (COV IT) to 2.51 (SOŠ mixed). Although this element oscillates around level B1, we see mixed behavioral evidence here as well. This category explored topics like finding appropriate digital content online, making use of third-party digital content, adapting it to local needs, and co-creating digital content with students, colleagues at school, and external partners. This is the first category where we see a strong ‘twin-peak’ distribution rather than a ‘normal’ Gaussian distribution of responses. Twin peaks mean that we see both very enthusiastically positive responses and also very passive, negative ones—very few were ‘in the middle’.

While 71% of teachers regularly turn to the virtual world to find, evaluate, and download digital content, only 43% work with this third-party content actively, that is, to adapt it, extend it, modify it, or personalize it. Barely one-third of teachers co-created their digital content, that is, to cooperate on it with their colleagues at school. In terms of behavioral evidence, we see this ‘lone fighter’ culture permeating the system and many respondents indicated that it is expected of them as professionals to cover the entire education lifecycle alone. This means they are expected to plan teaching, find and prepare material, deliver material, evaluate students, and improve the plan—

alone. This finding is disturbing, and we will dedicate more space to its exploration later. Let us just emphasize here that only a quarter of teachers engage their own students in co-creating and adapting digital content, despite acknowledging the students' confidence and dexterity with digital tools. Alarmingly, only eight percent of surveyed teachers, across all curricular domains, cooperate with at least one external partner in co-creating their digital materials. Under external partners we offered them a broad choice—teaching peers, teacher communities, industry partners, coaches from universities, and local or regional self-help circles.

Figure 17. Comparison of Digital Maturity: a) SOŠ Services, b) SOŠ Mixed



Source: Authors, 2023.

This isolation from the external world is indeed a feature in direct conflict with the core assumptions of digital education that theoretically emphasizes communication, interaction, cooperation, and so on. The relatively low sense of urgency is both culturally and strategically challenging; it is exhibited through a lack of willingness and plans to include more digital content and more co-created digital content in the near-term future. Despite the declared importance of digital agenda (88% of schools expect digital methods to improve the readiness of their students for their jobs and two-thirds associate digital with the higher quality of both outcomes and the teaching and learning experience), only 36% of the surveyed teachers have firm plans to increase the utilization of digital content in their teaching process. Thus, strategies, (or better, abstract visions), are not sufficiently translated into actionable items.

Looking at the dimension “teaching and delivery process” we see a range spanning from 3.24 (COV IT) to 2.40 (SOŠ mixed). In this area we looked at what specific activities during a typical teaching process are supported and enriched with digital tools. Almost half of teachers (44%) claim regular usage of digital tools in their teaching in general. They focus mostly on communicating tasks and assignments to students digitally and facilitating group work by means of tools like Webex, Zoom, or MS Teams—27% confirmed regular exposure to digital for these purposes. Yet only 15% of teachers offer their students digital tools for self-learning, self-monitoring of progress, and self-organization of their learning experience.

Digital tools are far too often restricted to the basic productivity tools (presentation and text document processors) and a favorite email client. Rather surprisingly, only 40% of teachers use digital tools to interconnect theory with practice—to illustrate, exemplify, and engage students in a hands-on way with the theoretical aspects taught. Even fewer (29%) choose digital tools to simulate, demonstrate, or visualize the real-life experience of the concepts and theories taught within the teaching processes. While the digital world is not alien to the surveyed schools, the evidence gathered from the behavioral perspective indicates a rather shallow, superficial relationship with it. Digital elements are used for basic tasks, yet there is relatively little willingness to go more in depth, to make the digital aspects more integral and more interactive.

The dimension “**teacher professional development**” (in digital skills), has the most compact range span—between 3.21 (COV IT) and 2.93 (SOŠ technical). Hence, irrespective of school type, the same regard to digital competence development is clear. On the positive side, 74% of teachers perceive themselves as active in self-driven exploration and the acquisition of digital skills. On a less positive note, only 10% of all surveyed teachers regularly take part in actual digital skill development events and courses (including self-paced) that expose them to the digital tools, methods, and/or techniques. Although this finding may appear strange at first glance, this phenomenon is connected to the already mentioned aspect of the superficial use of digital technologies combined with only a basic productive and communication toolkit; it may explain why teachers are reluctant to dive deeper into those learning platforms, MOOC environments, or specialized software tools for their subject.

In general, teachers are flexible and open to various aspects of skill development—about two-thirds prefer face-to-face digital skill development, but slightly more than half of them have taken part in hybrid or online delivery. Another positive driver in this dimension is the readiness to learn from observing more experienced colleagues or through coaching—70% and 72% respectively, are open to such methods. This, however, is in sharp contrast to the already mentioned lack of interaction with peers beyond one’s own school, that is, with those who might be observed or might even act as potential coaches. A deeper exploration of this phenomenon revealed another negative driver; there is very little knowledge of small-scale learning and skill development via so-called microcredits or self-organized ‘skill badge’ collections. In other words, the community is oriented toward traditional, larger-scale courses (which are more time-demanding). Although they are theoretically willing to try new methods, they still avoid more flexible self-development means (such as microcredits or educational microservices).

Under the dimension “**student facilitation processes**”, we explored how teachers use various digital means (tools, methods, and technologies) to motivate students, personalize their learning experience, help them self-organize their learning experience, and so on. The range here spans between 3.18 (COV IT) and 2.58 (SOŠ mixed). Slightly more than one-third of teachers (34%) actively use digital technologies to engage and include their students in their learning experience. About the same number (30%) rely on digital tools and methods to help their students self-organize their own learning process and experience to explore the subject and enrich the content received face-to-face with an online experience. Less than a quarter (24%) apply digital tools to offer personalized and varied learning experiences to their students.

There are less encouraging aspects that push this dimension to lower maturity levels. They include the fact that digital content and tools are not perceived as something that might make a subject attractive to the students. Only 32% of teachers actively permit and request their students to enhance their learning experience with digital (whether formally or as a part of informal self-exploration). Even fewer, only 25% of teachers actively coach and support their students or student groups in making more frequent and deeper use of virtual, online, and digital learning experiences.

Considered further, the aforementioned limited interest in involving students in digital content co-creation, this low degree of activating the young generation via tools that they are to a certain extent native to, essentially maintains the digital gap between schools and the student population.

Having observed the evidence in the previous dimension, the performance in the last one, “**student digital competence development**”, essentially follows a similar trend to the challenge mentioned in the previous paragraph. The range of school marks ranges between 2.85 (COV IT) and 2.32 (SOŠ technical and mixed). What was surprising to us is the low value for COVs that otherwise tended to outperform other types of schools and act as challengers to the population. Here they slid into an average role alongside other schools. On one hand, teachers and schools tend to acknowledge the digital know-how of their students (80% give positive marks to the students’ use of digital means for communication, 68% acknowledge their skills in using the digital tools for cooperating in study groups, and 32% see their students as active users of digital offering in learning). On the other hand, the majority of teachers leave the development of those skills to students themselves, to their informal networks, or home learning.

Less than 25% of teachers coach their students in the critical evaluation of online data and information, although as many as 85% expect the digital world to impact critical reading and critical thinking most positively. Some 18% of teachers actively assign tasks expecting students to create something using digital means, although over 90% see the digital as a great way to improve students’ creativity and problem-solving competencies. A similar number, 21% of teachers, design problem situations to encourage and boost the creativity in their classes. In addition, despite the fact that the dimension “data privacy and copyrights” mentioned earlier is one of the most mature among teachers, only a minority of teachers actively work with their students on topics like cybercrime, digital dishonesty, and unacknowledged copying and content reuse (40%), or how to develop and manage one’s own digital trail in the virtual world (30%). Despite data and copyright protection, only one-third of teachers would consider themselves a role model for their students when it comes to lawful utilization of third-party software, tools and/or content. As before, theoretical know-how relatively substantially diverges from what is being applied and lived in practice.

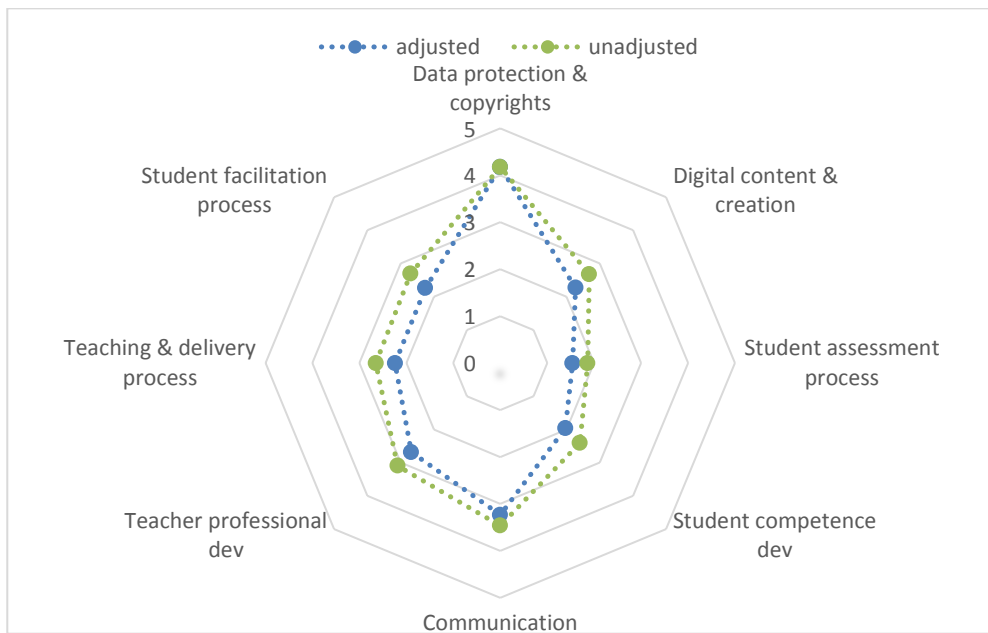
6.4 Digital Maturity Interpretations

Our survey showed a typical feature of attitudinal research—that respondents tended to overvalue their perceptions. When it came to applying those perceptions and applying them to specific tools, processes, methods, and so on, the answers to open questions shifted the subjectively declared attitude by as little as –7% (for example, for the “communication” dimension) down to –22% (for example, for the “student competence development” or “student assessment process” dimensions). A typical relationship between unadjusted and adjusted performance is shown in Figure 18. For the subsequent analysis and interpretation, we continue using the adjusted data.

This finding is neither novel nor is it specific to our survey. Overestimating one’s (digital) skills is a common phenomenon known as the Dunning-Kruger effect, which is associated with an egocentric perspective and narcissism. Hence, an adjustment to the responses is necessary, as well as an acknowledgement of the great subjectivity of the respondents. This means that even if the adjusted data point to an institution potentially perceiving itself as being at expert (B2) level, in many cases this perception cannot be substantiated by specific actions, tools, or processes.

Let us visualize the best-in-class versus weakest-in-class performances side by side and explore our interpretations of the performance along different dimensions of digital maturity. (See Figure 19) As an extreme on the more positive side, we selected COV IT schools; at the opposite extreme, we selected SOŠ with technical and mixed specializations that exhibited similar characteristics.

Figure 18. Comparison of Unadjusted Attitudes and Adjusted Indexes (a radar map shown for grammar schools as a sample)

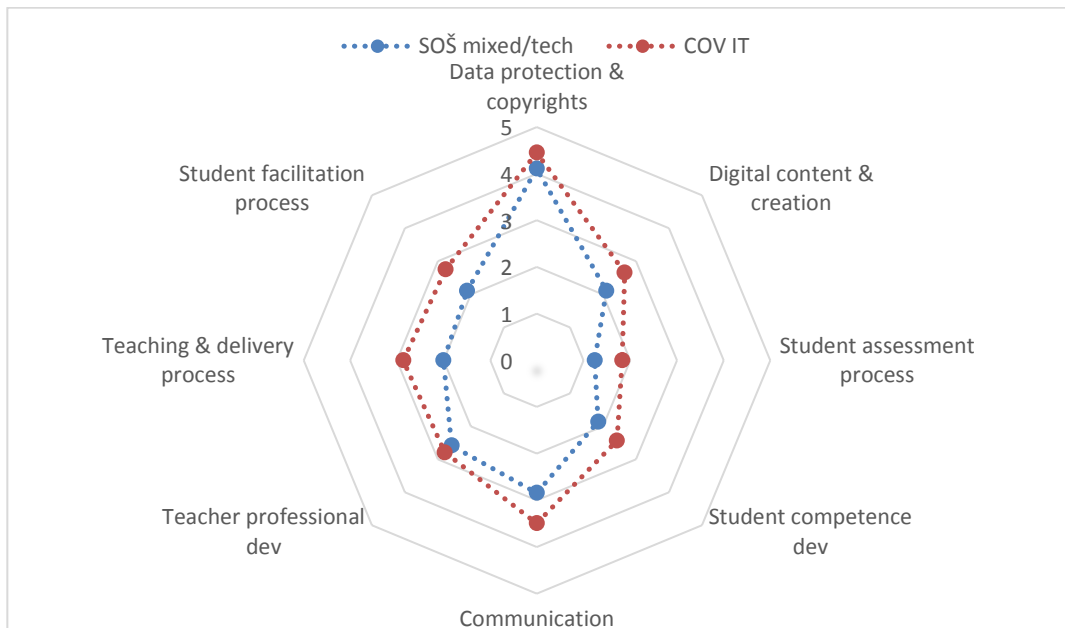


Source: Authors, 2023.

The difference between the two opposite poles is very varied. The least difference can be seen in the dimensions of “teacher professional development” and “data protection”; there was only eight percent in favor of COV IT schools. The gap is relatively more visible with the dimensions of “communication” and “digital content creation” which give more mature schools on average a 23% advantage. However, the gap for the remaining dimensions is even more visible, reaching a staggering 45% on average in the dimensions of “student assessment” and “teaching and delivery” processes.

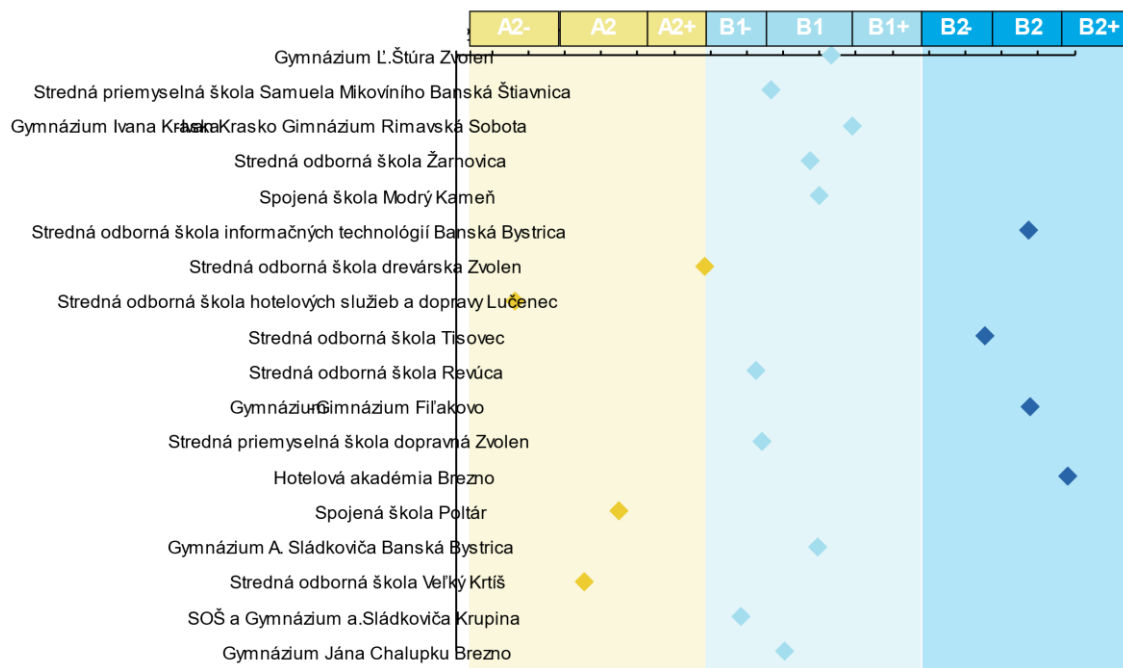
Let us review the interpretation of our analysis in terms of the DigCompEdu common evaluation framework, using the approach that was explained in the earlier section. Since we have quite an extensive list of schools, we split it into three natural clusters, that is, regions, in order to make it easier to read. Figure 20 shows the distribution and digital maturity assessment for the Banská Bystrica participating schools. As can be seen we have no schools in either C-level; thus, no school can be labelled as a true leader or pioneer. Only four schools reached level B2 – expert; one with an ambition to enter the upper expertise level (B2+), and two within full expertise levels (B2). The majority of schools occupy level B1—integrator; six being at the full integration level and three at a lower integration level. Four schools reached the level of explorer (A2), of which two are in the upper exploration levels (A2+) challenging the next higher level.

Figure 19. Comparison of “Best-in-class” and “Weakest-in-class” Digital Maturity



Source: Authors, 2023.

Figure 20. DigCompEdu Common Evaluation Framework Interpretation (Banská Bystrica Region)



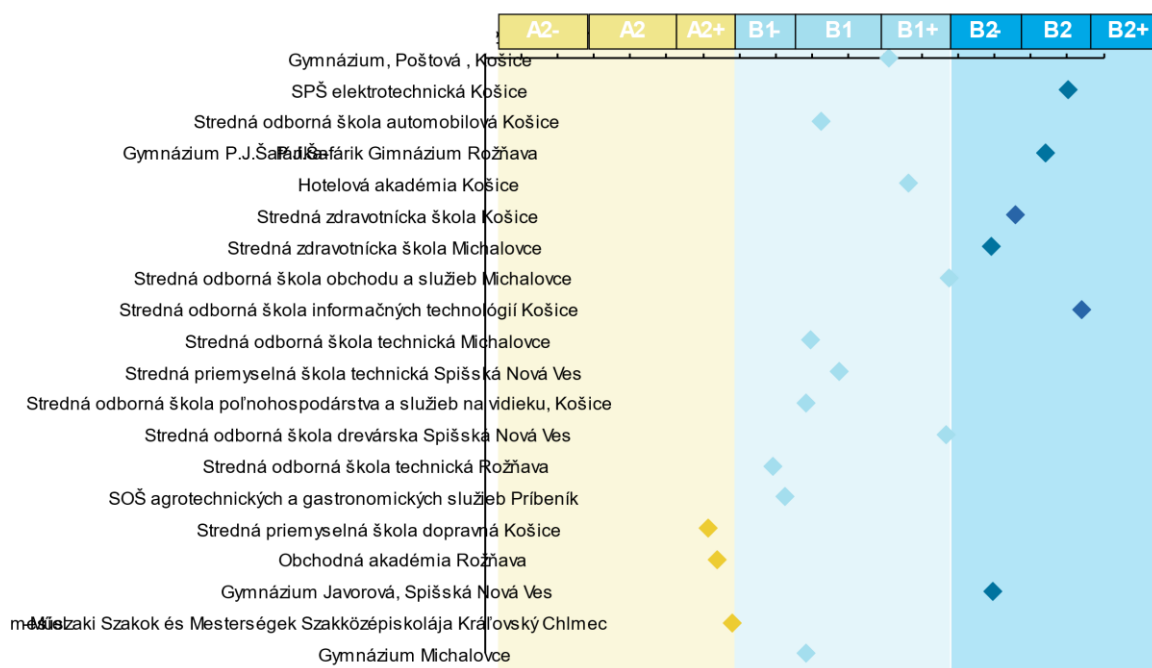
Source: Authors, 2023.

The data from the survey show clear room for improvement for every school in the Banská Bystrica Region; the highest attained digital proficiency barely touched the upper boundary of B2 (expert) level. On a more positive note, there are at least four clear frontrunners available in the region that can be used as role models, coaches, and good examples that digital transformation is not an abstract phrase, but an achievable goal that can be turned into specific actions. From the perspective of diversity, it is encouraging to see diverse types of schools in this frontrunner pack. Perhaps less surprising is to see the secondary vocational school of ICT (Banská Bystrica), which is one of the national centers for professional development in ICT, as one of them. Less obvious

frontrunners include a secondary vocation school (Tisovec), a hotel academy (Brezno), and a grammar school (*gimnázium*) in Filakovo. Thus, good practices exist across the board and these may be models for respective regional peers.

Figure 21 shows the distribution and digital maturity assessment for participating schools in Košice Region. As can be seen, again, we have no schools in either C-level; thus, no school can be labelled as a true leader or pioneer. We have more entrants reaching level B2 (expert) compared to the Banská Bystrica Region; two of them with an ambition to attain the upper expertise level (B2+). The majority of schools in the Košice Region occupy level B1 (integrator); six being at the full integration level, and three at the lower integration level. Only three schools reached the level of explorer (A2), at the upper exploration grade.

Figure 21. DigCompEdu Common Evaluation Framework Interpretation (Košice Region)



Source: Authors, 2023.

As with the Banská Bystrica Region, we see here some less and some more surprising entrants. Among the less surprising ones are again both regional centers for professional development in ICT—the secondary vocational school of ICT (Ostrovskeho, Košice) and the secondary vocational academy of electrotechnics (SPSE Košice). Both medically oriented schools perceive themselves as fairly strong (Michalovce and Košice), as well as two grammar schools (Roznava and Spisska Nova Ves). In this cohort, the overall leadership across all three regions is held by the secondary vocational school of ICT (Ostrovskeho, Košice).

Finally, let us conclude the cohort with the surveyed schools from the Prešov Region. The distribution and digital maturity assessment for participating schools in this region is depicted in Figure 22. As can be seen, again, we have no schools in either C-level; thus, no school can be labelled as a true leader or pioneer. The overall picture for the Prešov Region is midway between the Košice Region (“confident”) and the Banská Bystrica Region (“sober”). We observed six entrants reaching level B2 (expert), which is more than the Banská Bystrica Region, but fewer than that of Košice). One of them has an ambition to breach the upper expertise level (B2+). The majority of schools in the Prešov Region occupy level B1 (integrator); eight being at the full integration level, and five being at

a lower integration level. Two ‘integrating’ schools are within the upper integration level (B2+). Three schools fell into the level of explorer (A2), at an upper exploration level.

Figure 22. DigCompEdu Common Evaluation Framework Interpretation (Prešov Region)



Source: Authors, 2023.

Unlike previous regions, Prešov’s frontrunners are from different domains, not necessarily ICT. Among the frontrunners, there is a secondary vocational academy (Bardejov), a vocational academy for machine engineering and an academy for civil engineering (both from Prešov), and another vocational academy (Snina). While the ICT center did not reach the higher levels, the presence of four distinct, cross-sectoral vocational academies is an interesting feature of the Prešov Region.

Now, rather than present and speculate over some dubious rankings and league tables of individual schools, let us look at what might make an institution appear at higher levels of maturity. What are the typically correlated behaviors, processes, or activities arising from our survey, and how do they compare to the original expectations of the DigCompEdu model? When we reviewed the gathered data and visualized it as a ‘heat map’, that is, the numeric data were turned into hues and shades of red, orange, and yellow up to dark green, clear correlations emerged between frontrunning institutions and certain categories of strong performance.

All frontrunners are characterized by high scores in a conjunction of three dimensions “communication” AND “digital content and creation” AND “teaching and delivery process”. The combination of all three dimensions was rare, but when it happened, the respective school was among the frontrunners. These dimensions were pulled to more positive values by a strong performance on sharing digital content with a school community (“communication”), a good capability in reusing, repurposing, adapting, and evolving digital content acquired from third parties (“digital content and creation”). Another distinctive feature was a stronger culture of co-creating digital materials within a given school (“digital content and creation”), although they did not show much initiative beyond it. Another important feature was associated with the willingness of teachers to do mutual coaching and observation, as well as to make use of small microcourses and personalized self-development (“teacher professional development”). The factors recognized here as supporting higher levels of maturity all related to something we would label as cultural aspects of

the respective institution—the capability to share, to train (especially, to coach and allow the observance of more experienced colleagues), and to work with content more actively; these are all signs of digital leadership, also according to the DigCompEdu [7, 14]:

Experts use a range of digital technologies confidently, creatively, and critically to enhance their professional activities. They purposefully select digital technologies for particular situations, and [...] are curious and open to new ideas, [...]. They use experimentation as a means of expanding, structuring and consolidating their repertoire [...]

In their implementation of digital into teaching processes, the frontrunners go well beyond supporting merely communication via digital means. They show a stronger capability to use the tools to collaborate in virtual teams and/or student groups, to apply more often digital tools for simulating and exemplifying abstract concepts, to leave their students to self-organize and self-monitor their comprehension of both conceptual and practical know-how (“teaching and delivery process”). Indeed, the mere strong commitment to, application of, and focus on ‘deeper aspects’ of the digital seems to be synonymous with collaboration, interactive simulation, self-monitoring, and self-organization of student teams; hence, this appears to be a sufficiently reliable indicator of frontrunning.

A third cluster of sufficiently informing behaviors includes those that facilitate a student’s development of competencies, creativity, critical thinking, and similar skills. The frontrunners show greater than average belief (and application to practice) in the personalization of tasks through digital channels, the adaptation of tasks to facilitate creativity, and above all, the active coaching of the students or student groups in using and exploring the digital tools, methods, or platforms (“student facilitation process” and “student competence development” dimensions). This seems to be supporting another important feature of digital culture, which is the shift from documenting (writing up notes) to creating products, devising functioning prototypes, experimenting, and testing practical scenarios.

In fact, some of these behaviors are pointing to levels beyond B2. For example, to embrace the leadership level (C1), the teachers shall “...have a more consistent and comprehensive approach to using digital technologies to enhance pedagogic and professional practices” [14]. As the DigCompEdu recommends, this enhancement might be achieved and nurtured especially if the teachers are “...exchanging with peers, they keep updated on new developments and ideas” [7, 14].

7 Cross-validation with Third-party Digital Competence Analyses

As discussed in the introduction, digital readiness in education can be defined as the capacity of the system, at the policy level, to support digitalization initiatives, projects, and other digital objectives effectively. It is a concept recognizing that effective digitalization in education depends not only on the actions of individual institutions, but also on the extent to which digital technology and skills are embedded in the wider country context, and the extent to which public policy actions support institutions in their digital transformation agendas [17].

The development of digital education occurs within the framework of a wider digital economy. Citizens regularly exposed to beneficial digital technologies and processes across economic and social sectors are more likely to develop the skills required to navigate digitally enhanced education programs successfully, whether as teachers or learners. In addition, the digital transformation of secondary and VET education institutions depends on their access to connectivity and underlying technologies such as broadband, 5G, or cloud, where the rules and policies for procurement are usually rolled out at a national level. Therefore, a country’s overall digital development serves as a foundation for the digital transformation of its educational ecosystems, including secondary schools.

Table 1. Third Party Analyses of Digital Performance Featuring the Slovak Republic

Digital Performance Index	Focus	Jurisdiction/ publication date
Digital Economy and Society Index (DESI), based on DigComp	4 key dimensions, covering 37 indicators: human capital; connectivity; integration of digital tech; and digital public services	EU countries Annual updates since 2014
Centre for European Policy Studies’ (CEPS) Index of Readiness for Digital Lifelong Learning (IRDLL)	3 primary pillars: individual learning outcomes; institutions and policies for digital learning; and availability of digital learning	EU countries Published in 2019
Portulans Institute – Network Readiness Index (NRI) ⁹	4 key dimensions providing a composite index: technology; people; governance; and impact	131 global countries Annual updates since 2019
IT Fitness Test	ICT complex skill test	Slovak Republic (SK), Hungary (HU), Czech Republic (CZ), Poland (PL) Annual testing from 2012 Since 2022 with ‘V4’ countries

Source: Authors, 2023.

Digital literacy is a capability that forms part of a broader digital economy. Citizens who are regularly exposed to potentially beneficial digital technologies and processes across all economic and social sectors are more likely to develop the skills necessary to successfully navigate digitally enhanced educational programs, whether as teachers or learners. Moreover, the digital transformation of

⁹ Portulans Institute took over the index from the World Economic Forum in 2019.

secondary and VET education institutions depends on their access to connectivity and underlying technologies such as broadband, 5G, or cloud—with procurement rules and policies typically set at the national level. Therefore, a country’s overall digital development serves as a foundation for the digital transformation of its education ecosystems, including secondary schools.

The second component of digital readiness is the extent to which the public policy framework for secondary and VET education supports and incentivizes educational institutions. The incentives relate to embedding sound digital practices, and ongoing support and training for the educators and students. Developing coherent assessments of the digital readiness of education systems is challenging for most jurisdictions, due to substantial data gaps. Also, the fact that there is only a nascent data infrastructure for monitoring digitalization contributes to relatively low coverage of this topic in the country. However, some insight can be gained by reviewing the Slovak Republic’s position in international and national indices of digital performance, and from examining elements of the Slovak Republic’s national policy framework that may support digital readiness in secondary and VET education. The following sections review each of these in turn.

7.1 Country Position in Comparative Indices of Digital Performance

This section reviews the Slovak Republic’s performance on five existing international and national indices measuring digital performance and readiness at a country level. Taken together, these measures provide a range of insights regarding various aspects of digital readiness in the Slovak Republic, including connectivity, human capital, digital competitiveness, availability of digitalized services, geographic disparities in digitalization and the existence of digital strategies and processes (for overview see Table 1).

Digital Economy and Society Index (DESI)—2022 Edition

The European Union’s DESI is a composite index tracking the digital performance of EU member states. Among the 27 member states, the Slovak Republic ranked in the 23rd position in 2022 [18]. The Slovak Republic’s strongest components were in 5G readiness, the share of adults with above-basic digital skills, and open data initiatives (see also **Chyba! Nenašiel sa žiaden zdroj odkazov.**).

DESI shows that the connectivity of households and business organizations in the Slovak Republic steadily progressed in recent years. *The majority (81%) of households have fast broadband coverage, above the EU average of 78%. Additionally, the Slovak Republic is on the way of 5G readiness (67% of spectrum is assigned); however, only a minority of the population had access to 5G in 2022 (14%).* The Slovak Republic achieved a steady increase in the indicators for coverage and take-up of connectivity, often surpassing the EU averages. The Slovak government adopted the new national broadband plan in March 2021, setting out the Slovak Republic’s connectivity vision and targets until 2030. The plan aims for all households, whether urban or rural, to have access to an internet connection of at least 100 megabits per second (Mbps), with the possibility of upgrading to gigabit speeds, as well as for major socioeconomic drivers to have access to gigabit connectivity. This is also confirmed by our survey when the secondary schools considered their connectivity as sufficient and reported speeds above 100 Mbps.

The Slovak Republic’s overall *human capital ranking in DESI stands at 19th. Specialists in ICT account for 4.3% of the workforce, slightly below the EU average of 4.5%. In total, 59% of enterprises, including education institutions, report having difficulty filling ICT roles.* Compared to Europe, the Slovak Republic is slightly above the EU average, where 80% of young people aged 16–24 have basic or above-basic digital skills [19].

The Slovak Republic faces a major brain drain. According to the Institute for Public Affairs, half of young, educated Slovaks are seriously considering relocating abroad, in particular, to Austria or the

Czech Republic. This trend could significantly slow down the digital transformation in the Slovak Republic. Businesses and organizations would not be able to use advanced digital technologies if talented digital experts were to leave the country.

In 2021, the government adopted a new lifelong learning strategy. It aims to make the Slovak educational system more flexible, offering new opportunities for adults in continuous learning, as well as to better address the needs of the job market. The strategy includes the introduction of microcredentials that should help the workforce expand or refocus their qualifications to adapt to the digital transformation. The strategy also outlines the plan to develop a new digital skills strategy focusing on learning opportunities for adults to ensure their continued inclusion in a society transformed by digitalization.

Table 2. Overview of DESI Performance—the Slovak Republic versus EU averages

Dimension	Indicator	DESI 2022	
		the Slovak Republic	EU avg
Broadband connectivity	Overall fixed broadband coverage (% households)	81%	78%
	Fast broadband (NGA) coverage (% households)	84%	90%
	Fixed very high-capacity network (VHCN) (% households)	67%	90%
	4G Coverage (% populated areas)	86%	87%
	5G Readiness (assigned spectrum as a % of total harmonized 5G spectrum)	67%	66%
	5G Coverage (% populated areas)	14%	66%
Human capital	At least basic digital skills (% individuals)	55%	54%
	Above basic digital skills (% individuals)	21%	26%
	ICT specialists (% individuals employed aged 15–74)	4.3%	4.5%
	ICT graduates (% graduates)	4.4%	3.9%
	Enterprise providing ICT training	16%	20%
Digital public services	Digital public services e-Government users (% of users)	62%	65%
	Digital public services for citizens (Score 0–100)	65	75
	Digital public services for businesses (Score 0–100)	75	82
	Open data (% maximum score)	50%	81%

Source: “Slovakia in the Digital Economy and Society Index”. EC Digital Strategy, 2022 [18].

In May 2022, the Ministry of Education published the program of the digitalization of education for 2030 with the first action plan for 2021–2024. The program objectives and activities are built around five themes: i) digital infrastructure and equipment for education; ii) digital competencies; iii) transformation of education through digital technologies; iv) development of electronic services and information systems in the Ministry of Education and schools; and finally, v) cybersecurity and information safety.

At the end of 2022, the government adopted a new standalone digital skills strategy that should cover all population groups (young people, employees, job seekers, older people, ICT professionals, and others) with an aim to help the Slovak Republic meet the Digital Decade target of 80% of people with at least basic digital skills by 2030. In the integration of digital technology in the business sector and the provision of digital public services, including digital services for citizens, the Slovak Republic lags behind the EU average (ranks 21 and 24, respectively).

The 2022 Network Readiness Index (NRI) by the Portulans Institute is one of the most comprehensive efforts to measure global digital readiness. It ranks 131 global economies by technology development and their capacity to capitalize on ICT opportunities according to four core pillars and 62 subindicators [20]. The Slovak Republic ranks 37th out of 131 countries in the 2022 NRI edition (see Table 3).

Table 3. The Slovak Republic in the Portulans Institute’s Network Readiness Index 2022

The Slovak Republic’s Network Readiness Index	37th (out of 131 world economies)
Pillars/subpillars	Rank (out of 131 world economies)
Technology (overall)	37
<i>Technology subpillars</i>	Access: 39, Content: 37, Future Technologies: 46
People (overall)	65
<i>People subpillars</i>	Individuals: 102, Businesses: 36, Government: 63
Governance (overall)	29
<i>Governance subpillars</i>	Trust: 22, Regulation: 32, Inclusion: 40
Impact (overall)	32
<i>Impact subpillars</i>	Economy: 33, Quality of Life: 29, Sustainable Development Goal (SDG) Contribution: 43

Source: “Slovakia Performance Overview”. Network Readiness Index Report, 2022 [20].

CEPS Index of Readiness for Digital Lifelong Learning

The Centre for European Policy Studies (CEPS) Index of Readiness for Digital Lifelong Learning (IRDLL) measures digital learning participation and outcomes, institutions, and policies for digital learning, and the availability of digital learning. *The Slovak education system ranked on the CEPS Index in the 20th place in the EU.* The Slovak Republic’s ranking was heavily influenced by its 26th position in the “Learning Participation and Outcomes” and 23rd rank in subindicator Educators and Schools.

The CEPS report gave the following conclusions: that primary and secondary educators need to be motivated to participate in programs focused on the improvement of their digital competencies in order to implement digital technology; the regulatory framework should be revised to stimulate the digitalization of learning; and the availability of training programs for university and adult learning educators should be improved [21].

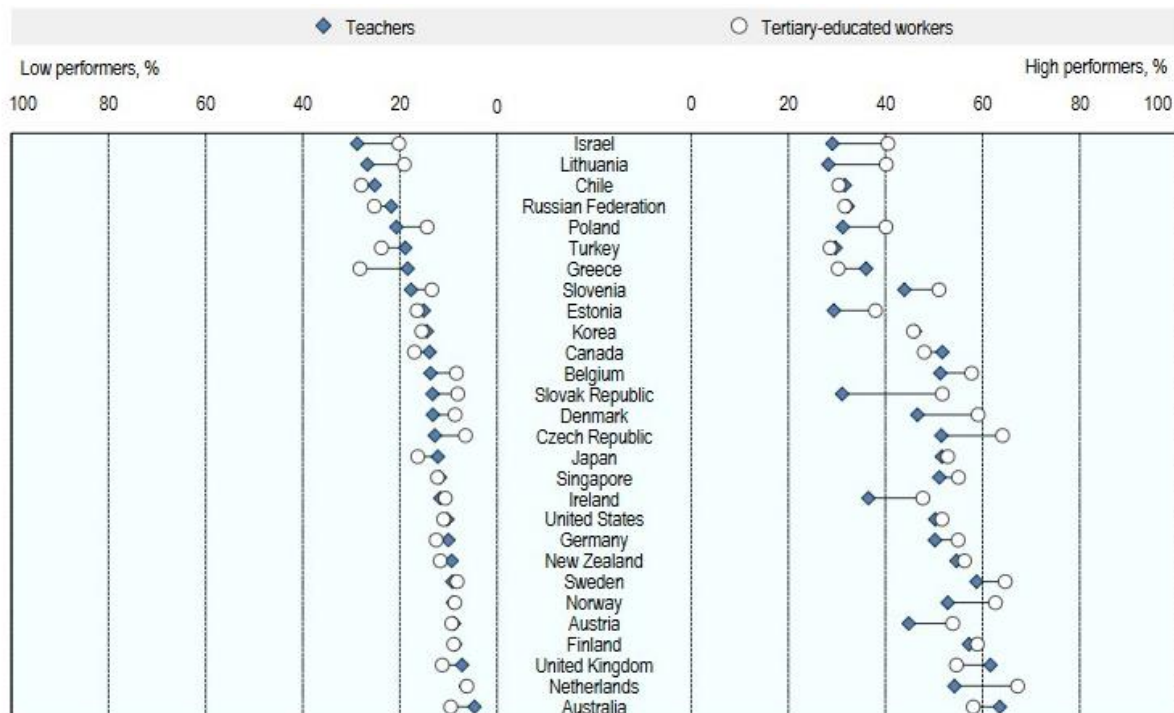
OECD Survey of Adult Population Skills

This edition of the Organisation for Economic Co-operation and Development (OECD) Skills Outlook aims to understand how policies, and, in particular, those that affect skills development and use, can shape the outcomes of digital transformation and translate into more equally shared benefits among and within countries’ populations. Ensuring people can benefit from new technologies and are not left behind requires a comprehensive and coordinated policy effort [26].

In addition, teachers’ skills are equally crucial to ensure they can tap into the potential of new digital tools for learning. The digital divide, which had initially focused on gaps in internet access, increasingly relates to divides in the ways that individuals use digital devices and the internet. Skills are important drivers of such gaps. Higher cognitive skills—literacy, numeracy, or problem-solving

skills in technology-rich environments, or a mix of them— enable individuals who go online to move from elementary uses of the internet to more complex and diverse uses [26]. In the OECD countries with available data in the Program for the International Assessment of Adult Competencies (PIAAC) and the Teaching and Learning International Survey (TALIS), the share of teachers with low problem-solving skills in technology-rich environments ranged from less than 5% in Australia to 31% in Israel [26]. The Slovak Republic achieved a 16% share for low performing and a 2 % share for high performing.

Figure 23. Share of Poor- and Top-Performing Teachers in Problem-Solving in Technology-rich Environments by Country

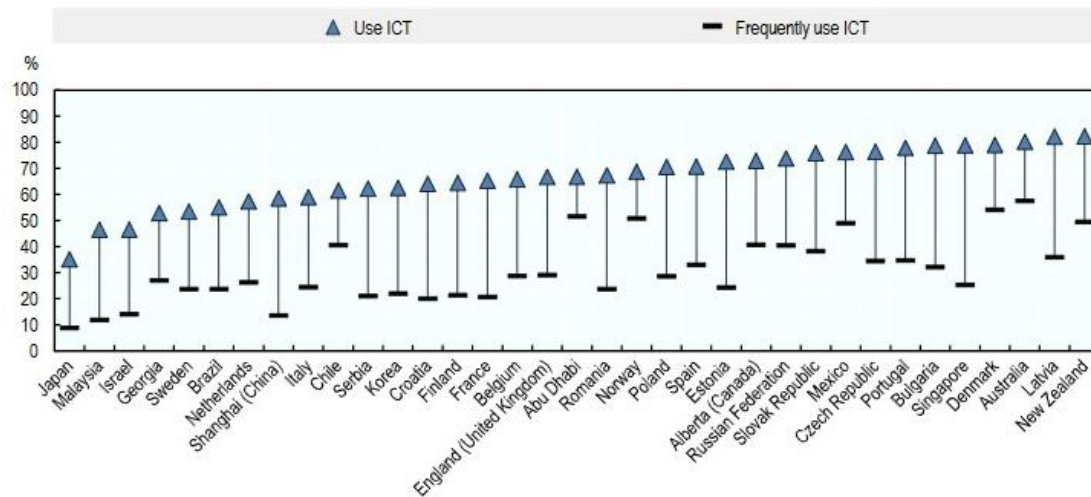


Source: OECD Adult Skills Survey, 2019 [26]¹⁰.

The use of ICT in the classroom can be facilitated by many factors, from the mere availability of a high-quality ICT infrastructure in the school to teachers’ digital competencies and attitudes, school regulations, or more general contextual factors. Analysis based on the TALIS dataset from the OECD past works [26] shows that training in ICT skills for teaching, teacher self-efficacy, and collaboration with other teachers play a role in the frequent use of ICT in teaching and self-efficacy in supporting student learning through digital technologies. In addition, teachers’ attitudes toward ICT also determine whether they use ICT as part of their practice. Teachers with a more constructivist attitude or a more positive view of the benefits of new technologies are more likely to use digital technologies. In contrast, teachers’ age and experience do not appear to influence the frequency with which teachers have their students use ICT for projects or class work when they teach ICT.

¹⁰ <https://www.oecd.org/skills/piaac/>

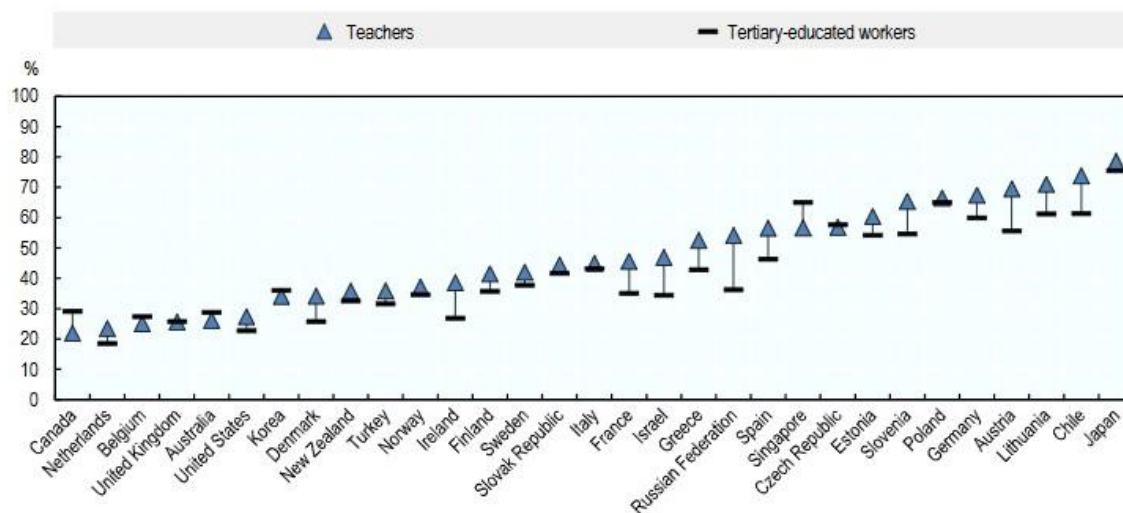
Figure 24. Share of Teachers Using ICT for Students' Projects or Class Work



Source: OECD Adult Skills Survey, 2019 [26]¹¹.

The COVID-19 crisis has brought digital resources and online professional development to the forefront of policy solutions to ensure the continuity of teachers' professional learning in the absence of in-person professional development opportunities. Greater teacher involvement in technology-enhanced learning activities can pave the way for more effective use of digital resources by teachers for their own learning, as they become more familiar with a wealth of resources, methods, and learning pathways and can use these resources more productively [26].

Figure 25. Teachers' Need for ICT Training by Country



Source: OECD TALIS database, 2013 [26]¹².

¹¹ https://www.oecd-ilibrary.org/education/oecd-skills-outlook-2019_df80bc12-en

¹² <http://www.oecd.org/education/talis-2013-results.htm>

7.2 National Index of Digital Readiness—IT Fitness Test

The National Coalition for Digital Skills and Jobs of the Slovak Republic coordinates the project IT Fitness Test, a large testing ICT skill test that helps people (especially students) evaluate their practical digital skills. The test *already* has a 10-year history. In 2022, over 69,690 users participated from the Slovak Republic. *From the secondary schools and universities, 45,043 participants took part in the testing.* The average score achieved was 50% [22]. From 2022, the testing also covers all Visegrád Four (V4) countries (Czechia [Czech Republic], Poland, Hungary, and the Slovak Republic).

Respondents also achieved the highest success rate in the “internet” category last year. The success rate has increased significantly compared to the previous year, by approximately 16 percentage points. In the category “security and computer systems”, respondents achieved the second highest success rate: 62.26% (compared to 46.52% last year). We can see that the respondents were relatively well versed in the common knowledge in the field of security, which they often encounter. In less standard situations, they navigate better than in the past. [22] Mapped onto our survey, we see fairly high achievements of our respondents in topics like security, data protection, internet usage, and communication.

In the “complex tasks” category, the tasks focused on problem-solving and algorithmic thinking, on complex skills in encoding information, on finding information in an interactive graph and evaluating it, and on revealing the control and settings of some program/process/some animation. The *success rate in the category was 45.68%* (up from last year’s 31.30%), which is the second lowest result compared to the other four categories. We see room for improving skills in solving complex problems. It is necessary to include tasks of this nature in the teaching process. This category shows similar outcomes as our findings in using digital tools for problem-solving, creative tasks, group work, and so on.

Table 4. IT Fitness Test Average Success Rates—2022 Edition

Categories	Performance (in %)			
	All	Teachers	Others	Students
I. Internet	65.60	70.71	71.26	64.68
II. Security and computers	62.26	65.30	68.53	61.72
III. Complex tasks	45.68	50.84	53.88	44.85
IV. Office tools	34.78	47.07	50.16	32.95
V. Collaboration and social networks	54.46	53.01	58.20	54.47

Source: “IT Fitness Test 2022—Závěrečná správa”. Digitálna Koalícia SK, 2022 [22].

In the “office tools” category, the *success rate was 34.78%* (down from last year’s 37.17%). This category has long been among the categories with the lowest success rates. It has been true for a long time that in this category there is the biggest difference in the success of teachers compared to students (of course, in favor of teachers)—almost 15 percentage points (in the past it was up to 20) [22].

7.3 Conclusions from Cross-validation

Overall, evidence regarding the Slovak Republic’s performance in a range of digitalization and digital readiness indices shows that the country continues to *rank behind its European Union counterparts* in many aspects of digitalization.

The evidence points to a *lower to average level of digital readiness of the secondary and VET education system in the Slovak Republic.* While basic digital skills in the population in the Slovak Republic are, in general, similar to, or higher, than the EU average, participation and interaction with

digitally delivered education remains relatively weak. *The availability of digital learning is lower than in many other EU countries.* The indices also may signal weaknesses in governance of digitalization within the system and challenges with prioritizing strategic focus on, and investment in, emerging technological solutions in both government and businesses.

The Slovak Republic is *working on catching up with many aspects of digitalization*, including connectivity and establishing a favorable regulatory environment for digitalization in the wider economy. It has achieved some success in several areas that will support progress towards digital readiness and maturity in its education sector. Several national plans and *policies for investing in digitalization are in progress, including investment directly in improving the digital maturity of education institutions.*

On the other hand, *more efforts may be needed to encourage the take-up of digitally delivered teaching and learning* in the education system. Although comparative data on the take-up of online learning across countries is lacking, there are reasons to conclude that participation in online learning is particularly low in the Slovak Republic. Overall *participation in adult education is low.* The absence of strategic policies to support distance and hybrid learning, infrastructural challenges, and a general perception of online education as being of low quality have been identified as causes of low take-up. Moreover, *there is a shortage of information on the digital competence of education teachers in the Slovak Republic.*

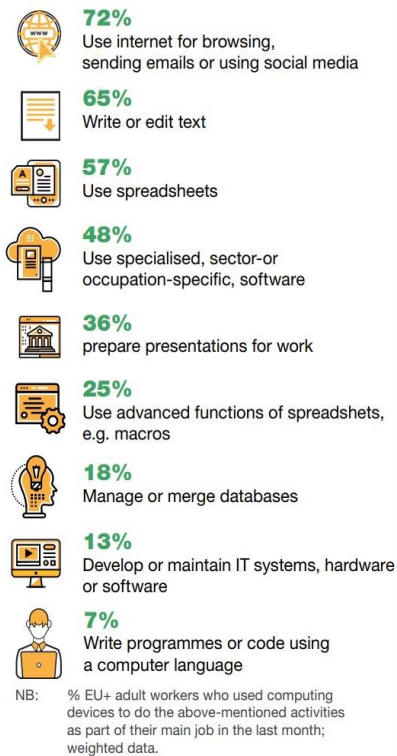
In conclusion, while the Slovak Republic is making strides in enhancing its digital readiness, more policy action is likely to be needed in the coming years if the Slovak Republic is to continue to improve the public perception, accessibility, and take-up of online and hybrid education options.

When discussing the depth to which digital tools, technologies, and methodologies need to be mastered, the second survey of the European Centre for the Development of Vocational Training (Cedefop) concerning skills and jobs provides a helpful background [23]. The summary of this survey is shown in Figure 26. The most basic skill relates to communication, browsing, emailing and similar activities, and that takes up to 72% of digital know-how. More intensive digital competencies include topics like advanced spreadsheeting, database management, programming, or systems development. In our survey, these advanced actions correspond to questions around using digital tools for simulations, exemplification, and the connection of theory and practice; these are all areas where we see a relatively low focus and low attention of our teachers. That, in turn, may have adverse impact on the performance in indices and tests, where student reach under-average outcomes compared to their EU or V4 peers.

Some of the key findings are that:

- VET teachers are more likely to let their students use ICT than general education teachers [26].
- A substantial proportion of teachers either cannot, or only to a limited extent, support their students through the use of digital technologies [26, 23, 18, our results].
- Not all teachers feel confident using digital technologies, and the confidence goes down with the increasing complexity of usage scenarios (especially for feedback) [26].
- Less than half of teachers receive strategic guidance and support to integrate new technology into their curricula, including the support from school managers for sharing, trying, experimenting, self-development, and so on. [26, our results].

Figure 26. Expected Application of Various Digital Skills, Technologies, and Methods to Jobs Across the Whole EU Economy



Source: “Setting Europe on course for a human digital transition”. Publications Office of the EU, 2022 [23].

Figure 27. Visual Summary of the DESI Index for the Slovak Republic Against the EU Average



Source, “Slovakia in the Digital Economy and Society Index”. EC Digital Strategy, 2022 [18].

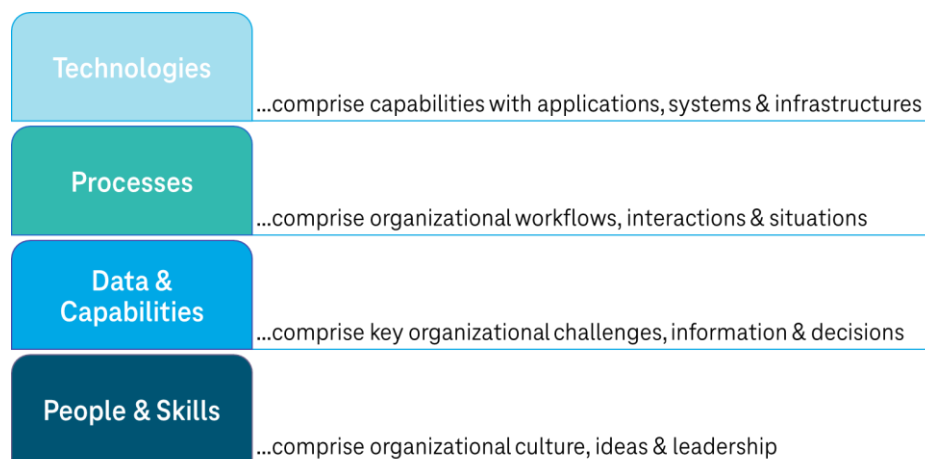
However, the state of digital maturity in the Slovak Republic is generally perceived as below-average, which is visually documented by the DESI index depicted in Figure 27 [18]. The situation is very similar to what our survey confirmed for secondary schools in the three regions. On a six-level common competence DigCompEdu framework, we see most institutions oscillating around level B1 or below, that is, around or slightly below the average performance mark. Indeed, in the charts reported and interpreted in Figure 20 through Figure 22 earlier, no school has reached either of the C levels, and only very few made it to average–mildly above-average level B2.

8 Deep Dive Analysis of Identified Challenge Clusters

Assessing digital maturity and expressing it either as a map or competence level is useful for digital transformation strategy creation. However, it might be a too coarse perspective if we want to identify and address specific challenges, shortcomings, and pain points. In this section, our goal is to elaborate issues we identified and briefly touched upon in Chapter 0. To have our analysis more structured, let us consider the four dimensions of a successful organizational modernization, or transformation. In the context of digital, we prefer talking about a full-scale, systemic modernization of an organization. Modernization is a strategy, not only a simple replacement of one organizational function or tool with a new one.

Value—whether in an education or in a business context—is no longer derived from just buying hardware, software, or packaged ICT solutions, and then deploying them. Modernization provides value that grows from the adoption of new and/or improved ways of conducting the core processing underpinning any (successful) educational institution. Increasingly, new ways of interacting, collaborating, and working with students, as well as the overall institutional culture or stance toward innovating, sharing, and improving play a central role in developing and delivering new digital capabilities at schools. Based on analysis and recommendations from Gartner [3], our survey as well as analysis followed the main pillars or aspects of organizational modernization, as depicted in Figure 28.

Figure 28. Four Layers of Digital Modernization in Organizations



Source: “Modernization in Higher Education Means More [...]”. Gartner, 2022 (adapted) [3].

What challenges arise from the analysis of our survey? Let us briefly ‘set the stage’ for the remainder of this chapter, which is aligned to the four layers shown above:

- **Technologies**
 - Our survey shows a discrepancy in managing the technological foundation in many secondary schools. While two-thirds of surveyed schools report a very good, good, or satisfactory number of computational devices, more than 80% rely on *infrastructures older than five years* and are hardly able to support modern application suites, software, or platforms.
 - Our survey shows that the schools are relatively well equipped for more traditional learning (frontal delivery, in a physical location, to a larger group of students) with enough interactive or projection boards in 71% of schools; however, more than three-quarters are *lacking equipment for hybrid* and interactive teaching/learning.

Furthermore, close to 90% of the surveyed schools cannot *provide dedicated equipment to their teachers*, be it for the preparation, self-development, or the exploration of new methods, tools, and other means.

▪ **Processes**

- Our survey shows a rather *superficial usage of digital tools* and methods in teaching processes. While almost 85% of schools use digital to communicate with teachers and students, active usage of digital tools for active collaboration and product creation is seen in only 61% of surveyed schools. The number of schools capable of digitally evaluating their students and giving them formative feedback then falls to just 35%.
- About half of schools perceive their teachers as active users of digital tools in their respective curricular domains. However, only 35% of schools can say that student activity in using digital tools for learning is satisfactory. Furthermore, digital aspects get relatively *rarely applied in teaching STEM* subjects—only 16% of schools do it regularly and about 25% do it occasionally.

▪ **Data, Content and Capabilities**

- In terms of strategic (or systemic) usage of data, the population splits into ‘twin peaks’—about half of schools do measure and evaluate their digital readiness versus a half not gathering such data. About one-third compile a dedicated digital transformation and modernization strategy (that is, plan) versus about half who *react to external changes opportunistically*.
- While close to three-quarters of teachers are willing to learn by observing their peers (or being coached by them), less than 40% of schools established the role of a digital coordinator/champion. More than half of schools face different *obstacles in implementing such a supportive, transformation role* (despite the formal legislative requirement for a digital coordinator).
- It is relatively positive that two-thirds of schools perceive the skills and confidence of their teachers in using digital tools as sufficiently supportive (as opposed to being an obstacle). However, we see the twin peaks distribution again when it comes to *awareness and availability of third-party digital content* and materials (about half of schools consider the lack of information on this topic a major obstacle). Similarly, almost half of schools feels they lack information on professional development in digital skills and competencies.

▪ **People and Skills**

- Three-quarters of surveyed schools see a key added value of digital in supporting teacher cooperation and interaction. Yet only a quarter of teachers regularly share digital content and materials with peers beyond their own school. About one-third co-creates digital content with their colleagues at school, and less than a fifth of them *cooperates at least occasionally with a partner* from another school, employer, or a university.
- About two-thirds of schools find it difficult to attract and retain skilled teachers and one-third believe they *cannot contribute to a regional or local digital transformation agenda* (planning, prioritizing, and implementing).

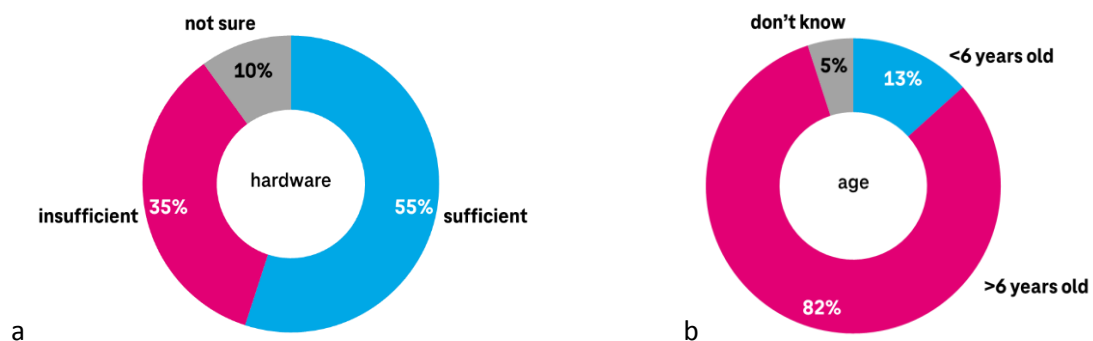
- A partly hidden message coming from our survey relates to a cultural aspect visible in many schools—*lone fighting*—whereby it is up to an individual teacher to find and prepare teaching materials, to deliver them, to test and assess students, and to keep improving the curriculum. That lone fighting leads to repeatedly investing in the same effort and significantly reduces time potentially available to exploring and learning new technologies, methods, and other means. It helps to prop up an *organizational culture that is not attractive to a younger generation* of enthusiasts and experts; in surveyed schools, the ratio of teachers aged below 40 versus above 50 reached 1:2. If the category below and above 40 are taken into consideration, the ratio falls to 1:3 (that is, one ‘younger’ teacher to three ‘senior’ peers).

Let us explore the identified challenges more in depth.

8.1 Operational Age of Educational Infrastructures

One of the perennial issues in Slovak education is a chronic level of capital underinvestment. Schools have often complained about the lack of computers and modern equipment. To address the gap (at least to some extent), several initiatives aimed to support schools in upgrading their computational and related infrastructure. Our survey showed that these initiatives had a positive impact and that an *acute hardware shortage is reported by only five percent of schools* and a *less critical shortage is declared by around 30% of schools*. A similar situation was observed with fast *internet connectivity (100 Mbit or more)*—75% of schools see it as sufficiently available, while concerning wired or wireless connectivity in school campuses, about two-thirds of schools see it as a resolved topic, being no longer an obstacle.

Figure 29. Situation with Essential Digital Infrastructure: (a) Availability and Perceived Sufficiency, (b) Operational Age and Fitness



Source: Authors, 2023.

However, these rather positive findings are dampened by the fact that *more than 80% of hardware at schools is well beyond its useful operational age*. While computers aged seven or more years are still suitable for some purposes (for example, listening exercises in language teaching, basic document processing, or the like), and by all means may (and should) find a use at school, their presence in ICT labs, programming labs, in analytic, graphic-intensive or multimedia digital content might be a critical obstacle to delivering an inspiring learning experience to the student and instilling the confidence in delivering the content to the teacher.

The operational age of infrastructure is connected to the *lack of capital funding*, to some extent. However, when exploring this with school managers, we identified another common behavior that is less common in enterprises. Schools have a tendency to purchase hardware in large batches—often 50–60 pieces or more—and do it when funds are released by the ministry. While that provides a

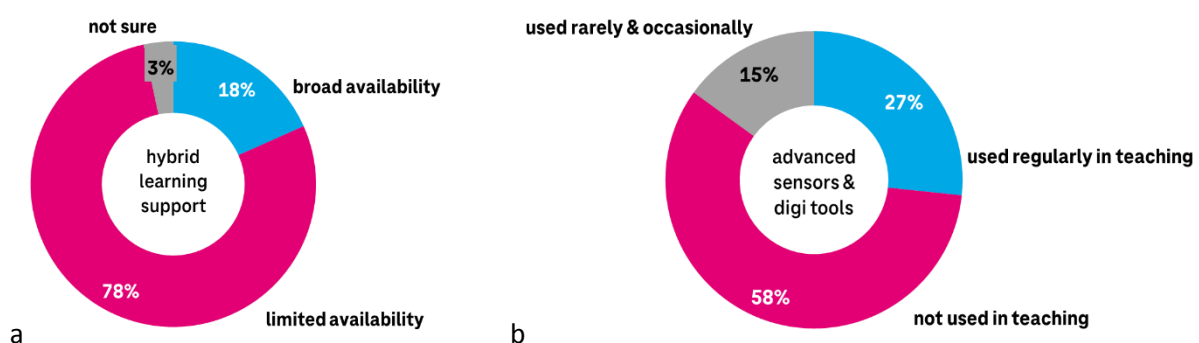
quick solution and theoretically lowers purchase prices, it also exposes the school to a relatively heavy burden in four to five years, when many items start failing at once. Here, a more *systemic approach of regularly turning around and updating* a percentage of digital infrastructure would be a *more risk tolerant one*.

If schools systematically replaced one-quarter (or one-fifth) of their equipment on an annual basis, they may actually save on total ownership costs (including maintenance) as well as on stress factors with the uncertain availability of increasingly more critical equipment to their teaching processes. Opportunistic management of infrastructure lifecycle and over-reliance on the on-site solutions can be *contrasted with a broader trend to make use of virtualized, cloud-based, software-defined solutions*. These, however, require more knowledge among the school’s technical ICT personnel, a coherent vision and plan, as well as architecture—all competencies that are in short supply for many schools. Perhaps pooling these competencies on a regional level, via a regional center, consultant, or advisory service, or interconnecting with relevant commercial/industrial partners might be a simple but sustainable way to address the paradox.

8.2 Availability of Infrastructure for Hybrid Teaching and Learning

This pain point may come as a surprise, considering how well schools managed to get through the recent pandemic situation, when much of teaching was pushed from the physical classrooms into a virtual space. Schools are well-equipped when it comes to tools supporting the traditional methods—presentations by the teachers, frontal methods, one teacher to many students, and so on. The survey showed that close to *three-quarters of labs feature interactive boards or projectors*. Similarly, close to 60% of regular classrooms have such equipment. However, when it comes to *videoconferencing and interactive group collaboration tools, these are often restricted to cameras built in the classroom notebooks*. While these are fully suitable for one-to-one virtual interaction, presentations, and similar such situations, they cannot be considered as equipment fitting the requirements of hybrid learning for student groups.

Figure 30. Availability of Infrastructure for (a) Hybrid Learning and Teaching, and (b) Exploring Advanced Digital Use Cases



Source: Authors, 2023.

In contrast with essential ICT infrastructure (notebooks, wi-fi, and interactive boards) and their relative availability, we found far lower usage of other digital equipment. Examples include various microprocessor or robotic sets, data sensors and actuators, internet of things (IoT) sets, virtual or augmented reality tools, and others. The good news is that there are some frontrunners among the surveyed schools that make use of these digital items in at least a fifth of their teaching time. Examples include VR labs in medical caretaking schools, IoT and robotic sets in many ICT or electrotechnical schools, and programmable and robotic sets in grammar schools. However, for a

majority of schools, the *utilization of digital sensors and exploratory devices is still beyond their capacities*.

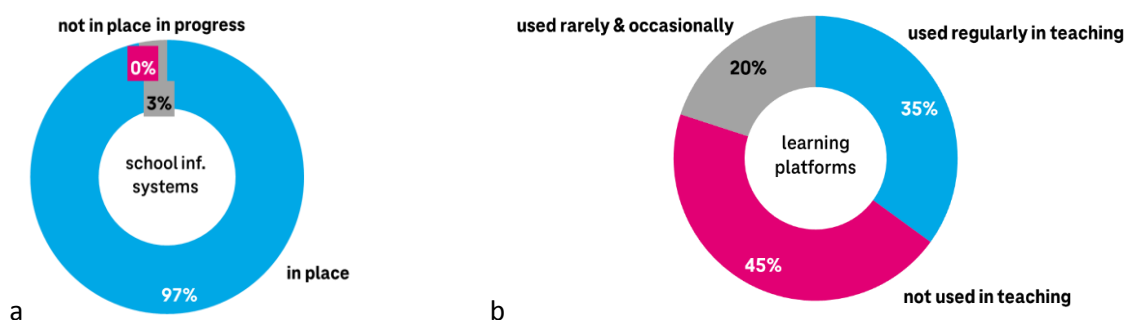
When questioned, we heard more positive reactions and examples of application from vocational teachers, and ICT and programming teachers; however, we heard rather apprehensive responses by the teachers of humanities, sciences, and physical education. Although these curricular areas might not be the early adopters of digital sensors or creative sets, their reactions tell more about the *lack of teacher awareness of what exists and how it might enrich the teaching process*.

This is magnified by the fact that in many schools a teacher has at his or her disposal only a device in the classroom or laboratory, or a private device. The lack of the employer's investment in the equipment for the teachers effectively restricts opportunities to explore and learn in a safe setting (without students, but with peers). According to the survey, as many as *three-quarters of schools could not provide a 'business' device* to more than a handful of teachers (usually the broader leadership team only). Teachers are expected to come to the classroom with a tool, device, or gadget fully mastered. Not surprisingly, many opt to avoid introducing any new tools, especially as they perceive their students being more comfortable and experienced with such devices than themselves.

8.3 Superficial Usage of Digital Learning Tools and Platforms

When it comes to teaching and supportive processes at schools, the survey showed a rather different picture. On one hand, all schools have a functioning school information system in place. That is a positive finding and might be one of the positive legacies of the pandemic time, when schools invested heavily in information systems such as EduPage¹³. Less positive is the relatively lower utilization of digital solutions directly supporting or facilitating learning, self-learning, and/or online learning. Only roughly half of the schools opt for some digital learning support; for the other half, it is not an item even 'on their radar'.

Figure 31. (a) Utilization of (Administrative) School Information Systems, contrasted with (b) Digital Learning and Teaching Platforms



Source: Authors, 2023.

¹³ EduPage is a cloud-based school management and scheduling system that facilitates many school tasks: curriculum input, attendance tracking, room booking, assigning homework, and so on. (<https://www.edupage.or>).

A relative minority of teachers are using digital learning systems for the exemplification of theory and for the exploration of a subject—only 40% tend to use it in their teaching practice. Even lower numbers use digital learning tools or platforms to facilitate problem-solving situations or to give creative assignments to their students (27%). As was highlighted earlier, only a negligible group rely on digital learning tools to give their students interim formative feedback, to track progress of the students, or to assist with their performance assessment (15%).

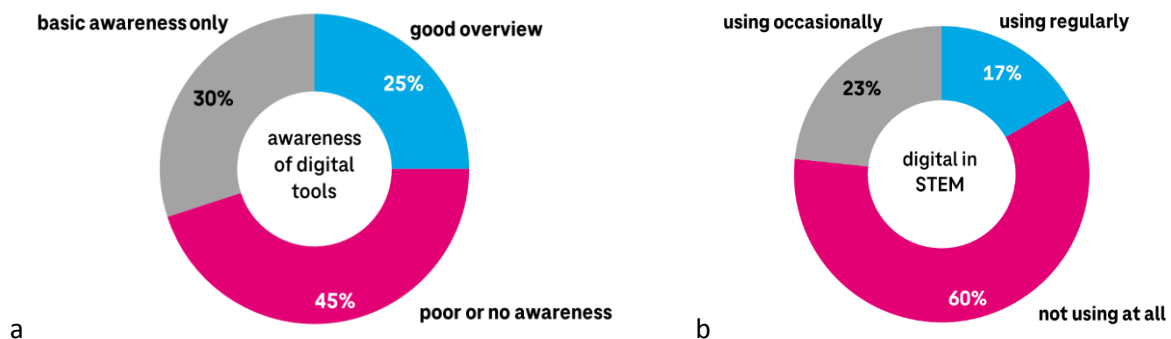
When exploring what toolkits and platforms dominate at school, the survey pointed to EduPage (usually in the role of an administrative system), Microsoft or Google office suites, free-to-use communication/collaboration tools (like Teams or Zoom) and diverse email clients. The lack of more in-depth tools and platforms, is to certain extent, associable with the difference in students’ and teachers’ performance in IT fitness tests, for example. In those tests, both groups fare much better in basic interactions (searching and browsing) and lose points in more complex problem-solving and analytical tasks.

The low levels of reliance on online student assessment puts a burden on teachers, as they need to invest their time in preparing, testing, and assessing student performance, often manually. One reason behind the low levels of using tool-enabled assessment is connected to the lack of more sophisticated platforms. While a part of the respondent cohort refers to EduPage as an assessment tool, they acknowledge its fitness for only relatively simple, multiple-option, or simple answer testing, recognizing that this tool has very little space for automated feedback. Tools like Kahoot, various e-portfolio builders, and self-assessment quizzes are used more for the activation of students, than for real assessment and meaningful deeper interaction.

8.4 Utilization of Digital Aspects in STEM and Vocational Context

Continuing with the observations made in the previous section, the survey explored how the usage of digital tools and learning support gets used by different groups of teachers. We found the digital tools are not very commonly used to make teaching and learning more interactive, exploratory, and creative in sciences, technology, engineering, and mathematics classes, where the Slovak Republic has a long-term gap in both testing performance, as well as in fulfilling labor market demand. Some 40% of teachers at least occasionally apply digital tools to their STEM lessons, and only 17% do it on regular basis, at least weekly.

Figure 32. (a) General Knowledge of Learning Support Systems and Tools, versus (b) Usage of Digital Learning Tools in STEM Subjects



Source: Authors, 2023.

One root cause may be seen in the relatively low awareness of our respondents and their schools concerning what tools and learning support platforms actually exist on the market for their specific class. Almost half of respondents have no awareness whatsoever, with a further 30% only having

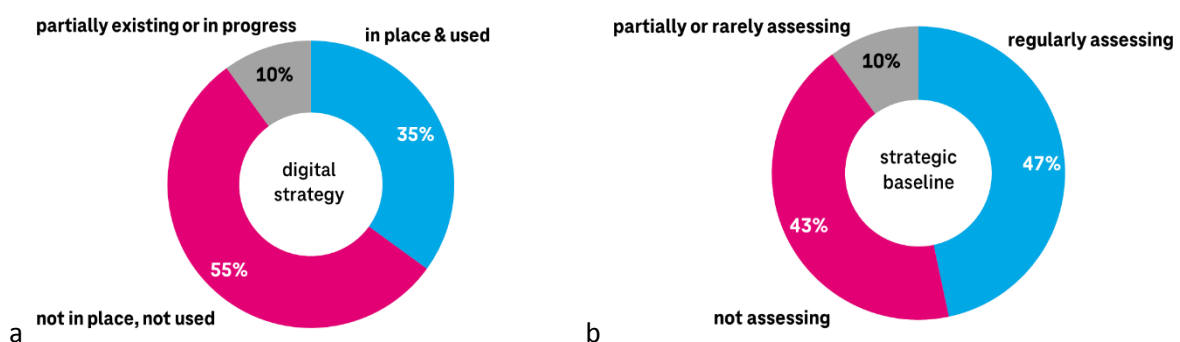
abstract, superficial information. Only a quarter of teachers feel they have a good overview and good insights into what tools exist, how they might be used, and how they work. When exploring the issue further, we often heard the reference to the lack of budget to purchase licenses, as well as the lack of language localization, as the main reasons why the tools they knew or learned about did not get rolled out and at least tested. English localization is prevalent; however, it does not help much with enriching the processes in the Slovak Republic. First, there is a semi-formal expectation (regulation) to teach in the Slovak language. Second, there is an issue of the relatively low command and low confidence of educators in their own level of English.

The lack of application of digital tools to teaching and learning STEM, reduces the capability of students to address more complex tasks and assignments. This has been documented by the IT Fitness Test, where this was one of the weaknesses in the country. Furthermore, students then perceive digital systems to which they are exposed as isolated tools that need to be learned to pass a given subject (for example, informatics). They often lack the opportunity to develop a more positive attitude to the digital tools; they perceive them more as ‘tools of the trade’, that is, as the means to achieve ends, rather than the means to solve broader, societal, ecological, economic, logistical, or engineering challenges. In other words, the ICT and digital world gets disconnected from the application domains. The methods are taught and learned *per se*, that is, application domains as isolated islands with their own (independent?) body of knowledge. In the modern world, such a division is contradictory to the capability to cope with complexity, volatility, and incompletely defined tasks and assignments.

8.5 Strategy—Systematic Versus Opportunistic Approach to Modernization

We mentioned earlier an interesting behavioral pattern in surveyed schools. When it comes to strategy—a digital transformation vision, plan, and execution timeline—a clear ‘twin-peak’ distribution appears. This is in contrast to a more typical normal (Gaussian) distribution, where there would be a few leaders, a few laggards, and a dominant group of slower or faster adopters. *In the twin-peak model, there are two similarly sized groups at both extremes.* There is a group of schools who strategize and subject various processes to support the strategy, and there is a group of those who pay little attention to planning for digital transformation.

Figure 33. (a) Digital Transformation Strategy and Action Plan Situation, versus (b) Evaluation of Digital Readiness and Progress



Source: Authors, 2023.

Despite a lot of media coverage (both professional and popular) about the impact of digital on jobs—on the creation of new jobs, and on making some jobs obsolete—*more than half of surveyed schools do not have any strategic (that is, forward-looking, planning, or visionary) material in place.* This lack of systemic planning to some extent explains the issues schools have with efficiently

managing their hardware infrastructures, managing, and inspiring the professional development of their teachers and trainers, and applying digital aspects to various subjects/classes. Instead, many *schools live in a reactive mode*, when they readily respond to the calls for proposals, to the waves of investment coming from the ministry, rather than doing it in a planned, systemic, well-thought-through manner.

The survey also contradicts one of the fundamental managerial recommendations—that of basing the transformation vision and agenda less on emotions and feelings. Studies emphasize the *important role of baselining the strategies on real data*, to look deeply into a mirror before starting to strategize. Indeed the first recommendation from Gartner analysts in modernizing educational technologies and processes is to “establish a baseline for the digital strategy by outlining the current state of the enterprise technology environment and defining future state digital capability objectives using the strategic roadmap”[3]. The successful organizations not only define their digital transformation plans, they compare or benchmark their priorities, operating models and/or technology platforms to those best-in-class, whether in their home country or abroad. They work on their digital capabilities (whether existing or to be developed) together with their stakeholders. They invite stakeholders to give feedback and assess from the outside the processes, the content, and the infrastructures.

In this context, it is not a sign of successfully mastering the art of change management. Almost *half of schools do not apply any assessment of their technology, resources, and capabilities*. Perhaps more positively, about half of the surveyed schools base their digital visions and plans on tangible data, on the regularly done internal ‘auditing’ of skills, processes, and/or technologies. Speaking to the school managers, only a small fraction invite external partners and stakeholders into the processes of assessing the school’s digital readiness and maturity.

Thus, the picture shown in Figure 33 is not entirely negative, yet it somewhat *reinforces the mentioned attitude of ‘lone fighting’ and isolating oneself in ‘a bubble’*. This bubble world attitude leads to minimal communication with partners outside of the bubble; only about one-quarter of surveyed teachers interact with peers or partners from outside communities and a shockingly low eight percent co-create, prepare, modify, or develop their teaching materials in cooperation with the external world. We take this aspect separately; however, it is an outcome resulting from the lack of systemic strategic vision and planning in the schools. A good vision would have started with promoting the core benefits of the digital world to the educators and making it clear how those benefits could be achieved at a specific institution.

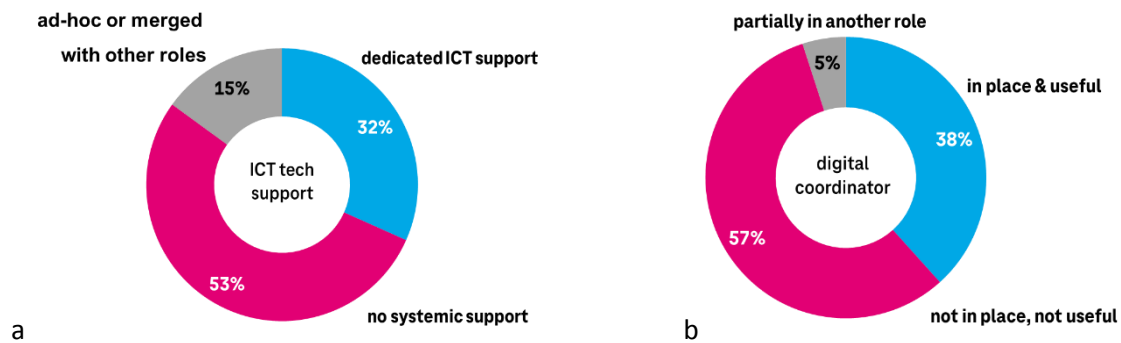
8.6 The role of a Digital Coordinator in Supporting the Transformation

The lone fighting attitudes continues also in the area of supporting the digital aspects and the transformation of various curricular plans for the new era. While the teachers do innovate their curricula and are open to using digital infrastructures, *in half of the schools there is no dedicated technical support for the ICT aspects of teaching*—no hardware maintenance, tool setup, system configuration, and so on. In a small number of schools, such a support role exists, but it is often merged and co-located with other roles (like, for example, the teacher of informatics).

A similar situation exists regarding finding a guide who can help their teaching peers get started with their specific digital transformation journey. Despite recent legislative support, more than *half the schools have not implemented the role of a digital coordinator* (or equivalent). The role itself raises mixed reactions among teachers and school managers. There are schools with multiple knowledgeable teachers, where they see little sense in picking one of them only and elevating them to a coordinator’s role. There are schools with potentially good candidates for such a role; however, transferring an expert teacher into a coordinator’s role might create a gap in teaching. That may

mean some schools must ‘sacrifice’ a potential coordinator to maintain their teaching capacity. Complicating the situation further, there are schools that recognize the value of a digital coordinator, but make it a virtual position. In such cases, it is executed by an individual on top of their daily teaching or managerial duties.

Figure 34. Creation of Dedicated Roles (a) For ICT Infrastructure Support, and (b) For Digital Coordination and Advisory Service at School



Source: Authors, 2023.

Furthermore, there seems to be a *very broad understanding of what the role of a digital coordinator comprises*. For some schools it is more a technician or technology consultant; for others, a digital coordinator is more a psychologist and coach trying to motivate their peers to transform their established ways of working and teaching. One obstacle to establishing the mentioned roles, as quoted by the respondents, touches the (not very) systemic support. While the role was first piloted in the context of a national project (IT Academy for the 21st Century), and a batch of candidates were fully trained, with the conclusion of the project, the subsequent candidates were left ‘high and dry’, with no or very limited access to education, which was a necessary condition to enter the coordinator’s role. Some schools reacted flexibly and found a temporary way around this obstacle, only to find out they were also left ‘high and dry’ when an ad hoc funding package emerged at the ministry to help the schools with no coordinators.

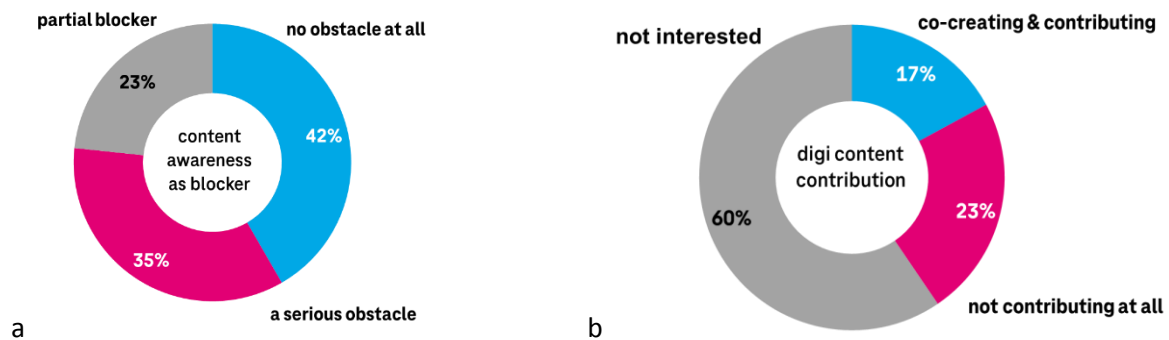
The challenge is to *align the well-meant legislation with a more systemic management of the intended outcomes*. Unfortunately for schools in the Slovak Republic, many innovations are tightly linked to various one-off funding sources, usually from European funding mechanisms. *Because of the temporary nature of EU-funded projects, many positive outcomes are threatened to die, starved of regular, foreseeable funding*. This is a strategic challenge which applies to digital coordinators, but also to numerous libraries of digital materials, training courses, or innovative processes that were developed in projects, without systemic backing from nontemporary sources. In other words, we see this as *a challenge to the sustainability and longevity of ideas*; it is not enough to support idea creation but (especially) the state and (preferably) the regions must treat sustainability more seriously.

8.7 Awareness and Availability of (Co-)Created Digital Content

The challenges reviewed in the previous sections touched on the gaps in processes (whether teaching or supporting), in data analytic capabilities and systematic execution, and in the management of technological infrastructure. At first glance, the challenge of digital awareness and the availability of (co-)created digital content does not appear to be so negative looking, but it potentially is a serious blocker, a sort of hidden iceberg that may thwart many well-thought visions and plans in the future. We refer here to a deep cultural feature, again touching on the isolationist thinking and behavior—the ‘bubble worlds’—of individual schools and teachers. The fact that only

17% of teachers are at least occasionally cooperating with external peers and partners is not positive. Even less positive is that fact that only eight percent do it on a regular basis. However, the most dangerous element shown in Figure 35b is the grey segment. That depicts people who are not interested in, and do not see any point or any value in interacting with the external world. They are not refusing to share or co-create. They simply do not perceive the aspect of sharing, co-creation, and co-ownership of digital content as something that is relevant to their roles at schools.

Figure 35. (a) Awareness of Third-party Digital Content, versus (b) Personal Willingness to Co-create Digital Content



Source: Authors, 2023.

To be fair, the culture of sharing faces many obstacles. The twin-peak distribution comes in again—there is almost a half of teachers who perceive third-party digital content as generally available and accessible. About a quarter identified obstacles, typically in terms of licensing, finding, and repurposing. However, a third of respondents complained that third-party content is very difficult to obtain—the general awareness of libraries is limited, and libraries created within projects are often hidden, locked, or discontinued after the project’s closure.

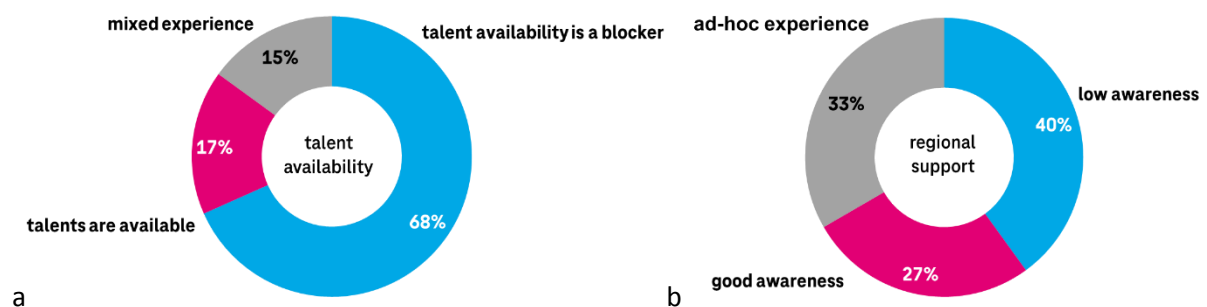
Several respondents shared their experience in participating in content creation activities in the past—that there were no lasting benefits, no sustainable access to content, and generally, they were left with a feeling that they gave something away but received little in turn. Doing something creative and ending up with the impression that it was all in vain, is far from a good practice. That negative experience, in our opinion, may be one of the root causes of that grey 60% of the population being indifferent, not interested, and pushing the topic out of their conscious attention. In other words, we re-emphasize the point from the previous section. It is not enough to launch projects and train people; schools and (even more so) regional educational managers need to consider the aspect of the sustainability, availability, and accessibility of outcomes before they launch a project.

We are clearly missing digital libraries and repositories, where digital content can be not only uploaded, but also maintained, updated, searched, correlated, and so on. We are also missing dedicated custodians of such digital repositories, and here we see an opportunity for the regional educational departments to offer such an innovative and inspiring service to their school communities. This is also an opportunity for the formation of sectoral advisory boards and an alliance of sectoral boards; these are virtual institutions that may and should, in principle, become patrons of the repositories with sectoral digital content. They might even act in cooperation with universities to curate, give feedback, and assure the high standards of such repositories.

8.8 Talent with Attitudes of Sharing, Collaborating, and Co-creating

Let us continue with the critical aspect of sharing and co-creation, this time less from the bigger strategic viewpoint and more from the perspective of attracting the experts with a positive attitude to the system. Our survey shows that two-thirds identify a major obstacle to their digital transformation journey: the access to, and availability of, talents with the right know-how, attitude, and persistence. This time the blue segment in Figure 36a depicts the bitter agreement with a statement on the blockers and obstacles to digitalization. This feeling of school managers—that their schools stand little chance in the highly competitive labor market filled with digital and ICT experts—can be a serious damper to their visionary enthusiasm.

Figure 36. Perception of Obstacles: (a) Talent and Expert Availability, (b) Regional and Sectoral Support for School Transformation



Source: Authors, 2023.

As briefly touched on in the demography section, in a typical secondary school there is about 40% of teachers older than 50 years, and then roughly 30% each of teachers between 40 and 50 years old, and teachers below 40 years old. Only 6% of the surveyed cohort were in their twenties. A similar picture comes from the focus on 'years of experience'—roughly a third of teachers serve more than 25 years, a third between 10 and 25 years, and a third shorter than 10 years. Only 7% of them are newcomers—those in service for three years or less. That is a challenge, as it suggests that a school career is not very attractive for younger experts and digital enthusiasts.

Partly because of financial reasons, these talented individuals (especially language competence ones) move to the regional 'daughters' of international corporations, usually outside of their area of study and specialization. Another root cause to the low acquisition and retention of talent is the aforementioned nonsystemic approach in the educational system. Our respondents touched on the following difficulties: frequent changes to the system; ad hoc amendments of minor aspects and disregard for deeper change aspects; a heavy administration and bureaucratic burden; the duplication of digital and physical (paper-based) processes; and many more.

While talent acquisition is clearly a challenge for a specific school, it will also be a challenge for the regional educational authorities. Here schools perceive gaps: only one-quarter of school managers feels well connected to the regional educational steering and ecosystem. The majority of schools are not sufficiently aware of what support they may obtain from their regional authority, sectoral patron, regional employers, and other stakeholders. The talent aspect is perhaps one of the pain points that may be better tackled at the level of a region, rather than an individual school. Regional educational authorities should look into opportunities for investing in regional competence centers or specialized training centers that may act as virtual entities above individual schools. They may help optimize the workload and bring in additional incentives and compensation to the talented individuals who are willing to contribute in sharing their know-how, co-creating digital content, and seeding local and regional co-working and mutual-support communities. While these are soft

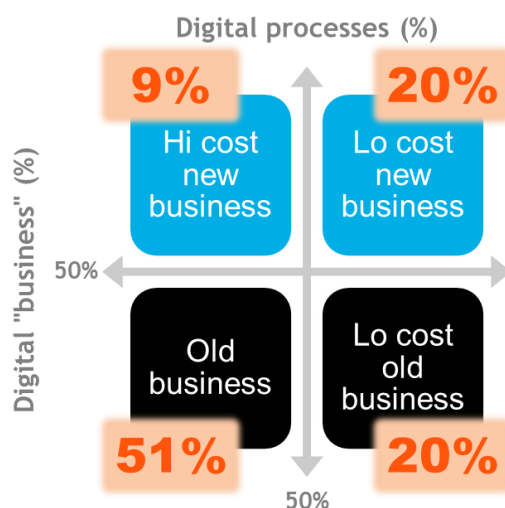
aspects of a digital transformation strategy, the experience of many organizations worldwide suggests the soft aspects might be vital and foundational.

9 Responses to Core Challenges and Their Prioritization

As can be seen across all three analytic chapters of this report (chapters 0 through 8), there is no shortage of challenges in the secondary educational ecosystem in the three in-focus regions. On the other hand, we are conscious of the fact that if too many challenges are given to be addressed, it may dilute attention and eventually hamper successful implementation of digital transformation strategies at our secondary educational institutions. Therefore, the main purpose of this chapter and its sections is to prioritize the most pressing challenges and offer a smaller number of themes that can be taken for further steps. The next steps will shift the activities from the analytic thinking more toward synthetic, constructive thinking of working on specific solutions and solution frameworks.

Before we delve into priorities, let us summarize the survey in the form of Figure 37. This chart considers two dimensions of 'digital'. The first dimension is the horizontal one: how digitalization affects the execution of various processes and the depth to which it goes within these processes. Digitalization may touch more superficial aspects (at a lower cost, usually) or deeper aspects (often, at a higher cost). The second dimension is the vertical one: the chart looks at how an educational institution perceives its 'business', and to what extent it applies the digital to maintaining the traditional approach, as opposed to designing a new approach to teaching and/or learning.

Figure 37. Map of Areas Where Secondary Schools Apply Digital Aspects



Source: Authors, 2023.

From the replies to the survey, it comes out that a lot of seeming digital effort goes essentially into maintaining the traditional, existing educational models. This 'old' business model emphasizes one teacher to a classroom full of students, usually a frontal presentation, the physical delivery of content, and the relatively passive role of the student. On the opposite side are various digitally native methods, tools, and technologies encouraging collaboration, creativity, and other positive qualities and skills. Looking at the above figure, the majority of schools fall into the lower left segment or quadrant, that is, "old business". These are the institutions where digital aspects are seen in the shape of projectors with interactive whiteboards as image displays, and fast connectivity, but they are restricted to one or two specialized informatics labs, and the like.

Smaller number of schools started using the digital during pandemic times in the form of various Zoom or Teams or Kahoot tools and keep using them. Such tools, more or less, only act as new channels for traditional processes and content delivery: instead of a physical teacher, we see a teacher on screen, or in a better case scenario, a remote expert addressing the classroom. About the

same number of schools started using the digital portfolio more creatively: they introduced various creative sets and simulators; they digitally supported student team collaboration; and they advanced tools on top of the standard office suite (like, for example, 3D modelers and viewers, collaboration canvas boards, agile methods, and so on). Only a small majority went all the way to designing and exploring completely new models of teaching and learning enabled by digital. These include the following examples: MOOC/Moodle style software; VR-/AR-equipped classrooms to offer embedded experience; the creative exploration of science through games like Minecraft; robotics, like Lego Mindstorm; or IoT sensory sets, like Microbits.

The prioritization happened in two steps or phases. First, we involved a broader range of stakeholders in the process, familiarized them with key preliminary observations, and worked with them using the methodology of focus groups. The process and its implications will be discussed in more detail in the following section. Then, evaluating our findings and conclusions, as well as the feedback from the experts invited to the focus groups, we formulated the core challenges in the subsequent section.

9.1 Validation of Observations in Focus Groups

On May 4, 2023, the CuRI VET team organized a workshop with two focus groups to share preliminary findings from our survey on the digital maturity of secondary school in the three regions. The workshop took place in Prešov, with great support from the Prešov Self-governing Region and its education department. Several representatives from different stakeholders were invited to the workshop to give feedback and help us prioritize recommendations arising from the survey. In total we had 32 participants, and the following categories of stakeholders were represented in the focus groups:

- Regional government representatives
- Representatives of the departments of education from Prešov, Košice and Banská Bystrica
- Members of school management teams from secondary schools in the regions
- Teachers and digital coordinators from the regional secondary schools
- A representative of the National Institute for Vocational Education, on behalf of the Ministry of Education
- Representatives of small, medium, and large regional employers
- Representatives of regional chambers of commerce and employer associations
- [Representatives of the Digital Coalition—The National Coalition for Digital Skills and Jobs of the Slovak Republic, as well as national projects and initiatives working in the field of digitalizing education](#)

The workshop comprised several complementary parts:

1. The first session was dedicated to sharing a selection of findings and observations from the survey. This was delivered by Martin Džbor, and it offered a summary of extracts from Chapter 8 of this report.
2. The second session offered an entry from the representative of the Digital Coalition—The National Coalition for Digital Skills and Jobs of the Slovak Republic, who presented the bigger picture of ongoing initiatives at the national policy level.

3. The third, and longest, part of the workshop was dedicated to focus group interactions. The attendees were divided into two focus groups that were facilitated by team members Andrea Hagovská and Helena Virčíková, on behalf of the World Bank and CuRI.
4. While consolidating the outcomes from the focus groups, we offered a panel discussion to the attendees, which was led by another member of the Bank team, Štefan Chudoba.
5. In conclusion, we summarized the outcomes from the focus groups, and the event was wrapped up by the VET team lead Husein Abdul-Hamid and Martin Džbor.

Figure 38. Focus Group—Introduction of Preliminary Outcomes



Source: Authors, 2023.

We opted for the use of the focus group concept [24] to obtain additional insights into the online survey, to launch a joint discussion on the challenges identified in the survey, and to offer an opportunity to publicly talk about good practices leading to improving the quality of secondary education in the regions. We organized the groups to observe as much diversity as possible and prepared four questions to facilitate the debate. Attendees could react at any time; they were asked to keep their feedback and entry short, to the point, and respectful of other opinions. Altogether we allocated 60 minutes to the discussion phase of focus groups and emphasized the need to achieve joint conclusions in addition to voicing opinions.

The four areas to steer the focus group interaction more systematically, included the following:

- Where do individual attendees see the most impactful contribution of digitally transformed secondary education—from the viewpoint of their institution, position, et cetera?
- How do individual attendees perceive the role of a digital coordinator or champion driving digital transformation at a secondary school in the region?
 - We aimed here to agree on the top three priorities/expectations on which digital coordinators should focus in their duties.
- What shall the interaction and cooperation with the external environment of a school look like, according to the individual attendees?
 - We aimed here to identify at least three good practices with the highest impact on the quality of education.

- Finally, we offered an open question on what the recommendations of the individual attendees were to improve the systemic and sustainable approach to digitalizing secondary-level education in the regions.
 - We aimed here to identify the top three recommendations for strategic management of the transformation in the regions.

In terms of focus groups, the attendees raised many valuable comments and examples of good practices they were exploring and implementing. Let us consolidate the key recommendations and outcomes of the focus group in the direction of our survey and its findings.

Figure 39. Focus Group—Presentation of National and Sectoral Initiatives



Source: Authors, 2023.

Question 1. Value of digital transformation of secondary education

We asked: *“What specifically do you see as the greatest benefit of the digitalization of secondary education (in your organization, at the level of your position)?”*

Experts noted the following thoughts that were discussed with them:

- Digitalization is a social trend—schools are responding
- New method (methodology), high level of efficiency and flexibility in the creation of educational content and education itself, exchange of information, improvement of the quality of education
- Efficiency in education (financial and time savings)
- Increasing competitiveness and space for cooperative learning, also internationally
- Flexibility and inclusion of the system, accessibility and equality, personalization
- Optimizing resources/maximizing the use of existing resources
- Access to lifelong learning

The invited experts validated and supported the premises of our survey, and they emphasized the key benefits and value drivers that each secondary school should be aware of (and indeed look forward to), including the following:

- Improvement of the competitive position of the school, by means of accessing cooperative methods of teaching and learning, possibly with an international connection
- Increase in the flexibility of the teaching process and its native inclusive capacity, which would manifest in teaching processes and materials becoming more easily accessible, ready to personalize, and reacting faster to the changing conditions of the market and external environment
- Optimization of existing resources (especially expert teachers)—through digital means; these resources could be used, shared, and redeployed more efficiently, and faster
- Digital approach to teaching and learning would open up know-how, labs, and offerings of the secondary schools to the broader, lifelong learning market, thus extending a school's direct impact on the local region and local economy

Thus, in a nutshell, the attendees identified themselves with the expected increase in the efficiency of educational and support processes. We fully agree with their position that they did not perceive digital transformation as a goal in its own right. Instead, they perceive it as a new method (or better, methodology) that focuses on scaling the efficiencies and economies arising from scale, flexibility, a high degree of interaction, and leading to the better quality and resilience of the entire educational system.

Question 2. The role of digital coordinator in digital transformation of secondary schools

We asked: "How do you imagine the role of the digital coordinator in supporting digitalization in the secondary school (in the region) so that the secondary school works better? Please name the key priorities for digital coordinators."

Experts noted the following thoughts that were discussed with them:

- System (support) of digital coordinator (DC) positions, including securing the funding required for the position
- Profile of a DC—a technology enthusiast, motivator; is flexible, creative, familiar with the school environment, and is a team player, connecting in practice and processes
- Specific approach—every school is unique
- The school should have a clear vision of digitalization and find allies, and this cannot be done without the school leadership (WHAT, WHERE, HOW)
- Finding a team and network with the external environment
- A mentor who motivates and guides the teacher individually—space for individual work with teachers
- He should have available methodologies and best practices to follow
- The coordinator can also be shared, but must be part of the internal team ('regional IT guru')
- Create a platform and connect everyone conceptually (including companies), for example, a joint virtual club

Figure 40. Focus Group—Presentation of Focus Group Conclusions



Source: Authors, 2023.

In this round, the invited experts shared different stories of their institutions involving digital coordinators. They touched on obstacles, questioned the premises of pushing such a role into the system, and aimed to identify a profile of a useful digital coordinator. In their conclusions, they emphasized the following key benefits and value drivers of the digital coordinator’s role at the level of secondary schools:

- Systemic support for the role of digital coordinator, including its continuous, sustainable funding
 - The attendees acknowledged a digital coordinator might be a shared role, perhaps across multiple institutions or at a regional level. They pointed to a potential ‘regional digital guru’ as a valuable value added from the regional level.
 - A part of systemic recommendation was also the call for establishing platforms, possibly virtual ones, but acting at regional levels as well, not only the central level. The expected value was seen in conceptual support, networking, and interconnecting that would facilitate the culture of sharing, exchanging, and reusing.
- The focus groups emphasized that schools are unique entities, and a ‘one-size-fits-all’ strategy in implementing the role of a digital advisor, supporter, and driver is unlikely to succeed. The role needs are to be taken flexibly, and its local or regional customization or adjustment should be permitted.
 - Schools shall invest, as a part of forming their digital transformation strategy, in formulating a clear vision for the role of digital coordinator and subsequently, for the transformation. Concerning this point, a good practice was suggested: to approach it as alliance buildup, involving stakeholders in it.
- Generally, the digital coordinator was seen as a technological enthusiast (as opposed to an expert) capable of motivating and inspiring creativity, teamwork, and above all, well-versed in the internal environment of the respective school, to efficiently interconnect the school with practical aspects as well as external opportunities in the digital arena.

- A recommended good practice in the context of a professional profile of digital coordinators included the capability to mentor individual peers, to put together small teams and facilitate networks among their members.

In conclusion to this question, the focus groups emphasized the challenge we identified in our data: a lot of activity happened opportunistically in the past, and a greater degree of strategic, systemic, and structured approach would bring more benefits than passing good; however, the outcome would be otherwise, if the approach was not supported by the needed legislative elements. With no systemic backing (and funding), even the good intentions of the legislators are bound to dissipate or fail.

Attendees also linked the roles of digital coordinators to being role models of ‘digitally friendly’ behaviors. The core of role modelling is about facilitating teamwork, networks, and cooperation. The call for platforms enabling the interactions and exchanges among the digital coordinators may indeed be one of the first steps and good examples inspiring other groups of teachers to interact, share, and co-create, as we emphasized in the analysis of the impacts of our findings in chapters 0 and 8.

Question 3. The means to improving the interaction of schools with their external environment

We asked: *“In your opinion, what should the cooperation and coordination with the external environment look like in the field of the digitalization of education? Please, name a minimum of three important areas and forms of cooperation with an impact on the quality of education.”*

Experts noted the following thoughts that were discussed with them:

- Cooperation between schools
- Cooperation with the external environment—universities and companies
- Outputs from international projects—shared and promoted project outputs
- Repositories of information—so that they do not perish when the project is concluded
- To create a complete functional system
- Continuity between the individual parts—the processing of the part—will contribute to the processing
- Twins—connection of related schools
- A portal or database of shared quality practitioners—one participant coined a hypothetical name for such an entity: “Edu Uber” (see the bullet point below, titled “technological”)
- Create conditions for informal meetings and activities between schools, between schools and companies, and between other actors
- Sharing of digital content between companies and schools (improving the view on the QUALITY of digital content in particular)
- Make a ‘league of exceptional digital schools’—support healthy competition (city, region)

In this question, the invited experts shared their stories and experiences involving functioning or dysfunctional cooperation. They touched on technological aspects, emphasized the sustainability of approaches and innovations explored in various projects, and touched on the cultural dimension of positively influencing cooperation between schools and external partners. In their conclusions, they emphasized the following key benefits and value drivers of the digitally facilitated cooperation of secondary schools:

- Technological, supportive infrastructure that can be sustained independently of any individual innovation project
 - This includes space where teachers can find useful data, materials, examples relevant to their field of specialization, and applicable to the secondary level of education, and possibly linked to the outcomes of international projects, where such materials were prepared.
 - At the very simplest level, the attendees emphasized a rational utilization of storage solutions (when available), such as an educational cloud or portal.
 - A more visionary proposal went in the direction they labelled “Edu Uber” to allude to the business model based on sharing and matching, as introduced by the well-known global taxi provider.
- Opportunities for informal meetups, exchange rounds, and panels for the educators active in secondary schools, as well as in companies and other relevant institutions
 - In this context, attendees emphasized that cooperation has a broader reach than just school-company exchange. Secondary schools will invest more effort in connecting to universities and faculties in their respective fields of specialization, as well as establishing links to similarly focused schools—at least within a given region.
 - There was a potentially valuable proposal to establish pairs or small clusters of schools (and their teachers) based on their specializations, shared co-working partners from among employers, shared approach to innovating specific subjects, or other common features.
- Availability of data and utilization of possibly advanced data analytics to simplify finding, extracting, or matching existing digital content to a particular teacher or purpose
 - A worthwhile proposal suggests that the regions facilitate a sort of ‘extraordinary league’, not based on nominations and appointments, but on personal contribution, peer-reviewed helpfulness, and relevance of co-created digital materials. Thus, this would seed a virtual ‘center of excellence’, which would not be bound to one physical school, but to the region.

In a nutshell, we appreciate the effort the focus group attendees gave into looking for the value added by cooperation. Their observations are fully in line with findings and outcomes we discussed in chapters 0 and 8. The need to step outside of their bubbles, to interconnect with other schools, as well as other stakeholders, is the right way forward.

Question 4. Improving the systemic and sustainable approach to digital transformation

We asked: *“What are your recommendations for improving a systematic (that is, sustainable) approach to the digitalization of secondary education? Please, name three recommendations for a systematic and strategic approach at the regional or local level.”*

Experts noted the following thoughts that were discussed with them:

- Existence of a common functional data center (cloud)
- Get materials on one portal—there are plenty of materials
- Financing planning + SW support
- Education and process implementation

- Do not think about egos and logos—if we do, the risk is that we will not enter into partnerships, but instead into competition—it is best to admit the color and recognize that we can prepare it better together
- Teachers must have soft skills—that is the most important
- WILLINGNESS TO CHANGE (CHANGE process)—tutoring and mentoring are important—support the professional development of teachers, and then there will be a quality system—quality management is important
- PROCESS OF CHANGE MANAGEMENT—create a support system for planned changes—change of ATTITUDE (double)
- We place new expectations on teachers and school leaders for which they are not ready—they must be given the time and space to become leaders

In this question, the invited experts shared their advice on strategic recommendations. They touched again on technological and infrastructural aspects, the systemic approach to funding and planning, but also discussed the cultural change aspects and the need to treat the situation as a change management challenge. In their conclusions, they emphasized the following key facets of what they mean by ‘strategic’ and ‘systemic’:

- One (possibly centralized) supportive infrastructure that can be sustained independently of any individual innovation project, or a network of stable (regional) cloud data centers
 - There is a need for the transformation and migration of digital materials from small project portals and partial repositories to these shared storage spaces/clouds. There is a wealth of materials, but the issue is that there is a very high degree of fragmentation and a lack of accessibility.
- Financing models for secondary institutions need to be foreseeable and stable as to the structure, priorities, and market relevance.
 - Frequent changes, and ad hoc adjustments often lead to placing new, additional, extra requirements on schools and regions. The attendees recommend increasing the transparency on what should be dropped/stopped to generate certain savings, which might in turn partially fund the innovative, new, and additional requirements.
- Creating a supportive foundation to enable the processes of organizational and cultural change management—at the level of schools, school managements, as well as regional authorities
 - The attendees emphasized the need to change the mindset of the players. For example, they see the change in teachers’ attitudes to mentoring, coaching, and sharing as vital. Yet that change in attitude requires a deep cultural turnaround, and as such, it will not happen simply because of an administrative order, central decision, or declaration.
 - As a part of their regular teaching schedule, provision needs to be made in the teachers’ contracts that guarantees them a certain number of hours for professional self-development. It is not a sustainable practice to expect self-development to happen during their free time, on top of (often) seven or eight hours of teaching.
 - Management changes should also address the external environment, with the goal of making the role of a teacher more attractive. With the lack of both talented individuals and new entrants to the system, many attendees quoted the situation

where incumbent teachers' contracts are often 30–50% above the recommended standard teaching time-capacity allocation. With such contracts, it is not realistic to expect any motivation for separate self-development, exploration of innovations, or learning and introducing new methods to the teaching process.

In conclusion, the planning, preparation, and subsequent execution of digital transformation is not so much about technological change. Rather, this transformation is heavily dependent on a thought-out organizational and cultural change, and on a professional and successful execution of change management in the context of individual secondary education institutions, regional educational authorities, sectoral attitudes toward secondary education, and eventually, the national authorities as well. This finding is probably the strongest conclusion that arose from the focus groups. Furthermore, this understanding of the invited experts is fully in line with findings from around the world. Finally, since the focus of our survey is on regions, we emphasize the need to competently support change management, especially at the level of regions and individual schools.

Figure 41. Focus Group—Expert Panel Discussion



Source: Authors, 2023.

9.2 Recommended Priorities for Schools, Regions, and the System

Let us start with summing up the key digital ‘anti-patterns’—those behavioral and procedural blockers that can be considered as the root cause of the present digital status depicted in Figure 37 (“Map of Areas Where Secondary Schools Apply Digital Aspects”):

1. The majority of secondary schools focus on one-time education

- However, one-time education at the age between roughly 15 and 20 years old, is a sort of ‘old business model’. It is demographically very sensitive, and the schools see it in the declining numbers of new entrants. Declining numbers lead to many schools serving only 150–250 students, which gives little space for efficiency. Compare that to larger school campuses in countries like Spain or Germany, but also in our regions; size gives economic advantage.

2. Our secondary schools rely on close to 100% in-person schooling

- One lecturer serves one class in one course, at any given point in time. While this made sense in the older days, with the opportunities offered by the digital ecosystem, these are sources of inefficiency. One expert teacher is tied to one

classroom only, and his or her expertise cannot be reused elsewhere. If we were able to share the workload based on core capabilities, we could get teams preparing content, teams delivering it, and teams assessing students, albeit with overlaps, but not expecting everyone to 'fight alone'.

3. Schools face a major barrier in 'space-time' lock

- In this locked situation, everything happens at a set time and place. While the concept of set classes gives a sense of order, it also contributes to silo thinking (of both teachers and students). Thus, in physics class we learn physics and do not consider how data analytics, visual skills, programming, essay writing, and other skills may relate to the challenge. Digitally more successful schools explore project-based learning, modular blocks, and more explicitly interacting school subjects. In addition, they consider combining self-learning with group work, and look for connections rather than boundaries.

4. Schools prefer short-term resilience

- They tend to opt for digitalizing their resources (hardware) rather than capabilities (know-how) and value propositions. In the survey, it became clear that a lot of effort went into modernizing the infrastructure (networks, wi-fi, labs, visualizing equipment, smart phones, and tablets). Far less investment went into helping the teachers truly grasp those new technologies—many were 'left to their own devices' and had to learn on-the-go. Support versus neglect for these soft aspects of transformation is the dividing line between digital frontrunners on one the hand, and digital laggards on the other one.

Let us now cluster the findings and bring the different perspectives we introduced in the earlier parts of this report to their logical conclusion. In our opinion, among many issues, challenges, and pain points, we argue that the following clusters present a viable set of priorities for the schools in the surveyed regions:

1. Digital transformation needs an alliance of stakeholders. In general, regions and school managements need to address the lack of motivated, enthusiastic, and digitally equipped experts at schools. In particular, new approaches need to be designed to attract such experts to the roles of digital coordinators, champions, advisors, drivers, coaches, and others.

- The core challenges for these champions include persuasion of their peers to use digital technologies more actively for exploration, co-creation, collaboration, rather than passively as a replacement for traditional blackboards.
- Digital coordinators need a supportive ecosystem, a platform, and also a clear expectation that they should be acting as role models—not only in using digital content, but in its creation, cooperative and shared development, as well as in strengthening the culture of coaching, observing, and exploring.

2. The 'lone fighters' and the cultural expectation of a teacher being able to cover the entire process end-to-end, while simultaneously innovating and simultaneously caring for the mental well-being of students is out of bounds in today's volatile, rapidly changing, and complex world.

- Digitalization must not stay on the surface; it must not end with shifting traditional processes to be in front of a camera and broadcasting the lecture through virtual media.

- Technological platforms and social networks need to be explored and supported at the regional and sectoral levels, leading to creating large (albeit virtual) teams of experts whose expertise may go beyond their 'home' school.
 - The resistance to mutual interactions with peers, to co-creating digital content, to reusing digital materials and good practices needs to be addressed, for example, via dedicated centers of digital excellence that pursue closer ties to industrial partners, as well as to academic partners from universities.
- 3. **The whole approach to digital transformation needs to shift from dominantly opportunistic and ad hoc to be more systemic, strategic, and structured. Digital transformation is a chance to stop rolling the legacy ballast in front of us and start working systematically on ballast removal and replace it with value-added activities, processes, tools, and so on.**
 - The system needs to transform to be more data-oriented, and schools need to acquire competencies in regularly assessing their capabilities, progress on their strategic plans, and increase their fitness for the changing markets.
 - New forms, possibly virtual or hybrid, need to be explored by the regional authorities to 'take the game to a new level'—including supporting hybrid digital leadership showrooms, campuses, where schools (teachers and students) meet their industrial partners (be it in the role of business counterparts or future employers).
 - Schools would benefit from designing and sharing good practices on how the digital might be applied to the following: classroom setups, school infrastructure designs, maintenance and upgrading, novel lab equipment, the hybridization of learning and teaching processes, and the introduction of analytic as well as automated processes in the system.
 - New forms of 'virtual digital campuses' also impact the role (and the novel capabilities) of the regional education authorities, who also undergo transformation from their current 'ownership' role to facilitatory, advisory, coordinating competencies, which might promote cooperation among the regional ecosystems.
- 4. **Digital transformation is not a matter of a single project or exercise. Schools need to learn to continuously adapt their currently prevailing analog model of teaching, not only to new resources and technologies, but especially to new capabilities, new consumers of learning content, and multiple different value propositions to them.**
 - The strategic journey toward a digital school is modular. Schools and regions need to approach digital transformation planning as a repetitive process. It is the dots that are seemingly random, but together make up a big picture.
 - School management and regional authorities need to master the art of cultural change management. There is no point in devising unrealistic strategies and putting too many expectations on stakeholders.
 - The cultural transformation happens in steps—it starts with digital enablement of the existing process, then the digital optimization and partial redesign, and onward up to the desired, full-fledged digital transformation of the underlying educational model (and indeed, business model) of the regional institutions.

Figure 42. Focus Group—Next Steps and Concluding Remarks



Source: Authors, 2023.

10 Public Policy Implications and Way Forward

Traditionally, quality assurance standards as well as projects aiming to improve secondary education in the Slovak Republic were primarily focused on face-to-face education forms and on physical learning spaces (schools and classrooms). Recently, digital technologies were increasingly integrated into educational operations, and digital forms are gaining popularity. It is not surprising that it was the recent COVID-19 pandemic that significantly accelerated this shift by forcing a system-wide transition to online digital forms of education.

However, there needs to be made further investment (in terms of attention, focus, as well as financial funding) simultaneously in several areas that underpin digital modernization. We need to close the gap in terms of the **infrastructural readiness** of our secondary institutions for digital, hybrid, and online learning. We also need to introduce the **focus on people and their readiness** in terms of skills, experiences, as well as the access to advisory and supportive mechanisms. New processes need to be explored, including a **tighter cooperation between multiple educational stakeholders, as well as educational and business/employer** stakeholders, in a version of public-private partnership. Such a partnership needs to be tangible at the level of regions and may need attention and patronship from regional educational authorities to keep involving all stakeholders (not only educational). And finally, we need to boost the capacity of the regional authorities and school authorities in terms of **managing cultural and organizational change**.

This chapter aims to support the national and regional stakeholders as they move forward with reforms and investment in higher-quality, more sustainable, more digitally enhanced education. The recommendations in the subsequent sections focus on the public support, capacity developments, and organizational culture shifts required to deepen the digital competence of our secondary education system. Digital transformation will bring our institutions closer to introducing new learning and teaching processes beyond the standard classroom education. Thus, the recommendations aim to give foundations to three novel processes [25], which are outlined below:

- **Fully online education:** All instruction is delivered online, either synchronously or asynchronously, or in combination. While instruction is wholly delivered online, learners may still be provided with opportunities to interact with peers or instructors in person, or to access on-campus facilities.
- **Hybrid education:** Instruction is delivered using a mix of online and on-campus instruction, with the online components taking place synchronously, asynchronously, or simultaneously with in-person instruction (the latter category being increasingly labelled as ‘hyflex’ education).
- **Blended education:** Instruction generally takes place in-person and is supplemented, but not replaced, by online materials and activities such as a virtual learning environment, open educational resources, simulations, or gaming.

Let us shape the four main areas of recommendations and elaborate on them in the following sections of this concluding chapter on policy recommendations:

1. Area: Digital infrastructure—smart, hybrid

- Digitalization as a concept has to go far beyond merely enabling (fast) access to online educational resources.
- Limited public investment is a key barrier to systemic infrastructure lifecycle management, and subsequently to digital transformation.

- Systemic, foreseeable, and digitally friendly methods of infrastructure lifecycle management need to be pushed forward and supported.
2. **Area: Education professionals' support structures—cooperation, co-creation, networking—while reducing the growth of the digital divide among both schools and users (teachers/students)**
 - A more systematic approach would be beneficial to develop digital competencies and content—continuously, collaboratively, and interactively.
 - The role of digital coordinator (motivator, advisor, coach) needs to be supported as a part of 'business-as-usual' (systematically), rather than being purely project-based.
 - A technological and methodological set of measures need to be put in place to stop, and, eventually remove the risk of an inherent digital divide through the facilitation of greater inclusion, support, and guidance.
 3. **Area: Novel educational process—learning platforms, hybridization, self-learning, and creation of means for reducing the digital divide among schools and regions, as well as participants of the educational process (teachers, students)**
 - Secondary institutions would benefit from a more regionally centralized provision and maintenance of digital content, software, and services.
 - A methodological set of practices, recommendations, and specific measures facilitating the reduction (removal) of a digital divide as well as the increase of inclusive education methods and techniques
 4. **Area: Strategic partnerships and digital leadership platforms—digital excellence**
 - A cultural change should be introduced in the Slovak regions, to link the educators more closely to their peers from other schools, and, especially, to industrial partners, so that the digital is not only an abstract vision but applies to a specific business reality.

11.1 Investment Area 1: Smart and Hybrid Learning Environments

Classrooms are no longer desks and chalkboards. In the 21st century, classrooms are fitted with multiple technologies that assist with teaching, learning, and other aspects of talent and competence development. Smart classrooms make for a near-perfect environment for students to engage with technology, and learn from it, and with it. A smart classroom is a space for learning that is enhanced by educational technology, and its design is used to improve the overall teaching and learning experience. There are still pencils, paper, and textbooks in the classrooms, but there is also a range of educational technologies designed to help educators enhance the learning experience for their students.

Smart and hybrid-learning friendly classrooms allow teachers to change and adapt their teaching styles to help meet the needs of the students in their classrooms. Technology can help students with a variety of learning needs, including learning challenges. Some examples of hybrid-learning friendly smart classroom space include a subset of the following:

- Interactive whiteboards
- Tablets, laptops, or chromebooks
- Connectivity with sufficient bandwidth
- Learning application
- Student response systems
- Lecture recording equipment

- Hybrid learning support (video conferencing)
- Online learning ecosystems (Canvas, Kahoot, Wikispaces, and others)
- Digital podium
- Collaborative and flexible furniture
- VR and AR headsets/toolkits

Although these technologies may not be present in a smart and hybrid-learning classroom simultaneously, they are components that can make its design successful. We suggest creating a dedicated priority package continuing to support the transformation of school space, classroom space, and labs at schools to make them more flexible, hybrid-learning friendly, and more digitally embedded. To avoid setting unrealistic goals, some predefined journeys may need to be proposed to schools; these may include the following:

- **Entry-level smart and hybrid classroom/lab**

This is the initial step when transforming a school. These are teacher-led learning spaces that include computers and interactive whiteboards/projectors (these are today's common infrastructure). Teachers might remain at the front of the classroom giving instruction, but the setup will be flexible and open enough to bring in technologies as required by the lesson or topic, in order to give students the opportunities to interact with the content, teacher, and with each other.

- **Intermediate smart and hybrid classroom/lab**

This is the next archetype in classroom redesign. Intermediate classrooms extend entry-level versions with technologies like a digital podium, embedded laptops, VR/AR headsets, and so on. In these labs, students work one-to-one with diverse devices, tools, and applications, and technologies are shared between student teams. These learning spaces shift the focus from a pure teacher-led presentation to more independent learning, creative exploration, and co-creation.

- **Advanced smart and hybrid classroom/lab**

These spaces are student-led; every student can access educational technology (edtech) whenever possible. Students control and self-organize their learning, explore, and investigate topics independently—with the teacher acting as a coach and mentor. These spaces include all the edtech of earlier versions, plus items like 3D printers, virtual world simulators, simulator engines, and other technology. They bring in required software for students to co-create their own content, like CoSpaces, ThinkLink, and the like. This type of learning space is also known as a 'flipped classroom'. Students work on assignments and challenges creatively and pitch their ideas in a way similar to a business context.

For the purpose of supporting the EU Digital Education Action Plan, a conceptual framework for highly equipped and connected classrooms (HECCs)—was developed and published. The content highlights the HECC model, which is based on four dimensions: digital technological devices, network requirements, the professional development of teachers, and access to digital content. The model aims to enhance the effective use of digital technologies in teaching and learning practices. This concept should be systematically brought into our regional secondary education and will encourage schools to design and propose diverse application scenarios making use of HECC in advancing their teaching and learning processes in the digital era.

Estimating the financial impact of this proposed priority area is as follows: The average cost per student per year to equip and connect a typical classroom at the secondary level with advanced HECC components *ranges from € 300 to € 700*. This estimate includes costs for digital technology

equipment (about € 120–€ 200 per student per year), robust connectivity infrastructure (about € 60–€ 300 per student per year), the professional development of teachers (about € 100–€ 250 per student per year), and the costs to access digital shared content (about € 50–€ 100 per student per year). So, for a typical learning space for 20 students, the costs are between € 600 and € 1,500 per student, or from € 12,000 to € 30,000 per classroom. Still, our estimate does not include the establishment of physical infrastructure in terms of high-capacity networks. Furthermore, it is important to allow for the opportunity to adapt the costs to local conditions and the specific needs of each school.

From the perspective of policymaking, especially at the regional level, we recommend launching a project effort and sustaining it beyond the project lifecycle, where regions explicitly explore their options, prioritize their needs in terms of ICT and digital learning infrastructure, and design systematic actions plans that help shape digitalization strategies also at secondary schools in the respective regions. Among others, regions will start working on answering (or facilitate the answering of) the following policy-related aspects (aligned with [29]):

- How are ICTs integrated into students' learning time? What are the optimal levels of ICT use relative to traditional instruction?
- Are ICT-based programs intended to increase instruction time at school or at home, or to substitute other activities?
- Are there incentives for the effective use of ICT at different levels of the system?
- How do secondary teachers benefit from support/feedback/rewards on innovative approaches using ICT?
- How will be the ICT-based programs be evaluated by the regional authorities, and how is the collected evidence used?
- What role shall the region take in piloting, experimenting, and product-testing before scaling up ICT-based programs?
- Where and for which students are ICT and digital investments most beneficial?
- How can ICT bring about innovation in educational practices and enhance efficiency?

The establishment of a robust infrastructure for digital education is essential if schools plan to make use of technology to meet their teaching and learning goals. Students and teachers should have learning devices and high-speed internet access. Infrastructure also includes digital tools and resources for learning. By complying with data privacy and security regulations, as well as teaching digital competencies, a robust learning infrastructure also ensures that students remain safe online. To build and maintain infrastructure for digital learning, one must consider how schools will manage the lifecycle of their technology investments. Assessing the needs of the school system, procuring, and deploying technology, measuring the effectiveness of new investments, and determining when to renew or replace software licenses are all part of managing the education technology lifecycle.

A part of education technology lifecycle management is to audit existing digital tools and resources to determine if they are effective for students and teachers, while meeting the teaching and learning goals. Regardless of how much technology is implemented, quality, accessibility, and privacy must remain the primary considerations. Effectiveness is critical in this sector—for example, surveys in schools in the United States indicate that approximately 67% of educational software licenses are unused, resulting in big financial resources wasted [33]. We cannot expect a better situation in Slovak VET schools, because, according to our knowledge, there is no existing policy and capacity for

license management at the central or school level. In the United States, a platform, [instructure.com](https://www.instructure.com), has been put in operation with an aim to provide school districts guidance for transparent and evidence-based lifecycle management of edtech products¹⁴. Something similar might be worthwhile also in the context of the Slovak Republic.

Box 1. Successful Implementation Example: TVET Platform for Professional Development at BIBB

While the use of technologies such as augmented reality (AR) and virtual reality (VR) offer entirely new approaches to teaching and learning, the development of technology-enhanced learning (TEL) applications requires considerable expertise. Most importantly, TEL can only generate benefits for learners if digital learning applications are embedded in an appropriate pedagogical concept. To offer support and inspiration to technical and vocational education and training (TVET) personnel, the German Federal Institute for Vocational Education, *Bundesinstitut für Berufsbildung* (BIBB), has worked with experts and partners from around the world to produce practical guidelines that showcase possible learning scenarios for AR-/VR-enhanced learning in TVET [27]. A feature of this sample approach by BIBB that motivates our proposal in this section is that this is not only a single course or project, but rather covers multiple aspects of TEL. It offers the following benefits:

- A systematic overview about technical and organizational prerequisites for using AR/VR in TVET
- A step-by-step approach for defining suitable learning objectives and didactic methods
- A checklist on content-related, technical, organizational, and legal aspects that need to be taken into account for the planning and implementation of AR/VR in TVET
- An overview of several typical learning scenarios for AR-/VR-based learning with examples from VET practice in Germany

Source: BIBB, 2023¹⁵.

11.2 Investment Area 2: Support Centers for Professional Development, Virtual Teams and Digital Content Co-creation

In particular, the last element mentioned above represents a value to VET educators, as it clearly offloads the effort necessary to prepare digital materials by tapping into community content and reusing existing contributions from colleagues or experts. Another good example of such an approach is the Enhanced Digital Teaching Platform from the United Kingdom¹⁶.

Thus, one recommended area for further development addressing the gaps in skill development, as well as content creation and availability, goes in the direction of dedicated support platforms for digital teaching and learning. This could be an online platform designed to help develop teaching and training practice using digital technology across secondary education, but it may also reach out into further education (FE) and lifelong training and development (LLD) sectors. The platform should be an online hub for digital teaching resources, including webinars, courses, and other materials. It aims

¹⁴ Evidence-based edtech ecosystems (<https://www.instructure.com/k12/products/learnplatform>)

¹⁵ <https://www.bibb.de/en/148130.php>

¹⁶ <https://enhance.etfoundation.co.uk/>

to provide teachers with the skills and knowledge they need to use technology effectively in their teaching practice. Such platforms are usually ‘patroned’ by either central or regional authorities and are usually free to access for teachers and trainers.

The best practice platform for digital teaching should not be a mere repository of presentations, lesson notes, and the like. It should offer bite-sized, certified, online self-learning modules mapped onto digital professional standards that transparently define expectations onto teachers, trainers, and other stakeholders in the system. The training modules could be designed to improve the use of technology in teaching and assessment, and to improve learners’ experiences and learner outcomes. The modules are typically grouped into categories and mapped to specific elements of the digital competence framework. The platform provides fully funded, bite-size training resources to help practitioners enhance their use of educational technology as part of developing their teaching and training practice.

For example, the platform from the United Kingdom offers two fully subsidized trainings to support teachers and trainers in developing their digital skills. It supports mobile learning in teacher professional development programs and also records achievements through a badge system to mark stages of maturity—for example, “exploring”, “adopting”, and “leading” with digital technologies.

The key features and requirements of such a regionally maintained platform include the following:

- Modules are bite-sized, providing between five to twenty minutes of learning.
- Digital learning and teaching content is mapped onto a standard competence framework, so the user can easily identify what skill they develop and what value it gives them.
- The achievement tracking offers an evidence-based approach to developing digital skills in the shape of an achievement badge system.
- Evidence of acquiring certain digital skills follows the evolutionary approach and rewards achievement of know-how in stages, for example, exploring, adopting, and leading, as set out in the competence framework.
- The content platform shall have a user-centered, mobile-first design to make it easy for users to access training anywhere, anytime, and on any device.

Another focus area we strongly recommend including in the policy focus for the near term relates to artificial intelligence (AI), especially generative AI that recently is making great leaps forward. With the market implementations of AI language models into chatbots (a software application that simulates human conversation via text or voice interactions), education as well as other sectors of economy have at their disposal a (potentially very) disruptive transforming technology that promises a great increase in the productivity of knowledge-related tasks. AI-powered solutions should be among the supported innovative educational processes and models, where awareness as well as exploration and adaptation to a school’s context is needed to be carried out in projects.

Already this generation of chatbots offers several features and capabilities that streamline communication within a team (including a classroom), save time (for example, in processing and digesting larger volumes of text), and enhance efficiency (for example, in speeding up preparation for a lecture or testing) in educational settings. A toolkit, based on AI, needs to be experimented with to support activities such as design and content creation, teaching, assessment, and evaluation.

AI tools require a change in approaching problem-solving. It shifts attention from formulating search queries and ‘playing’ with discovered materials to an efficient way of giving the AI agent a prompt, a hint, or a problem statement. Such AI-enhanced tools are designed to augment, not replace, the

teacher; it inspires the teachers to create engaging content that aligns with best practices in education, making it easier for them to deliver effective and impactful lessons to students. The hypothesized benefit to be validated experimentally includes the opportunity to save the time and effort (of a teacher) by automating the creation of high-quality lesson plans, learning objectives, assessment questions, and a range of other resources (for students).

Box 2. Successful Implementation Example: TVET Platform for Professional Development at GIZ

An example of a working platform fulfilling some of the requirements mentioned in this section is the work of the German Society for International Cooperation, *Deutsche Gesellschaft fuer Internationale Zusammenarbeit* (GIZ). Although the primary purpose of its academy is to strengthen experts and managers in international cooperation and in digitalization of cooperative interactions, they also offer service under the sub-brand of the TVET Academy¹⁷. The TVET Academy supports competencies development for labor market-oriented vocational training, which plays an important role in sustainable development in developing, emerging, and industrialized countries. Since people learn primarily by working independently and through exchange with colleagues, dialog between participants and learning from each other, play an important role. The focus is always placed on the transfer of what has been learned into practice.

TVET and digitalization are associated with changes and challenges in work processes, developments towards Industry 4.0, and in teaching and learning supported by digital media. To take these developments into account and support the adaptation processes, the TVET Academy offers selected training activities for different target groups in the following areas of “Digital Teaching and Learning in TVET” and TVET in the context of “Digitalization and Industry 4.0”. The portfolio of courses developed by the GIZ company is aimed at educators and defines outcomes in an ‘educational style’, while aligning the content of the individual courses to key drivers of today’s economy (automation, Industry 4.0, MES, and others.). The courses come at different dates, from different centers, and in different payment options.

Source: GIZ, 2023¹⁸.

Developing a learning platform requires a comprehensive set of requirements that identify the product’s needs and purposes. Developing a platform requires significant preparation work as part of the product development process. Additionally, such efforts force organizations to think about why to undertake a project, what the software product should provide, and how it will accomplish the desired goals. The following are some of the requirements that need to be considered when developing a platform:

- The starting point for the development of new applications or systems is determined by the various needs of teachers, learners, partners, and others.
- Legal requirements deal with the fact that a platform’s features and capabilities need to be compliant by (local) legal frameworks.
- Various system features and requirements include functional requirements, external interface requirements, interaction features, and various types of nonfunctional requirements.

¹⁷ <https://www.giz.de/akademie/en/html/60706.html>

¹⁸ <https://www.giz.de/akademie/en/html/59514.html>

- ‘Functional requirements’ describe *what* the software will do (for example, serve as a MOOC, virtual learning environment, visual instructor-led training, discussion board, and so on), while ‘nonfunctional requirements’ describe *how* it will perform.
- ‘Business requirements’ identify the product’s business needs and purposes at a high level (education collaboration, subscription-based, paid certificates, paid courses, and so on).
- ‘User requirements’ describe the needs of the users who will be using the platform. In this category, not only do students belong, but also practitioners, teachers, examiners, advisers, and others.

11.3 Investment Area 3: Platforms for Virtual Cooperation, Career Development, and Networking of Stakeholders

To address the multiple priorities identified and discussed before, in particular, pertaining to the lack of a strategic, systemic, and coordinated approach to digital transformation management, we recommend also including in policy considerations the creation of an experientially oriented learning and demonstration platform that would connect educators and employers. It could also help match them with students to complete real-world industry projects. The platform should be designed to help VET institutions get the most out of experiential education with its toolkit for project management and collaboration in the cloud. It should offer a multitude of benefits for all stakeholders involved. For educators, it presents an opportunity to utilize real-world scenarios in their curriculum to enhance learner engagement and employability outcomes. Students benefit from hands-on, practical experience that prepares them for the workforce. Employers and regional companies can demonstrate their latest technologies, business use cases, and involve schools in their early adoption.

Core functionalities of the platforms for virtual cooperation, interaction of school-industry stakeholders, and involvement of all stakeholders into one joint activity, include the following:

Experiential Learning Projects: The proposed platform connects educators and employers with students to collaborate on real-world industry projects. These projects allow learners to apply their knowledge and skills in practical settings, gaining valuable experience. Educators can provide students with opportunities to develop marketable skills, align with existing workforce development initiatives, and help employers strengthen their talent pipeline with a diverse pool of candidates.

Matchmaking: The proposal includes an innovative course on business project matchmaking, which will help educators find suitable projects and motivation and/or demonstration scenarios for their students. The platform matches the skills, interests, and goals of students with relevant project opportunities provided by employers. This matchmaking process ensures that students can work on projects aligned with their learning objectives and career aspirations.

Project Management: Once a joint digital exploration project is started, platforms provide support for its project management, tools, and features. Students and workers co-working and interacting teams can track their progress, view project details, manage deadlines, and communicate through project-specific chats. These features enhance collaboration and allow for effective project management.

Networking and Talent Connection: The platform will allow students to build their network of potential employers, while gaining relevant business exposure and work experience. By engaging in real-world projects or situations, students can connect with industry professionals and demonstrate

their skills to the network. Employers, on the other hand, gain access to a pool of talented students and can identify potential candidates for future employment opportunities.

Platform Updates and Support: The platform will continuously evolve and develop to provide an improved stakeholder experience. Updates may include features like improved navigation, customization options, upgraded reporting functionality, and more. Additionally, the platform offers support and resources to guide users through the platform and help them maximize its benefits.

In addition to the above-mentioned platform, we also recommend focusing attention directly on one specific competence likely to significantly impact vocational education and training (VET) to keep pace with the developments in a broader market context. Blended learning (BL), also known as hybrid learning (HL) refers to any educational activity that combines traditional classroom activities (in person, ‘book & pencil’) with activities that use digital technology (on- or off-line). It extends learning beyond the physical space of the secondary school and develops important skills for lifelong learning.

As one element of a way forward, we recommend enabling a project (or set of projects) that will address the need of secondary education and VET providers to get more familiar with the BL/HL approaches, by means of having access to professional support and advice, in order to introduce blended learning in their daily practice effectively, and in an accelerated timeline. Such a supportive investment package shall include the following elements:

- Development of a strategic plan for the efficient introduction of BL in secondary schools, avoiding unnecessary failure through self-learning and self-exploration
- Adaptation of the digital competence framework to account for teachers’ competencies for blended learning (the International Association for K–12 Online Learning [iNACOL])
- Development and implementation of training for BL, aimed at teachers and trainers in secondary schools, and enabling its customization to different school types (needs)
- Support to enable additional secondary schools in the catch-up regions that will participate in such training (beyond the pilot cohort participating in the survey)
- Facilitation of international study visits to countries with implemented blended learning in the context of secondary and VET systems (potentially aligning with the EU’s program offer, Erasmus+)
- Facilitation of cooperation and exchange of experience initiatives among teachers within a given region, across a given school type and, possibly, also internationally
- Evaluation and self-evaluation of schools and teachers/trainers for the purpose of continuous improvement of teachers' competencies
- Communication with key stakeholders, target groups, and the general public (newsletters, public events, and so on) to explain the benefits of accepting such innovations, and enacting the cultural change necessary to make such acceptance possible.

Box 3. Successful Implementation Example: IT Academy Program for Digital Coordinators

At the national level in the Slovak Republic, much progress in identifying key features and ‘design requirements’ on how career development and virtual support for newly created roles of school digital coordinators has been done in the context of the national project IT Academy [30]. Some of the outcomes of the project can be considered good practices in accelerating the digital transformation at schools, including secondary ones. The content developed to support selected courses, including digital materials, is in the public domain, and thus, during the project, it was broadly shared among participating teachers and

institutions. Similarly, an initial cohort of digital coordinators has been trained via an accredited development program. Yet, with the conclusion of the project, many good insights and plans were, metaphorically, ‘put on a backburner’ (deemed unimportant for the present) and are relatively difficult to find, link to, and/or reuse in daily practice.

Source: IT Academy—Education for 21st century, 2020 [30].

One of the recommendations that remained unfulfilled relates to the creation of a (national) center for digital technologies in education. While the national center with such a remit might be interesting indeed, we believe and argue for bringing the co-responsibility for digital content and competence development also to the regional and local levels, thus closer to specific schools, communities, and local companies. The scope of such a regional support center might include the following capabilities:

- Co-creation, review, and quality assurance of educational content, methodological guidance, and digital coordinators for regional (secondary and VET) schools
- Networking and facilitation of professional interactions among digital coordinators, as well as the exchange of their insights, experience, and good practices
- Realization of educational programs (and possibly, the creation of virtual self-paced online modules) aimed primarily at expert educators with a potential to develop into a digital coordinator
- Formulation of methodological best practices in coordinating digital transformation at (secondary and VET) schools, and its effective transfer to young and future teacher training programs (including those at universities)

11.4 Investment Area 4: Building a Smart Education Data Foundation

Education data management is an often-overlooked aspect of facilitating modern, digitally enhanced educational processes. Why? Because it usually requires an institutionalized information architecture that understands and engages with the whole education system in a comprehensive, structured, and systematic manner [31]. As the authors in [31] continue, regardless of a ‘data layer’ being seen by the public authorities as too expensive to build and maintain, unable to promote efficiency, riddled with unreliable data, or not contributing to effectiveness and equality across the education system, information and data systems remain an area of confusion in many countries. Unfortunately, the Slovak Republic also partially falls in this group in many aspects. Oversights in data management often result in data gaps, hampering the ability of countries and/or regions (and their accountable educational authorities) to conduct data-driven decision-making.

Box 4. Successful Implementation Example: Ed-Fi Alliance and Technology Suite

The Ed-Fi Alliance is an American nonprofit organization devoted to helping every school district and state achieve data interoperability. By connecting educational data systems, they empower educators with comprehensive, real-time insights into their students’ performance and needs. The Ed-Fi Data Standard, supported by additional technologies and the community, empowers school districts and states to better serve teachers and students, and education technology providers to better serve their customers. Since their founding in 2012, the Ed-Fi Alliance has been focused on creating the finest, most secure, community-defined data standard and interoperability application programming interface (API) available. The code may be complex, but the aim is simple—make student data usable and safe. The Ed-Fi technology suite, which includes the tools that make implementation of Ed-Fi quick and easy, and also includes the applications that help educators visualize their data, are regularly improved and expanded. Some of its features include the

following:

- Operational data store (ODS) stores information from multiple systems in a central location
- Data import tool simplifies the loading of comma-separated values (CSV) data into an Ed-Fi ODS/API.
- Analytics Middle Tier (AMT) is a set of analytics views over the ODS/API that supports the analyst to build intelligent reporting
- Community members contribute solutions to the Ed-Fi Exchange that may be downloaded by other Ed-Fi licensees. The exchange contributions take the form of data standard extensions, ODS and API extensions, and dashboard plugins.

Source: Ed-Fi Alliance, accessed 2023¹⁹.

Countries that have created successful systems are harnessing the power of data to improve education outcomes. Increasingly, the focus of educational management systems is moving away from using data narrowly for counting students and/or schools. They are using data to drive system-wide innovations, accountability, professionalization, and, most importantly, quality and learning [31]. Hence, we argue for an investment package addressing the development of a robust and scalable educational ‘data layer’ at the regional level, supported by a well-defined policy framework, organizational structure, infrastructure capacity, human resources, and budgets to produce high-quality data *and* insights. A culture of data means that education decisions at all levels of the education structure are based on data and evidence. Data provide policymakers with the opportunity to implement cost-efficient, smart, and effective investments, focusing on outcomes.

While we see partial attempts for establishing the above-mentioned ‘culture of data’, these are largely isolated from each other in the Slovak Republic, get executed once (nonrepeatedly), and are rarely seen in the same context (for example, of a specific region or industry segment). We propose building a data layer at the regional level, so that various learning, administrative, strategic, and/or innovative indicators pertaining to each specific school in a region are gathered on a regular basis (for example, annually, after the closure of academic year) via standardized census forms or questionnaires and, possibly, directly from the educational information systems of the schools. Each such dataset serves as a snapshot of the position achieved by any given institution (as well as the regional system as a whole). Such data is comparable over time and indicates the level of progress toward strategic goals and objectives (including those related to digitalization).

The research conducted by the World Bank team and analyzed in this document presents one possible approach to ‘bootstrap’ such a data layer for regions. In other words, the system has to start with an architecture and technological implementation; however, starting from zero, with no prior data often brings frustration to the stakeholders. Yet, repurposing the approach and tools of this survey, and connecting it to other initiatives, such as an IT skills testing platform, and the existing school management systems, may provide initial insights very quickly after the initial investments. Among the key recommendations, we would like to emphasize the following, which aims at the time- and cost-efficient rollout of a potential regional data platform:

¹⁹ <https://www.ed-fi.org/what-is-ed-fi/ed-fi-technology/>

- Designing the system architecture (for example, client–server versus cloud-based options)
- Choosing between self-developed or ‘off-the-shelf’ software
- Deciding on proprietary (‘self-coded’) and open-source paths
- Considering short- and long-term required resources
- Ensuring data quality

Data architecture for education involves designing and implementing systems that facilitate data collection, processing, storage, and utilization to support teaching, learning, and administration in educational institutions. These systems help to transform raw data into useful information and insights, which aid in decision-making processes and improve overall educational experiences. We believe the ‘data layer’ should be considered as a dedicated component in the context of secondary education in the Slovak Republic, as 1) it underlies previously proposed systems and interventions, and 2) its shortcomings are a great fragmentation and a lack of systemic approach.

Box 5. Successful Implementation Example: Sample Educational Data Solutions

In general, regardless of the specific technology or platform used, well-designed data architecture for education should be capable of managing large volumes of diverse data, provide data security, ensure compliance with relevant regulations, and ultimately support the education institution's goals and objectives. Some approaches used in successful implementations worldwide include the following:

Education Data Architecture (EDA) is an open-source data platform specifically designed for the education sector. It fosters innovation in education technology and supports an evolving perspective of education, not as discrete stages (primary, secondary, undergraduate, and post-graduate), but as a lifelong journey. The aim is to enable the integration between these stages. EDA is a framework that helps manage data, processes, and interactions in a more interconnected manner [Ex. 1].

Data Lake for Higher Education Student Analytics focuses on gathering data from several different application databases into a single store that can be used for analysis. In this scenario, data from different sources (which could be software as a service [SaaS] applications, NoSQL databases, and others) is pooled together in a ‘lake’. This gathered data can then be used for timely and impactful data-driven insights [Ex. 2].

Cloud-based architecture, like Microsoft Azure, offers tools for enhancing remote learning and enabling smart campus models. The data architecture in this context would involve leveraging cloud services for storing and processing data and using machine learning models for insights. Azure services can connect teachers to students, help create models of smart campus buildings, deploy virtual labs, and more [Ex. 3].

Source: [Ex. 1] Salesforce²⁰, [Ex. 2] Amazon²¹, [Ex. 3] Microsoft²², accessed 2023.

It is not only data architecture, but also a strong **enabling environment** that gives foundation to an effective decision-making system. This refers to regional policies, processes, (human, expert) resources and overall data-driven culture surrounding the core processes of data collection, management, utilization, and access. Policy needs first to be designed as a part of the proposed

²⁰ <https://www.salesforce.org/blog/get-to-know-eda-the-education-data-architecture-for-salesforce/>

²¹ <https://aws.amazon.com/blogs/architecture/architecting-data-lake-for-higher-education-student-analytics/>

²² <https://learn.microsoft.com/en-us/azure/architecture/industries/education>

investment (project) to define what the data layer stands for and its overarching purpose; this step needs to be done by regional decision-makers and documented in relevant policies and standards. Then the intended policies need to be communicated, implemented, and internalized by the stakeholders; this is also an important expectation of the proposed project. Good guidance on how an information system can be approached by regional stakeholders—the intended investors in the proposed data layer—is available in detail, for example, in [31].

The quality of data also needs to be invested in, in order to establish the mechanisms required to collect, save, produce, and use information in an accurate, secure, and timely manner. Data quality is a multidimensional concept that encompasses more than just the underlying accuracy of the statistics produced. It means not only that the data are accurate but also that the data address specific needs in a timely fashion. Quality data lay the groundwork for utilization. In order to maintain quality, internal and external reviews are performed and processes are in place to ensure data quality, validation, monitoring, processing, and dissemination of education statistics.

An important feature to include in the proposed investment in (regional) educational data systems relates to the opportunity to standardize and benchmark across a wide variety of educational institutions in the region. It is often the benchmarking capability that is perceived as the most visible, most vocal, and (often) the most motivating for schools and their stakeholders. While benchmarks cannot be given a priori, they can be established through repeated data gathering cycles. One of the proposed objectives of an investment package should be an initial set of benchmarks—or more accurately, ‘good practices’—specific to the region. These practices and standards should be considered at multiple levels:

- ‘Data standards’ refer to high-quality data that are reliable, accurate, timely, and complete, where benchmarks can be identified as best practices. These can be of different types: quantitative, qualitative, longitudinal (to measure the lifecycle of some indicator), and/or time series (over a period of time).
- ‘Technological benchmarks’ include required capabilities, compatibilities, training and technical support for the maintenance of the educational services, detailed implementation plans, and the description of responsibilities to maintain educational processes at schools.
- ‘Utilization benchmarks’ include the following elements: the analysis of available information in the form of charts, graphs, and visuals (for example, as presented in chapters 5 and 7 of this report); the use of information by stakeholders across the education system (from parents and schools to the regional authorities); accessibility; and the dissemination of the information.

11.5 Investment Area 5: Seeding of School-industry Platforms of Digital Excellence to Bridge Schools and Practice More Effectively

Today secondary school is perceived as an institution where a young person's professional training starts, and as such it stands in the shadow of universities. Universities are usually credited with a capability to facilitate a knowledge-based economy and contribute to it with research and development competencies. However, from the point of view of the Slovak Republic's economy, which is mainly focused on production, industry, and tangible goods, universities may not always be an ideal foundation for the manufacturing companies and their future needs for retraining the existing (production) workforce.

Box 6. Successful Implementation Example: EXAM 4.0 Project

An inspiring example for this section can be found in the EXAM 4.0 project and its results. The Excellent Advanced Manufacturing 4.0 project (EXAM 4.0), is one of the five platforms of VET excellence approved for funding by the Erasmus+ program in 2019 under the Centres of Vocational Excellence (CoVEs) pilot initiative launched by the EC in 2018. Its goal was to design so-called EXAM labs, where students can acquire relevant competences to work in 4.0 environments in the advanced manufacturing sectors. Their model is holistic in terms of catering for infrastructure, ICT applications, tools, skills needed, and working processes. The project consortium defines various aspects of what they call collaborative learning factories [28] — essentially, learning centers built in cooperation between schools and companies to deliver opportunities for work-based learning, practical exposure to latest trends, and the like.

Source: Exam 4.0 Project, accessed 2023²³.

It is the secondary-level school that shall be a basic profiling force not only for young professionals, but also for existing employees, entrepreneurs, or self-employed people who may feel the pressure to update their skills in the fields of electrical engineering, automation, and/or ICT. Hence, we see a space on the Slovak market for a regionally focused institution that will act as a direct partner to the manufacturing sector and its (today predominantly manually oriented) employees for adequate (re-)skilling, corresponding to the requirements of the labor market and the changing trends of digitalization and automation. The envisioned institution will bring in new capabilities that correspond to the nature of emerging and future jobs. At the same time, it must be an institution that harmonizes the differences between vocational educational institutions and the stakeholders of the labor market. It will create not only a theoretical model, but an overall ecosystem equipped with modern technologies and facilities.

While a detailed focus of such a ‘center of digital excellence and experience’ needs to be elaborated in a broader circle of stakeholders, we recommend considering the following business capabilities in the design and setup of such a center:

- It shall feature a multifunctional flexible space (classroom + demonstration laboratory) for the development, testing, and exploration of the industrial use case of secure cloud-based solutions with a focus on the following: the transformation and migration of legacy production systems to the public cloud; a secure and sovereign cloud; software-defined communication, and others.
- Another feature shall cover a multifunctional flexible space (classroom + demonstration laboratory) for the development of knowledge and the demonstration of the deployment of the internet of things (IoT) as well as the industrial internet, with a connection to system installations, and smart installations applied to regional use cases.
- The next feature addresses a multifunctional flexible space (classroom + demonstration laboratory) with modular cyber-physical equipment, including the following: a professional and compact training system for the development of knowledge and skills in the fields of robotics, edge/5G, autonomous and real-time control, industrial informatics and energy with

²³ <https://examhub.eu/exam-4-0/>,

a focus on Industry 4.0 and digital twin manufacturing automation solutions, with simulation software for teaching the programming of production industrial stations and robotic arms.

- Yet another option or feature considers also a multifunctional flexible space (classroom + demonstration laboratory) with modular training systems for the development of knowledge and skills in programming control devices in the circuits of electrical engineering, pneumatics, and electropneumatics, with an emphasis on the use of smart sensor technologies, virtual and augmented reality, and digital pneumatics, with a complete set components and simulation software.
- Next, the opportunity is seen in supporting a multifunctional flexible space (classroom + demonstration laboratory) for the development of knowledge and skills in the field of ICT supporting ecology (green IT) with modern modular technological systems in the field of renewable energy sources (wind, solar, biomass, water, and so on) in the electricity industry, with emphasizing the collection, transmission, processing, and visualization of data and the smart/green management of physical infrastructure.
- Also to be considered, is the capability to alter, adjust, and transform any of the flexible spaces mentioned above into a demonstration laboratory—the digital fabrication laboratory, FABLAB, enables rapid prototyping and implementation of pilot projects and demonstrations, together with business partner target groups in the areas of ICT, Industry 4.0, and/or around renewable resources.

In the context of implementing a center of digital excellence and experience, we emphasize its public-private partnership (PPP) nature. Thus, this shall not be an institution isolated in one particular vocational school in the region. On the contrary, this shall become a digital hub, a meeting point bringing together diverse educational institutions on a ‘neutral ground’, where effective communication and cooperation across educational institutions and across educational and industrial sectors may happen and thrive. To achieve the neutrality of the proposed center of digital excellence and experience, we suggest that the investments should be made in the following areas:

- Building new or refurbishing existing infrastructure in modern workplaces for vocational training and a demonstration center in the field of ICT, Industry 4.0, and renewable resources
- Procurement, purchase, and co-investment in progressive and innovative technologies in the field of ICT, digitalization, and Industry 4.0—with an aim of providing transformational education and professional retraining to partners in the wider ecosystem, as well as the demonstration of the use of advanced technologies to streamline production processes
- Procurement and purchase of progressive and innovative technologies in the field of renewable resources and their application to existing and new premises with the aim of providing transformative education and professional retraining to partners in the wider ecosystem, as well as demonstrating the use of advanced technologies to optimize the ecological footprint of physical infrastructure
- Establishment of a business model sustaining a core personnel security for the sake of achieving the continuous education, development, testing, and demonstration of modern technologies beyond the existing activities of any single school and any single commercial partner

The estimation of the potential investment package for one such center of digital excellence and experience is given in Table 5.

11.6 Summary of the Proposed Structural Changes

Based on the reports of others and our own findings, as discussed in the preceding chapters of this report, we sum up the main argument as follows: (VET) teachers need to equip their students, not just with vocational skills specific to a particular industry or service segment, but also with strong digital and soft skills. Regional and national policymakers need to be aware of the importance of these skills and ensure their incorporation into VET teaching and learning, in order to guarantee a smooth transition of VET graduates into the labor market.

Pedagogical approaches such as enquiry-based, project-based, and collaborative learning need to be included in action plans to help develop key soft skills, such as critical thinking, creativity, teamwork, and communication. These pedagogical approaches may include innovative elements, for example, gamification, blended learning, and experiential learning. The use of innovative technology—robots, virtual reality (VR), augmented reality (AR), or simulators—allows teachers to develop students’ vocational skills while also addressing their digital and soft skills. These technologies are likely to become more common in VET in the years to come, as their flexibility, cost base, as well as safety of usage, will be improving.

Table 5. Estimation of Cost/Investment Baseline for Centers of Digital Excellence

Area of Activity	Investment Estimation	Expected Outcomes, Deliverables, KPIs
1. Establishment of labs, demo areas, learning zones	€ 2,000,000—€ 4,000,000	<ol style="list-style-type: none"> 1. One backoffice space for HW equipment of a shared nature (cloud, edge) 2. One front office (FABLAB) space for demonstrations and the development of pilots (AR/VR, sensors) 3. Two smart classrooms and spaces (green IT, sensors) 25% reduction in energy consumption per meter² 100% barrier-free accessibility to classrooms and labs
2. Supplementing existing labs with progressive Industry 4.0 technologies (cloud, robotics, 5G, digital twin, and others)	<i>Midi cloud</i> € 300,000—€ 600,000	Technologically equipped workplaces, with regard to the priorities of regional partners and companies (possibility of gradual implementation of ‘use cases’, based on a market feasibility study):
	<i>5G/Edge mini campus</i> € 200,000—€ 400,000	<ol style="list-style-type: none"> 1. Cloud—HW environment of approx. 10 servers, 40 terabytes (TBs) network-attached storage (NAS), firewall, and licenses
	<i>UX showcase</i> € 200,000— € 500,000	<ol style="list-style-type: none"> 2. Robotics, edge/5G—establishment of a mini campus 3. UX analysis in production management— establishment of a UX center for VR, AR, and CHI (AI digital platform)
	<i>Green workspace</i> € 350,000—€ 500,000	<ol style="list-style-type: none"> 4. Green infrastructure—establishment of a pilot installation and its analytical, data, and control elements
3. Costs of specialized workforce—a core able not only to educate or prepare materials, but to	<i>Total labor costs</i> € 300,000—€ 600,000	Three to five product owners of the innovation areas from point 2 above (est. € 2,000—€ 2,500 / month gross salary)

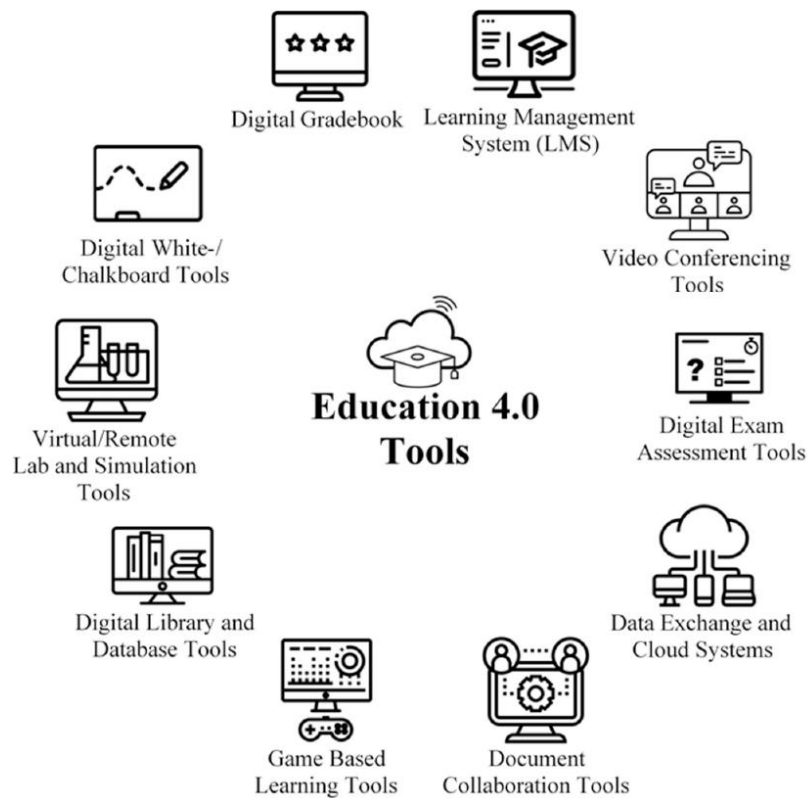
work with the partners, clients, and on the border between consulting and educational roles		
4. Editing, digitization, modification of materials for online and remote study, partial self-study	<i>Digital materials</i> € 300,000–€600,000 <i>Migration</i> € 100,000–€ 200,000	Creation and editing of educational content (case/practical studies)—4 innovation areas, each with 3–5 exploratory modules with ca 20 digital materials Migration and modification of digital materials to self-study modules in the portal—ca 75% of created volume

Source: Authors, 2023.

To make use of technology to introduce innovative pedagogies in their teaching, individual teachers need to have solid digital background themselves. Yet, a large proportion of them are currently not well-equipped with the skills to teach in digital environments. To address this, high-quality initial teacher training and continuous professional development are vital to advance the know-how of our population of educators. Keeping VET teachers up-to-date with the latest technological developments in industry requires close collaboration with employers. The key policy pointers we want to emphasize as collaterals of this survey, analysis, and report, include the following:

- Providing teachers with strategic guidance and institutional support at the level of both schools and regions for the integration of new technologies in education
- Fostering innovation through partnerships between the educational sector, industry, and research institutions, particularly at the local and regional levels to facilitate the interchange of ideas, and to align education to the economic needs of the region
- Continually raising awareness about the importance of innovation, ICT, and soft skills in VET teaching

Figure 43. Overall Model and Categories of a Modern Education 4.0 Toolkit [32]



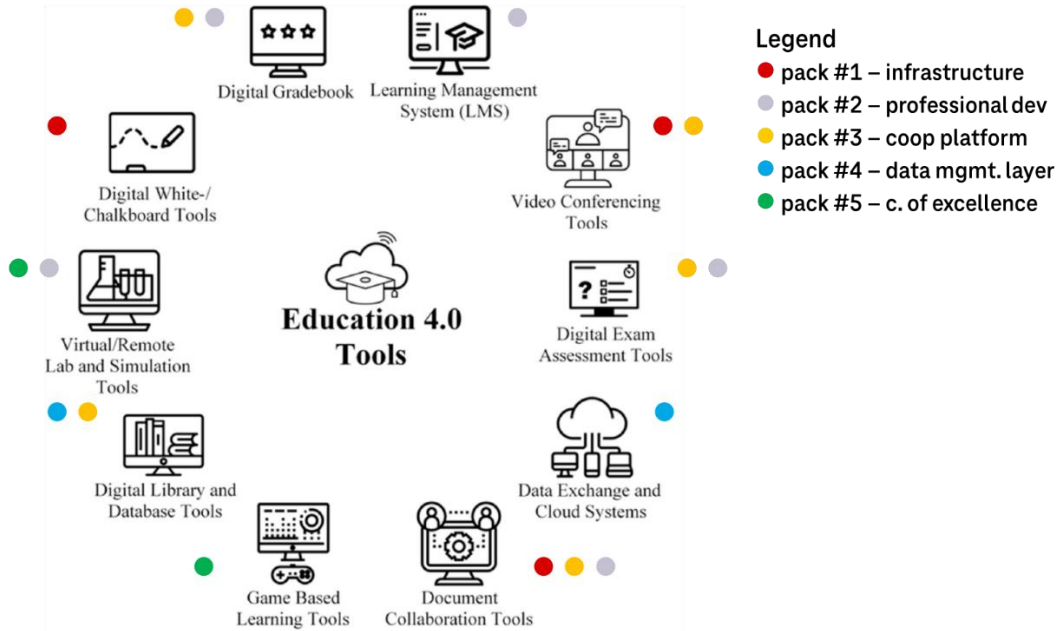
Source: Goldin, Rauch et al, "Reference Architecture for [...] Education 4.0", [32]

Modern, digitally friendly, digitally enhanced education is by no means a simple concept. We touched on individual aspects or features throughout this document. How do our recommendations fit the bigger picture? How do we satisfy the high expectations of, what is referred to by some authors as, Education 4.0 [32]? In the previous sections (and throughout relevant literature) we emphasized that to prepare students for the future work environment, new teaching methods are to be applied in education. The literature mentions approaches to teaching through new learning formats such as blended learning or flipped classrooms [32]. In addition, education should be available to a broader public through MOOCs. Flexibility in learning is also vital, for example, e-learning should make learning content accessible from everywhere, at any time. Students should also be taught how to deal with new information and knowledge sources. Subjects will become more and more interdisciplinary as there are no clearly defined boundaries. What is learned in the classroom should always be linked to practice so that the student can apply it immediately. With teachers taking a mentoring role and supporting the students, the emphasis is no longer on the pure transfer of knowledge, but on the transfer of competencies.

Let us reuse a relatively simple but rich summary from [32] of what is entailed in making an impact on an educational system, and show the facets of this multidimensional concept visually in Figure 43. While we proposed five relatively self-contained investment packages, they focus on different aspects of the educational wheel shown in the figure. Altogether, they aim to address the overarching complexity. However, we divided them into smaller packages to offer an opportunity to invest step-by-step in different facets, thus keeping the whole system in balance and aiming to perform from the very early days of implementing individual options, as proposed in Chapter 9 of this report. Let us conclude our analysis and synthesis of key recommendations to the policymakers by sketching a bigger picture, in order to facilitate their perception and understanding of how

different recommendations and investment packages contribute to the 'greater target' (see Figure 44).

Figure 44. Contribution of Recommended Investment Packages to the Education 4.0 Architecture and Vision (extending [32])



Source: Authors, 2023.

12 References

- [1] R.Yanckello: *Education Digital Transformation and Innovation Primer for 2022*. Gartner analysis G00758947 (2022).
- [2] K.Calhoun Williams: *Facilitating K-12 Education Executive Discussions to Challenge 1:1 Assumptions*. Gartner analysis G00742342 (2022).
- [3] R.Yanckello: *Modernization in Higher Education Means More Than Just Replacing Outdated Technology*. Gartner analysis G00760802 (2022).
- [4] ETF Working Group: *Digital Transformation challenges and opportunities for Vocational Education and Training (VET)*. NEXA Centre for Internet & Society report (2021).
- [5] N.Begičević Ređep: *Comparative overview of the digital preparedness of education systems in selected CEE countries*. Centre of Policy Studies working paper series 2021/08.
- [6] T.Sheehan, R.Yanckello, T.L.Thayer et al: *Predicts 2022: Education — Review, Refocus, Rebuild*. Gartner analysis G00745581 (2021).
- [7] A.Economou, G.Kapsalis, et al: *Digital Competence Framework for Educators (DigCompEdu)*. EU Science Hub web site https://joint-research-centre.ec.europa.eu/digcompedu_en (2021).
- [8] D.Sveda et al: *IT Akadémia – Vzdelávanie pre 21.storočie*. Národný projekt 312011F057. Web site <https://itakademia.sk> (2021).
- [9] G.Zinke: *Berufsbildung 4.0 - Fachkräftequalifikationen und Kompetenzen für die digitalisierte Arbeit von morgen: Branchen- und Berufescreening*. Federal Institute for Vocational Training (BIBB), special issue 213 (2019).
- [10] Deloitte & Ipsos MORI: *2nd Survey of Schools: ICT in Education*. Technical Report for European Commission, ISBN 978-92-79-99680-1 (2019).
- [11] N.Begičević Ređep, I.Balaban, B.Žugec et al: *Framework for Digitally Mature Schools*. In Proc. of Annual Conf. of European Distance and E-Learning Network (2017).
- [12] VET Working Group: *Innovation & Digitalization*. Report of the ET 2020 Working Group on Vocational Education and Training (VET), European Commission (2020).
- [13] C.Redecker & Y.Punie: *Digital Competence of Educators DigCompEdu*. Luxembourg: Publications Office of the European Union (2017).
- [14] M.Ghomi & C.Redecker: *Digital Competence of Educators (DigCompEdu): Development and Evaluation of a Self-Assessment Instrument for Teachers*, Digital Competence. Berlin: Joint Research Center (2018).
- [15] Boston Consulting Group: *Digital Maturity*. <https://www.bcg.com/capabilities/digital-technology-data/digital-maturity> (website accessed 27th Apr 2023).
- [16] M.Winik: *Digital Maturity Model: Calculate your path to growth*. In Research Intelligence (online) – created 2nd June 2021, updated 18th April 2023. <https://www.similarweb.com/amp/blog/research/company/company-research/digital-maturity-model/> (website accessed 7th May 2023).
- [17] OECD: *Supporting the Digital Transformation of Higher Education in Hungary*, Higher Education Edition, OECD Publishing, Paris, <https://doi.org/10.1787/d30ab43f-en> (2021).

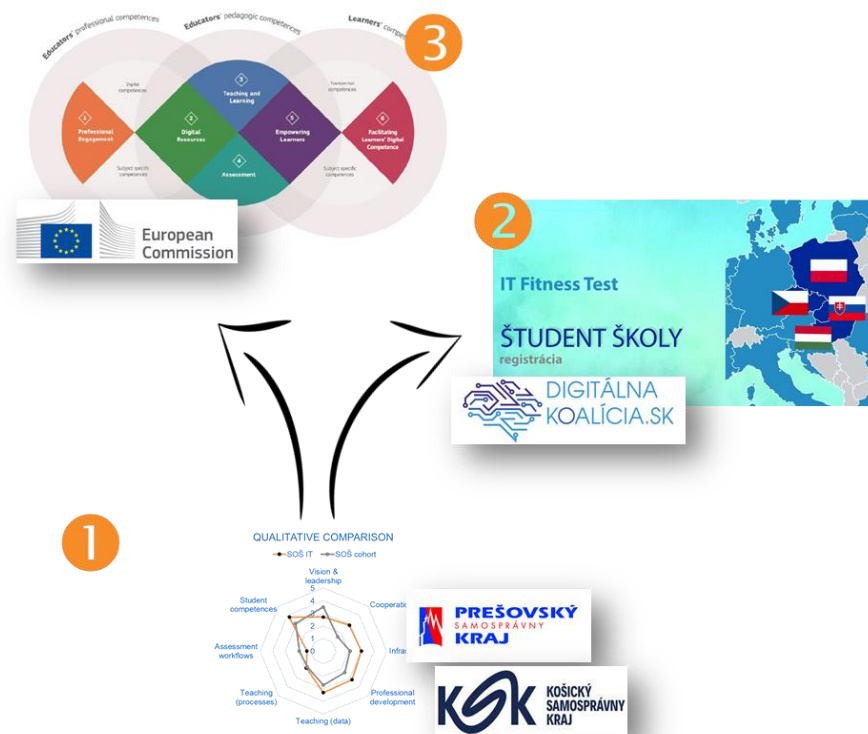
- [18] European Commission: *Slovakia in the Digital Economy and Society Index*. Digital Strategy Policies Library, EC Digital Strategy, Brussels, <https://ec.europa.eu/newsroom/dae/redirection/document/88712> (2022).
- [19] Eurostat: Do young people in the EU have digital skills? World Youth Skills Day Edition, Brussels, <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20200715-1> (2020).
- [20] B.Lanvin, S.Dutta et al.: *Slovakia performance overview*. Network Readiness Index Report, University of Oxford, Said Business School Publishing, <https://networkreadinessindex.org/country/slovakia/> (2022).
- [21] M.Beblavý, S.Baiocco, et al.: *Index of Readiness for Digital Lifelong Learning: Changing How Europeans Upgrade Their Skills*. Centre for European Policy Studies, Brussels. (2019).
- [22] F.Jakab, A.Bederka et al.: *IT Fitness Test 2022 – Záverečná správa*. Digitálna Koalícia SR, Bratislava, <https://itfitness.eu/en/pages/zaverecna-sprava-it-fitness-test-2022/> (2022).
- [23] Cedefop: *Setting Europe on course for a human digital transition – new evidence from the 2nd European skills and jobs survey*. European Centre for the Development of Vocational Training, Luxembourg, Publications Office of the European Union (2022).
- [24] J.Kitzinger: *Qualitative Research: Introducing focus groups*. The BMJ; Vol.311:299 doi:10.1136/bmj.311.7000.299 (1995).
- [25] Staring et al., *Digital higher education: Emerging quality standards, practices and supports*. <https://www.oecd.org/education/digital-higher-education-f622f257-en.htm> (accessed on 14 May 2023).
- [26] OECD: *OECD Skills Outlook 2019: Thriving in a Digital World*, OECD Publishing, Paris, <https://doi.org/10.1787/df80bc12-en> (2019).
- [27] E.Hanau (editor): *Planning the Use of Augmented and Virtual Reality for Vocational Education and Training*. Federal Institute for Vocational Education and Training (BIBB). Report no. 0035-vetrepository-779477-5 (2021).
- [28] EXAM: *A VET centre 4.0: Action Plan draft*. EXAM 4.0 Partnership. https://examhub.eu/wp-content/uploads/2021/12/WP6_1_ActionPlanDraft.pdf (accessed 6 June 2023).
- [29] OECD: *Notes from the Meeting of the Group of National Experts on School Resources*. Review of Policies to Improve the Effectiveness of Resource Use in Schools (2020).
- [30] IT Akadémia: *Návrh programu digitálnej transformácie vzdelávania na Slovensku a akčného plánu na obdobie 2021–2024*. IT Akadémia – vzdelávanie pre 21.storočie (2020).
- [31] H.Abdul-Hamid: *Data for Learning: Building a Smart Education Data System*. DIRECTIONS IN DEVELOPMENT Series. The World Bank Group, <http://dx.doi.org/10.1596/978-1-4648-1099-2> (2017).
- [32] T.Goldin, E.Rauch, et al.: *Reference Architecture for an Integrated and Synergetic Use of Digital Tools in Education 4.0*. In *Procedia Computer Science* 200, p.407–417 (2022).
- [33] M.R.Davis: *K-12 Districts Wasting Millions by Not Using Purchased Software*. In *EdWeek Market Brief*, May 2019 (<https://marketbrief.edweek.org/marketplace-k-12/unused-educational-software-major-source-wasted-k-12-spending-new-analysis-finds/>).

13 Appendix 1. Research and Survey Instrument

15.1 Assessment Methods and Assumptions

For the assessment of digital maturity, we developed a three-stage process that comprises qualitative self-assessment, student performance assessment, and quantified self-assessment. The relationship between the three stages of the process is shown in Figure 45 below.

Figure 45. Three-stage Process for the Assessment of Digital Maturity



Source: Authors, 2023.

The individual stages of the process are defined as follows:

1) Perceptual quick self-assessment

Focusing on the educational institutional level, with multiple dimensions and snapshot outcomes, enabling quick comparison with cohorts, identification of hotspots, and basic *orientation* on the topic of digital maturity

2) Student/employee competence assessment

Focusing on the individual learner level and their performance in digital skills; and evaluating the impact of education processes, technologies, and other elements, on the actual skills and capabilities of the target audience—essentially serving as *evidence* of positive impact

3) DigCompEdu-motivated quantifiable 'deep-dive'

Focusing on the institutional level, with multiple dimensions; however, unlike stage 1, bringing in the quantification of extent (depth and scope) for which assessed capabilities, resources, skills, and so on, are available at the respective educational institutions, thus serving as a baseline for further *planning* and transformation strategy formulation

For the purpose of the individual steps, as mentioned above, we developed different methods to achieve a balance between the complexity of execution and the informative value of the answers. The methods and their rationales are described below.

For stages 1 and 3, we introduce a questionnaire as a basic data gathering method, while for stage 2, we reuse data available through the national survey, IT Fitness Test. Briefly, the IT Fitness Test is a structured set of questions and tasks filled in by respondents—ranging from children, through students, graduates, different categories of employees, and up to seniors. Respondents answer and solve questions on their general awareness of IT, the internet, cybersecurity, data processing, and the usage of basic tools. The answers can be obtained on a per-school basis and collated on a per-region basis; hence, one can interpret the achieved levels on deeper levels of granularity. Furthermore, as the test is repeated annually, it is possible to observe (or start observing) not only the actual, but also the trend values.

Regarding **stage 1**, an *attitudinal assessment* is completed by means of a *questionnaire*. The questionnaire is structured into eight dimensions or *factors*, each containing a number of questions. Altogether, there are 35 *questions* in the questionnaire. The questions are formulated so as to allow the application of the 5+1-level Lickert scale. The respondent is asked to record his or her perception of (or *attitude to*) a questioned capability, activity, process, or its aspect, in terms of “strong disagreement”, “disagreement”, “partial agreement”, “agreement” or “strong agreement”. The five scaled answers are complemented by the sixth option, allowing the respondent to state “non-applicability” of a particular aspect to his or her school (again, based on her perception). The respondent is not expected to justify the recorded perception, elaborate it in detail, or provide any form of evidence. However, the questionnaire permits recording an *optional* note to explain, illustrate, or complement the “agreement”. The questionnaire is available in English as well as Slovak localization—we *recommend using the Slovak version* to avoid misunderstanding or misinterpretation.

The qualitative assessment questionnaire comprises the following dimensions (or factors), along which the data can be clustered and evaluated. Each factor points to a category or area of potential strategic focus, transformational change, or action:

- Attitudes related to communication and collaboration using digital tools
- Attitudes related to professional self-development in digital upskilling
- Attitudes related to working with digital resources in learning and teaching
- Attitudes related to applying digitally enabling learning and teaching techniques
- Attitudes related to the role of digital tools for learner assessment
- Attitudes related to the empowerment of learners in applying and exploring digital resources, tools, and so on
- Attitudes related to developing digital competencies among the learners
- Attitudes related to perceiving data privacy and data protection in educational processes
- Category selection for organizational demographic and classification data to identify the type of institution and enable data consolidation and collation

Regarding **stage 3**, the quantifiable assessment is also conducted through a dedicated *questionnaire*. The questionnaire is structured in eight dimensions or *factors*, each containing a number of questions; altogether there are 57 *questions* to be answered. Part of this questionnaire is based on

the Lickert scale, asking the respondent to choose from four levels of agreement—“strong disagreement”, “disagreement”, “agreement”, or “strong agreement”, complemented by the sixth option allowing the respondent to state “non-applicability” of a particular aspect to his or her school. Alternatively, some questions explore the degree of focus on different aspects questioned: “major focus”, “partial focus”, “limited focus”, and “no focus”. The scale deliberately avoids the middle ground to facilitate the respondent taking a position, rather than remaining indecisive.

The assessment questionnaire comprises the following dimensions (or factors), along which the data can be clustered and evaluated. Each factor points to a category or area of potential strategic focus, transformational change, or action:

- Attitudes related to ownership of basic IT infrastructure and tools in the school
- Attitudes related to digital know-how and skills in the school
- Attitudes related to evaluating the progress of digitalization at school
- Ranked prioritization of perceived obstacles and challenges to effective use of digital tools for learning and teaching
- Degree of focus on procuring different items of digital infrastructure, tools, and equipment
- Degree of focus on utilizing digital tools and methods in the educational process to achieve different outcomes
- Degree of focus on different aspects of curricular content and their impact
- Degree of focus on different processes affected by digitalization
- Category selection for organizational demographic and classification data to identify the type of institution and enable data consolidation and collation

While the responses around “agreement” are purely subjective and attitudinal, responses around the “degree of focus” are recommended to be interpreted by the facilitators in the following ways:

- *Major focus*: The questioned aspect applies to more than 75% of relevant situations, contexts, or decisions.
- *Partial focus*: The questioned aspect applies to more than 50%, and up to 75% of relevant situations, contexts, or decisions.
- *Limited focus*: The questioned aspect applies to more than 25%, and up to 50% of relevant situations, contexts, or decisions.
- *No focus*: The questioned aspect applies to less than 25% of relevant situations, contexts, or decisions.

In terms of implementing the questionnaires, we *recommend an online, digital version* accessed individually by each respondent independently from others at the same school. Furthermore, we recommend organizing the questionnaire answering as a *group session* and *facilitating the groups of respondents*. Thereby, questions are introduced by the facilitator, exemplified, and the respondents are allowed an agreed amount of time to record their answers (click the respective box online). An alternative to the *active facilitation* is a *passive clarification*, where respondents ask for theme clarification or exemplification during a group session, as needed, not necessarily for every question. We *recommend the active approach to facilitation*, to avoid ad hoc talks potentially upsetting the focus of the respondents.

15.2 Target Population / Focus Group Definition

The questionnaires forming the baseline of the digital maturity assessment target two distinct populations of respondents. However, before we attend to the specific target groups of respondents, let us first define the focus of the measurement. For the sake of the initial phase of the digital maturity assessment, the CuRI VET project team, in cooperation with the representatives from the regional educational authorities, selected the following *mixture of school types*:

- *For Prešov Region:* 14 VET schools from across the region + 6 grammar schools across the region = altogether 20 institutions
- *For Košice Region:* 20 VET schools from across the region + 6 grammar schools across the region = altogether 26 institutions
- *For Banská Bystrica Region:* The process shall be negotiated in due course.

Next, the *qualitative (purely attitudinal) questionnaire is targeted at teachers and other educators* in the VET or non-VET institutions. In order to achieve the statistical significance of responses, we recommend applying the following 'rules' to approaching the potential respondents from among the school staff:

- *Diversity of perspectives:* We strongly recommend gathering teaching staff from all curricular domains at the given school. That is, it is not advisable to focus only on the teachers of IT or informatics, languages, or maths.
- *Representativeness:* We strongly recommend inviting to the questionnaire at least 50% of teaching staff in their respective curricular domain, at least 3 teachers per area.
- *Independence:* While we recommend the facilitation of a group session to reduce the stress among respondents, it is important that each member of staff invited to the questionnaire answers on his or her own behalf—that he/she records his or her own attitudes and perceptions of questioned aspects. Technically, it means each respondent must have access to a dedicated laptop or computer with a web browser.
- *Statistical validity:* We recommend inviting at least half (50%) of teachers and educators at each invited institution to achieve valid outcomes.

The *quantifiable questionnaire (stage 3) is targeted at the management and digital leaders* of the selected VET or non-VET institutions. To achieve the statistical significance of responses, we recommend applying the following 'premises' to inviting relevant respondents from among the school and digital leaders:

- *Managerial perspectives:* We strongly recommend that the questionnaire is answered directly by the respective head or his nominated deputy head directly.
- *IT/digital technical perspective:* We strongly recommend that the questionnaire is answered directly by the respective digital coordinator or the most relevant IT leader/expert/manager (if the coordinator role is not active).
- *Representativeness:* We strongly recommend inviting to the questionnaire at least 3 members of the school managerial and digital leadership team.
- *Informed reliability:* We recommend the facilitation of a group session to reduce the stress among respondents. Unlike the teacher-oriented questionnaire, in the case of stage 3 assessment, *a single, jointly worked-out answer per school is sufficient*. The invited heads

and leaders are encouraged to work as a focus group to align and best justify the chosen answers.

15.3 Evaluation of Data Gathered via the Survey

Data will be gathered by electronic means (electronic questionnaire) and will be stored in a database for further processing by analytical tools and reporting. Data gathered using the methods described in earlier sections will not contain personal data of the individual participants. In fact, the questionnaire and the facilitators shall make it clear to participating teachers and leaders that no response will be associated with a specific individual and no personal data (for example, name, position, years of experience, previous experience, specific training, or certificates) will be captured, stored, or used during the survey.

On the other hand, for the purpose of analyzing the gathered data, the questionnaires contain a so-called “demographic” (or organo-graphic) section, where statistical data about the school are collected—including the name and type of school, the school region, the overall number of teachers at school, the numbers of teaching staff in high-level curricular areas, and similarly. The data collected will not be analyzed at the level of individual responses; they will be collated and consolidated as “per school”, “per region”, and “per school type”, while other ‘demographic’ variables serve to cross-check the representativeness and parameters mentioned in the previous sections.

Participating schools and their leaders will receive outcomes on a “per school” basis that includes the consolidated results arising from their responses. In addition, the “per school” data of that particular institution will be evaluated (compared) with the “per region” consolidated, average answers in order to offer the school leadership context and relative position of ‘me versus others similar to me’. The evaluation will be presented and conducted in the Slovak language; the English version will be secondary—for the purpose of reporting to, and aligning with the needs of, the World Bank and European Commission, upon specific request.

15.4 Roles and Responsibilities

To execute the recommendations and design premises introduced in the previous sections, we recommend establishing the following roles and responsibilities in the process of preparing, executing, and evaluating the questionnaires’ rollout. For the definition of responsibilities, the roles and responsibilities matrix (responsible, accountable, consulted, and informed [RACI]) is used as a relatively simple means of recording:

- One or more stakeholders *is/are responsible* for doing, or implementing a given task (**R**)
- The single stakeholder that is *accountable* for a given tasks and *owns it* (**A**)
- One or more stakeholders in a supportive, consulting, or *cooperating* position/s with respect to a given task (**C**)
- One or more stakeholders that may be *informed*, that is, passive recipients of information related to a given task (**I**)

Before applying RACI to the relevant tasks and activities, we identify the following stakeholders in the survey and associate shortcuts to construct a simpler and cleaner RACI matrix. See Table 6 below for an overview.

Table 6. Definition of Key Roles in Assessing Digital Maturity in the CuRI Context

Role	Abbreviation	Description	Optional
Regional Education Dept. Lead	R_Mgr	Manager of the educational/VET dept. in the respective region	
Regional CuRI Lead	R_Lead	Appointed representative or leader of regional engagement in CuRI	
Regional Education Dept. Analyst	R_Data	Member(s) of regional education dept. specializing in data analysis	yes
Regional IT Support	R_IT	Member(s) of regional education or IT dept. with know-how in IT tooling	
Regional Education Dept. Specialist	R_Staff	Member(s) of regional education dept.	
School Head	S_Dir	Statutory head (director) of VET or non-VET school	
School Deputy Head	S_Dep	Statutory deputy head of VET or non-VET school	yes
School Digital Coordinator	S_Digi	Appointed digital coordinator (or closest role) at a given school	
School Teacher / Educator	S_Edu	Full- or part-time member(s) of teaching staff at a given school	
WB Digital Consultant	WB_DC	Appointed World Bank local expert(s) of digitalization and digital transformation	
WB VET Expert	WB_Exp	Appointed World Bank local VET expert(s)	
WB Task Leader	WB_TL	Nominated World Bank task leader	
Group Facilitator	R_Fac	Trained member of World Bank local team or regional educational dept. to facilitate questionnaire sessions	

Source: Authors, 2023.

The recommended assignment of responsibilities to roles yields the RACI matrix as below:

Table 7. RACI Matrix for the Implementation of the Digital Maturity Assessment

Task/Activity	R	A	C	I
1.1 Questionnaire design	WB_DC	WB_DC	WB_Exp, WB_TL	R_Mgr, R_Lead
1.2 Questionnaire review	WB_Exp, WB_TL	WB_DC	R_Lead, R_Staff	R_Mgr
1.3 Questionnaire approval	WB_Exp	WB_TL		
1.4 Questionnaire translation	WB_DC	WB_DC	WB_Exp	
2.1 Training of facilitators	WB_DC, WB_Exp	WB_DC		WB_TL

2.2 Training of operational owners	R_Data, R_Staff, WB_DC, WB_Exp	WB_DC	R_Mgr, R_Lead	
2.3 Pilot facilitated run (with 'hypercare')	R_Staff, WB_Fac	WB_DC		
3.1 Nomination of assessed VET/non-VET schools	R_Staff, R_Mgr	R_Mgr	R_IT	WB_Exp
3.2 Invitation of nominated schools	R_Staff	R_Staff	R_IT, S_Dir	WB_Exp
3.3. Nomination of respondents from a school	S_Dir	S_Dir	S_Dep, S_Digi	S_Edu
3.4 Invitation of responding teachers from a school	R_Staff	R_Staff	R_IT, S_Dir, S_Edu	WB_Fac
3.5 Invitation of responding school leaders and coordinator	R_Staff	R_Staff	R_IT, R_Mgr, R_Dir, R_Digi	WB_Fac
4.1 Selection of tool for questionnaire implementation	R_IT, R_Mgr	WB_DC	R_Staff, WB_Exp	WB_TL
4.2 Coding of questionnaire into online tool	R_Staff, WB_DC	R_Data	R_IT, WB_Exp	
4.3 Review and release of questionnaire to the region	R_Staff, R_Data	R_Mgr	WB_Digi, WB_Exp	WB_TL, R_Lead
4.4 Monitoring of data gathering	R_Staff, WB_Exp	R_Staff	R_IT	WB_Exp
4.5 Preliminary data review / pre-analysis	R_Staff, WB_DC	R_Data	WB_Exp, R_Mgr, R_Lead	WB_TL
4.6 Export of gathered data from the online tool	R_Staff	R_Data	WB_DC	
4.7 Analysis of gathered data for respective region	R_Data, WB_DC	R_Data	WB_Exp, R_Staff, R_Mgr	WB_TL

Source: Authors, 2023.

15.5 Assessment Execution Timeline

We recommend following a set timeline and roadmap to lead the team from the initial steps, through the released questionnaire products, up to the point of analyzing the responses from the participating stakeholders. The timeline is estimated and summed up in the table below. The primary objective is to achieve the major milestone of the completed preliminary analysis of the gathered data by, at the latest, March 31, 2023. Bearing in mind this ambition, some tasks allow some buffer. However, we strongly recommend aiming at launching the respective tasks at their 'earliest start date' (ESD). In addition to defining ESD, each task has an estimated duration (DUR) and a 'latest start date' (LSD) to still guarantee meeting the major milestone.

Table 8. Recommended Timeline for Executing the Digital Maturity Assessment

Task/Activity	ESD	DUR	LSD
1.1 Questionnaire(s) design	Oct. 25, 2022	30 days	Nov. 14, 2023
1.2 Questionnaire(s) review	Nov. 14, 2022	5 days	Dec. 7, 2023
1.3 Questionnaire(s) approval	Nov. 30, 2022	2 days	Dec.13, 2023
1.4 Questionnaire translation	Nov. 25, 2022	5 days	Dec.20, 2023
2.1 Training of facilitators	Dec. 15, 2022	2 days	Jan. 9, 2023
2.2 Training of operational owners	Dec. 15, 2022	2 days	Jan. 9, 2023
2.3 Pilot facilitated run (with 'hypercare')	Jan. 16, 2023	1 day	Jan. 30, 2023
3.1 Nomination of assessed VET/non-VET schools	Dec. 12, 2022	2 days	Jan. 10, 2023
3.2 Invitation of nominated schools	Dec. 15, 2022	3 days	Jan. 10, 2023
3.3. Nomination of respondents from a school	Dec. 20, 2022	10 days	Jan. 10, 2023
3.4 Invitation of responding teachers from a school	Jan. 9, 2023	5 days	Jan. 20, 2023
3.5 Invitation of responding school leaders & coordinator	Jan. 9, 2023	5 days	Jan. 20, 2023
3.6 Facilitation of group session(s)	Jan. 16, 2023	45 days	Jan. 30, 2023
4.1 Selection of tool for questionnaire implementation	Dec. 12, 2022	2 days	Jan. 9, 2023
4.2 Coding of questionnaire into online tool	Dec. 20, 2022	5 days	Jan. 9, 2023
4.3 Review and release of questionnaire to the region	Jan. 9, 2023	1 day	Jan. 23, 2023
4.4 Monitoring of data gathering	Jan. 16, 2023	45 days	Jan. 30, 2023
4.5 Preliminary data review / pre-analysis	Feb. 15, 2023	3 days	Feb. 28, 2023
4.6 Export of gathered data from the online tool	Feb. 27, 2023	3 days	Mar. 10, 2023
4.7 Analysis of gathered data for the respective region	Mar. 1, 2023	15 days	Mar. 15, 2023

Source: Authors, 2023.

15.6 Recommendations for Facilitating the Assessment

We recommend following up the invitation to selected schools and their management with an introduction and possibly, a face-to-face discussion of the 'bigger picture'. In this context, the DigCompEdu framework might be a suitable means to introduce the overall picture of digitization with its multiple dimensions, factors, and their purpose. DigCompEdu is a comprehensive framework that reflects multidimensional aspects of the process of systematically integrating digital learning in

educational institutions. The purpose is to enable self-assessment as schools implement their digital learning and transformation of their organization. It enables policy owners to design, implement, and appraise programs, projects, and interventions for the integration of digital learning technologies:

1. **Professional commitment:** This is the capacity to use digital technologies to improve the teaching process and interact professionally with colleagues, students, parents, and different agents of the educational community. Communication through technology allows for individual professional development, and for collective and continuous innovation in the organization.
2. **Digital resources:** It is important to identify quality educational resources. Teachers must also be able to modify, create, and share these resources to adjust them to their objectives, students, and teaching styles. Likewise, they must know how to use and administer digital content responsibly, respecting the author rights and protecting personal data.
3. **Digital pedagogy:** This involves knowing how to design, plan, and implement the use of digital technologies in all the phases of the teaching process, thereby promoting student-centered approaches and methodologies.
4. **Evaluation and feedback:** Digital technologies can improve the existing evaluation strategies and pave the way for new and better evaluation methods. Moreover, after analyzing the large amount of available data (digital) about the individual interactions of students, teachers can provide more specific comments and support.
5. **Empowering the students:** One of the key strengths of digital technologies in education is their potential to boost the collaboration of students in the teaching-learning process and their autonomy in it. Moreover, digital technologies can be used to provide learning activities adapted to the competence level, interests, and learning needs of each student.
6. **Facilitating the competence:** The capacity to facilitate the digital competence of the students is an integral part of teacher competence in ICT and the main theme of this competence area.

We also recommend keeping to certain minimum participant numbers in executing the survey with the educational institutions. As the survey will use the information obtained from the questionnaires to create a snapshot of where the school is in relation to its use of digital technologies, in principle, the greater the number of questionnaires submitted, the more accurate and useful this information will be.

Minimum participation rates have been defined to guide the schools, in this respect. Table 9 below provides the minimum percentage participation rates for school leaders, teachers, and students per survey. In the case of teachers, if there are 100 teachers in the school, at least 40% should participate. That means we would expect around 40 members of each teaching staff to take part in the survey. In the case of students, for example, if there are 200 students in an institution, the minimum participation rate of 40% would mean that 80 students should participate.

Table 9. Minimum Percentage Participation Rates for School Leaders, Teachers, and Students per Survey

School Size (no. of teachers in curricular area)	No. of Interviewed Teachers	Min. Participation Rate (teachers)	No. of Interviewed Leaders
10 or fewer	4–6	60 %	1–3
11–20	6–8	50 %	2–4
21 or more	8–12	40 %	3–5

Source: Authors, 2023.