

Digital Maturity Level of Bulgarian Primary and Secondary Schools

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Abstract

The road to the digitalization of schools is long and requires investment in digital technologies, equipment and teacher professional development. The European Union recognizes the significance of the digitalization of schools and encourages the development of digitally mature schools with a high level of ICT integration in school management and educational processes. In recent years, the Bulgarian Ministry of Education and Science has allocated funds under national programs for schools' digitalization. The paper presents the results of a pilot evaluation of the digital maturity level of 50 primary and secondary schools in Bulgaria. Based on the grades of each indicator from the specially developed DigBGSchool model the schools' digitalization indexes are calculated, and the digital maturity level of schools are determined (Initial, Pre-Intermediate, Intermediate, Advanced, Expert). Finally, some recommendations for increasing the digital maturity levels of schools are given.

Keywords

Bulgarian schools, Digital Index, Digital Maturity Level, Digitalization, Pilot Evaluation, Recommendations

1 Introduction

The benefits of digital technologies led to an increasing interest in their use in schools [1]. The road to the digitalization of schools is long and requires investment in digital technologies, equipment and teacher professional development [2]. The digitalization of schools must be well planned to take into account the view of all stakeholder groups [3] and implemented at the level of school in accordance with local and state policies.

The European Union has recognized the significance of the digitalization of schools and through its policies, encourages the development of digitally mature schools with a high level of ICT integration in school management and educational processes [4, 5, 6, 7].

In Bulgaria, there is an increased interest in the digitalization of administrative and educational processes in education. The digitalization of education is among the main priorities of the Ministry of Education and Science. The collection, processing and storage of information in the system of preschool and school education is carried out through the National electronic information system for preschool and school education, which includes three modules ("Institutions", "Documents on the activities of the institution", "Children and students") and registers integrated with them [8, 9]. The normative document [8] allow some documents to be kept in electronic form, but it is still possible for schools to keep them on paper (e.g. Book of decisions of the pedagogical council and minutes of the meetings, Book for registration of the director's orders, Book for registration of the inspections of the control bodies of the Ministry of Education and Science, Book for the results of the students' exams, Diaries, Personal card,

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Protocols for admission to examinations, Examination protocols, Registration book for the issued documents for the completed degree of education, acquired professional qualification, etc.).

In recent years, the Ministry of Education and Science has allocated funds under national programs for the digitalization of schools, e.g. purchase of devices (tablets, laptops, etc.), software tools (electronic diaries, tracking students' achievements), providing the Internet connection and building of Wi-Fi network, promotion of innovations and digital technologies in the learning process.

The digitalization of the administrative processes facilitates the bureaucratic and administrative work, reduces the amount of used paper in the administration, improves the communication between the school and the parents. Digital solutions (electronic diaries, electronic student cards, digital protocols for exchanging information with institutions and parents, etc.) significantly reduce the workload of teachers and principals in terms of administrative activities and improve communication between school and parents. These solutions enable parents to monitor the achievements of their children in school (e.g. grades, absences, feedback, program, homework, etc.) in real-time.

The learning process of digitalization requires investments for creating an interactive learning environment and increasing the qualification of the teaching staff. During the last year, the COVID 19 pandemics forced all educational institutions worldwide to transform some or all of their face-to-face courses into online programs [10, 11]. COVID 19 catalysed the processes for implementing digital solutions in the learning process (e.g. virtual classrooms, e-learning environments, video conferencing tools, etc.) and increasing teachers' digital competencies.

The paper presents the results of a pilot evaluation of the digital maturity level of 50 primary and secondary schools in Bulgaria. Based on the grades of each indicator from the specially developed DigBGSchool model the schools' digitalization indexes are calculated, and the digital maturity level of schools are determined (Initial, Pre-Intermediate, Intermediate, Advanced, Expert). Finally, some recommendations for increasing the digital maturity levels of schools are given.

2 Design of the study

In accordance with the digital maturity model DigBGSchool [12] suitable for the evaluation of the digital maturity level of primary and secondary schools in Bulgaria, a tool for evaluation of the digital maturity of schools is developed. The DigBGSchool is developed after studying 16 digital maturity models, strategic and normative documents, and consultations with school managers and teachers. It contains 100 indicators divided into ten key areas (School Management, Learning Documentation, Training, Admissions of Students, Administrative Processes, Information Infrastructure, Digital Competencies and Support of Teaching and Administrative Staff, Collaboration with Parents and Students, Public Information, Quality Assurance and Inspection).

The study's methodology is based on an empirical approach – an exploratory survey using a questionnaire for data collection. The questionnaire, used for data collection, contains 105 questions divided into 11 sections.

The questions in Section 1. Main Information is used to determine the profile of the respondent who filled out the questionnaire and the school: name of the school, state, town, number of employees and the position of the respondent.

The other ten sections contain indicators from DigBGSchool model as follows:

- Area 1. School Management – 11 indicators;
- Area 2. Learning Documentation – 16 indicators;
- Area 3. Training – 13 indicators;
- Area 4. Admissions of Students – 5 indicators;
- Area 5. Administrative Processes – 13 indicators;
- Area 6. Information Infrastructure – 13 indicators;
- Area 7. Digital Competencies and Support of Teaching and Administrative Staff – 9 indicators;
- Area 8. Collaboration with Parents and Students – 5 indicators;
- Area 9. Public Information – 6 indicators;
- Area 10. Quality Assurance and Inspection – 9 indicators.

The respondents must evaluate each indicator on a ten-point scale (with a number from 0 to 10) according to the degree of implementation of the indicator in the evaluated school. A grade of 0 is given when no action has been taken in the school to implement the indicator and a maximum grade of 10 when the indicator is fully implemented.

Based on the grades, the school's digitalization index is calculated. The calculation is performed according to the formula $(\sum_{i=1}^{100} gr)/10$, where gr is the grade for each indicator. The index can be in the range 0-100 and based on it the digital maturity level of the school is determined – Initial Level (0-20), Pre-Intermediate Level (21-40), Intermediate Level (41-60), Advanced Level (61-80), Expert Level (81-100). Table 1 presents the interpretation of each digitalization level.

Table 1: Digitalization levels and their interpretations

<i>Digital Index</i>	<i>Digital Maturity Level</i>	<i>Interpretation</i>
0-20	Initial Level	The school is not aware of the possibility of using digital solutions in its activities, digital solutions are not used in its activities or used in a small number of activities.
21-40	Pre-Intermediate Level	The school is aware of the possibility of using digital solutions in its activities but digital solutions are used in a small number of school activities.
41-60	Intermediate Level	The school is aware of the possibility of using digital solutions in its activities and its top management investing in the digitalization of main processes.
61-80	Advanced Level	The school recognizes the benefits of using digital solutions in its activities, its top management investing in digitalization of main processes, encourages the staff to increase their digital competencies and to use a digital solution in their work.
81-100	Expert Level	The school recognizes the benefits of using digital solutions in its activities, its top management investing in digitalization of all activities and increasing the digital competencies of the staff and requires the use of digital solutions in all activities.

The questionnaire (<https://forms.gle/ANwkgtiD3z6dsQjy6>) was sent to representatives of schools by email or using social media. After collecting the data through the questionnaires, they were analysed using Microsoft Excel.

3 Results

This section presents the profile of schools and the results of their pilot evaluation.

3.1 Profile of the evaluated schools

50 schools from 16 provinces were evaluated within the conducted pilot evaluation of the digitalization level of schools. The largest is the number of the evaluated schools situated in the Plovdiv Province (22 schools). The participation in the pilot evaluation took per 4 schools from Sofia-city and Veliko Tarnovo provinces, 3 schools from Pazardzhik Province, per 2 schools from Stara Zagora, Smolyan, Burgas and Blagoevgrad provinces. The digitalization level of only one school from Varna, Vratsa, Kardzhali, Kyustendil, Montana, Sofia-Province, Targovishte, Haskovo and Shumen provinces was evaluated.

The pilot evaluation included mainly small schools with up to 50 employees (25 schools) and secondary schools with a staff between 50 and 100 employees (19 schools). Only 6 of the assessed schools have above 100 employees.

3.2 Summary results by evaluated areas

This sub-section summarizes the grades of the indicators in each key area. To evaluate the digitalization level of schools on a national level for each indicator, school grades are divided into five intervals ([0-1], [2-3], [4-5], [6-7], [8-10]). The absolute and relative frequencies are calculated for each interval.

For each key area, the results from the first and last interval are presented in detail.

Area 1. School Management

Over 50% of the assessed schools show high grades in Area 1. School Management (over 8). The digital strategy is an element of the school development strategy and is updated periodically following the development of ICT and the needs of stakeholders in 65% of the evaluated schools. In most schools (63%), the integration of ICT in institutional activities is an element of their strategic planning, the management work on expanding and optimizing the set of digitalized administrative and educational processes, and employees widely use ICT to perform administrative work. Just over half of the evaluated schools (53%) have the appropriate information infrastructure, resources, budget and financial investments to digitalize institutional processes and practices to digitalize new and changeable processes. In 55% of schools, the staff uses digitalized procedures and e-services in everyday institutional practice. Information management, acceptance and support of management decisions are supported by digital solutions (including data analytics tools) in 51% of the evaluated schools. There are more schools (75%) that give possibilities for the dissemination of issued orders, decisions, messages, regulations through the use of digital solutions. It is encouraging that in 82% of the evaluated schools, the management supports and motivates the teachers to use ICT in the teaching and learning process and do experiments with new methods and solutions for digitalization. The high results in this area are partly because 69% of the evaluated schools participate in projects and cooperation networks related to ICT and the digitalization of education.

The results in this area clearly show that the achieved digitalization of institutional processes at the management level is satisfactory. In only 2% of the evaluated schools, the digital strategy is not part of the school development strategy, and their management doesn't work on the integration of ICT in the institutional activities and the expansion of the set of institutional processes implemented using e-services and ICT (results below 3). A reason for poor performance in this area is that these schools do not perform digitalization projects. The percentage of schools (4%) in which digitalized procedures and e-services are not used is small. The management of the 6% of the evaluated schools does not use digital solutions for information management, acceptance and support of its management decisions.

Area 2. Learning Documentation

Most evaluated schools have high results for digitalization of their institutional processes in Area 2 Learning Documentation. 73% of the schools ensure the development and storage of the learning documentation following their digital strategy. Electronic diaries are used in 98% of the evaluated schools, and the personal electronic diaries for each student – in 68% of schools. There is also a large number of schools that use digital solutions to develop annual school plans (78%), plan the educational process (73%), fill in the material book (80%). Digital solutions are also widely used for filling in and submitting Form 1 (82%), reports (monthly for absences, for dropped out students, etc.) to the Regional management of education and the National electronic information system for preschool and school education (88%), annual reports to the National Statistic Institute (86%). Digital solutions are used for the generation of the weekly report on student performance in 71% of evaluated schools and of other various reports (GPA in subjects, GPA of class, absences, parental involvement, teacher workload, unformed students, teacher activity, the rhythm of assessment, etc.) in 78% of schools. The percentage of schools that prepare the curriculum (65%) and the schedule for classes and exams (67%) with specialized software, allowing compliance with the requirements, is lower. More than half of the evaluated schools (57%) use digital solutions to analyse test results. The percentage of schools in which teachers use digital solutions to fill in the personal cards of the students and the main class book is relatively lower – 45%. Most schools (65%) store the learning documentation in a digital archive with authorized access.

The results from the pilot evaluation showed there is still something to be achieved in the field of Learning Documentation. There is a small percentage of schools in which digital solutions are not used for the development of annual school plans (2%), filling in and submitting reports to regional and national systems (2%), generating reports (4%), analysis of test results (6%), filling in the material book (8%). Many schools do not use personal electronic diaries (16%) and digital solutions to fill in students' cards and(or) the general class book (24%). Many schools do not use digital solutions to prepare a curriculum (18%), schedule classroom/tests (10%), generate weekly reports on student performance and absences (10%). An encouraging fact in the direction to a digitalization of the processes in this area is the small percentage of schools that do not store the learning documentation in a digital archive – 8%.

Area 3. Training

Despite the widespread use of ICT due to the transition from in-person to e-learning in the last year, the evaluation results in this area are lower than expected. Only 53% of the evaluated schools have an organization and system to integrate digital solutions in their information infrastructure to provide and support the entire education life cycle. A relatively high percentage of schools have high grades for the development of e-learning materials (71%), ensuring the availability of learning materials for students (73%), using e-learning systems (80%) and video conference tools (86%) during distance learning, providing timely feedback during the learning process using ICT (73%), and giving homework which requires students to use (69%). In 55% of the evaluated schools, the development of electronic tests for checking the acquired knowledge and skills is widespread. In 49% of schools, many tests are performed and evaluated using ICT. The percentage of schools where teachers widely use ICT to teach students with special educational needs (41%) and provide personalized student support (59%) is also relatively low. The results show that there is still much to be achieved in using digital solutions to track students at risk of poor performance or dropping out of the school system for timely intervention – less than half of the evaluated schools have high scores on this indicator. (55%). Only 27% of schools have high grades for the use of software systems (library, hall rental, etc.) for organizing and participating in extracurricular activities.

It is worrying that there are schools without achieved results for digitalization of educational processes. In 10% of the schools, there is no established organization and system to integrate digital solutions in the information infrastructure. Worrying is the fact that in some schools, e-learning materials are not available to students (2%), teachers do not use e-learning environments (4%) and video conferencing tools (2%) during distance learning, and teachers do not use ICT to teach students with special education needs (10%) and provide personalized support (6%). These low results may be among the reasons why in 4% of the schools, teachers do not give homework assignments that require students to use ICT. In 2% of the schools, no electronic tests are developed (2%). In 10% of schools, digital solutions are not used for conducting and evaluating test tests. The percentage of schools in which no steps have been taken to use digital to track students at risk (12%) and to organize extracurricular activities (16%) is relatively high.

Area 4. Admissions of Students

Significantly lower are the results from the assessment of the digitalization level of schools in this area. Only 45% of the schools have high grades for the organization of student admission through a software system. Just over half of the evaluated schools have high results for the provided opportunities for online submission of documents for participation in the ranking (55%) and electronic notification for ranking results (53%). Significantly lower is the percentage of schools with high grades for the provided organization for informing and attracting students with remote access (41%) and accessible procedures and follow-up measures for enrolment, training and graduation of students supported by ICT (45%).

In not a small part of the schools, no actions have been taken to digitalize processes related to student admission. 6% of the schools do not provide the possibility for online submission of documents. Many schools (12%) do not use any digital solutions for the organization of student admission and sending notifications to candidates for the ranking results. In many schools no organization for attracting students with remote access (16%) and using digital solutions for student enrolment (20%).

Area 5. Administrative Processes

The percentage of schools rated high for digitalization of administrative processes is relatively small. The highest is the percentage of schools with high grades for accounting activities (80%), management of fixed and current assets (69%) and financial management (67%) through specialized software systems. Just over half of the evaluated schools manage their administrative processes following their digital strategy (57%), use software systems for human resources management (53%) and manage their document flow through a record-keeping system that supports digital archives (51%). Schools are less likely to use digital solutions to maintain a register of graduates (49%), submit documents by staff (47%) and applications from students (41%) electronically. The percentage of schools with high grades for using software systems for processing employee documents and digital archives for storing documents (invoices, employment contracts, certificates for acquired qualifications of teachers, etc.) is small – 37%. Only 33% of schools have high grades for the provided opportunity for the electronic submission of applications by graduates electronically (issuance of a duplicate diploma, certificate of professional qualification, European application of certificates of professional qualification, etc.). The lowest is the percentage of schools with high grades for doing the ranking for scholarships through specialized software systems – 22%.

The results show that there are schools where no steps have been taken to digitalize all the evaluated processes. In 2% of the evaluated schools, the administrative processes are not managed following the digital strategy and no software systems are used to perform the accounting activities. There are schools in which assets (4%) and finances (6%) are not managed using software systems. The percentage of schools that do not use document management systems (14%) and human resources (16%) is higher. Over 20% of schools have not provided opportunities for submission of documents (20%) and applications from current (24%) and graduates students (24%) electronically, haven't digital register of graduates (22%), haven't practise to store documents in a digital archive with authorized access (22%) and to process employees' documents through a software system (25%). Nearly half of the schools (49%) have not implemented software ranking systems for scholarships.

Area 6. Information Infrastructure

Most of the evaluated schools (82%) have an active video surveillance system. A relatively large number of schools have received high grades for maintaining integration with digital solutions at regional and national levels (76%), measures taken to protect personal data (75%), providing digital solutions for conducting pedagogical councils, discussions of the school budget and reports on its implementation, parent meetings (71%) and software tools for teaching and learning (69%). The results show that the organization of the information infrastructure provides reliable support of all systems in 67% of the evaluated schools. The number of schools with material and technological bases (including laptops, computers, tablets, multimedia projectors, interactive whiteboards, etc.) and network infrastructure suitable for implementing a wide range of digital solutions (65%) is also relatively high. 61% of schools have measures for authorized and reliable access to e-services and resources and support of users for their use (61%). More than half of the evaluated schools have high results for measures for restoration of the information infrastructure in case of damage or collapse (57%), ensuring an effective access regime for access to the buildings through the use of digital solutions (55%) and provision of software systems for management of administrative processes (55%). Nearly half of the schools (49%) annually develop plans for improving their information infrastructure. At least schools have high grades for maintaining a digital archive for document storage and digital content with authorized access (43%).

Again, for all evaluated criteria in the area, there are schools with poor results. In a small percentage of schools (2%), no measures have been taken to protect personal data, and no software has been provided for teaching and learning. 4% of schools do not have video surveillance systems and material and technological base and network infrastructure for implementing a wide range of digital solutions, do not support integration with digital solutions at a regional and national level and do not provide digital solutions for conducting councils, meetings and discussions. The same is the percentage of schools in which reliable maintenance of all used systems is not provided. No measures for authorized and reliable access to e-services and resources, recovery of the information infrastructure and data in case of damage have been taken in 6% of the evaluated schools. The percentage of schools that do not have software systems for managing administrative processes (12%) and digital archives (18%) is significantly higher. Every fifth of the evaluated schools does not use digital solutions to implement an

effective access regime to buildings and do not develop an annual plan for improving its information infrastructure.

Area 7. Digital Competencies and Support of Teaching and Administrative Staff

Teachers and staff in many schools can use software tools for synchronous and asynchronous communication (75%). In 73% of the evaluated schools, teachers receive notifications about upcoming Olympiads, competitions, patron saints' holidays and other extracurricular activities electronically. Planning and organizing training to increase the digital competencies of teachers and employees and encourage their participation is a common practice in 71% of the evaluated schools. The last is one of the reasons why in many schools, teachers have the competencies to use digital solutions in the learning process and participate in professional networks (71%) and widely apply the acquired competencies from the courses for raising digital competencies in their work as teachers (69%). The staff training aims to prepare staff for implementing the school's digital strategy and practices in 63% of the evaluated schools. Just over half of the schools have high results in creating conditions for raising the digital culture (53%) and providing access to specialized electronic libraries with electronic resources for conducting e-learning (51%). The lowest number of schools is where the majority of teachers maintain electronic portfolios – 39%.

Compared to other evaluated areas in this area, the percentage of schools without any results is lower. There are few schools in which training for increasing the digital competencies of staff and implementing the digital strategy are not planned and organized (2%). The results show that in only 2% of the evaluated schools, teachers do not have the competence to use digital solutions in the educational process and don't participate in professional networks. The number of schools in which teachers do not receive messages about extracurricular activities electronically and the digital culture is not part of the general corporate culture is also relatively small (4%). 10% of the evaluated schools do not provide teachers with access to specialized electronic libraries with electronic resources for conducting e-learning. Teachers do not maintain electronic portfolios in 12% of the schools.

Area 8. Collaboration with Parents and Students

The number of schools with high grades on indicators in this area is relatively large. In 75% of the evaluated schools, it is common practice for parents to receive notifications of upcoming parent meetings electronically. There are many schools in which digital solutions are used to inform students and parents about the results of assessments, rankings, absences – 73%. 65% of the evaluated schools have high grades for ensuring the interaction with parents and students following their digital strategy and using digital solutions to communicate with parents and other participants in the learning process.

The number of schools with poor results in this area is small – less than 4% are schools that have shown poor grades for all evaluated indicators.

Area 9. Public Information

Most schools provide information to the public following their digital strategy (73%). A good impression makes the fact that most schools publish information about activities and events on their official websites (86%) and pages on social networks (75%). In many schools, it is common practice to provide public remote access to curricula (76%) and procurement information (73%). 51% of schools widely use digital solutions for cooperation with stakeholders (employers, local communities, universities, etc.).

The results show that few schools were not performing a step towards digitalization in this area too. The highest percentage of schools do not use digital solutions for cooperation with stakeholders (6%) and do not provide public remote access to public procurement information (8%). For all other indicators in the area, the percentage is below 4%.

Area 10. Quality Assurance and Inspection

In Quality Assurance and Inspection area, the percentage of schools with a high level of digitalization is the lowest. 69% of the schools have high grades for ensuring the quality of the education following their digital strategy.

All documents for the National Inspectorate of Education are stored in a digital archive with authorized access in 57% of the evaluated schools. In 53% of the schools, it is common practice for

staff to monitor and periodically review the curricula for implementing modern digital solutions and use digital solutions to assess the degree of satisfaction of stakeholders (teachers, students and parents) from the administrative services and the quality of training. Learning analytics tools for the monitoring learning process and its results are used widely in 43% of the assessed schools. The preparation of self-assessment reports on the quality of the conducted training through digital solutions is a common practice in 47% of the evaluated schools. Relatively low is the percentage of schools in which automated procedures and tools for management and analysis of information about the learning process (45%) and results of audits related to assessments of the school's level of digitalization are reported and taken into account in the development of the institutional information infrastructure (47%). 49% of schools have high grades for providing remote access for conducting external audits using ICT.

The percentages of schools in which the processes in this area are not digitalized are relatively high. 2% of the schools do not ensure the quality of the conducted education following their digital strategy. Monitoring and periodic review of curricula from the point of view of using modern digital solutions are not carried out in 8% of the evaluated schools. Every tenth school does not store documents for inspection in a digital archive with authorized access and does not use digital solutions to assess stakeholder satisfaction. 14% of schools do not take into account audit results when improving their information infrastructure and do not provide remote access to conduct external audits using ICT. Every sixth school does not use tools for data analysis for monitoring the learning process, digital solutions for the preparation of self-assessment reports and automated procedures and tools for management and analysis of information about the learning process.

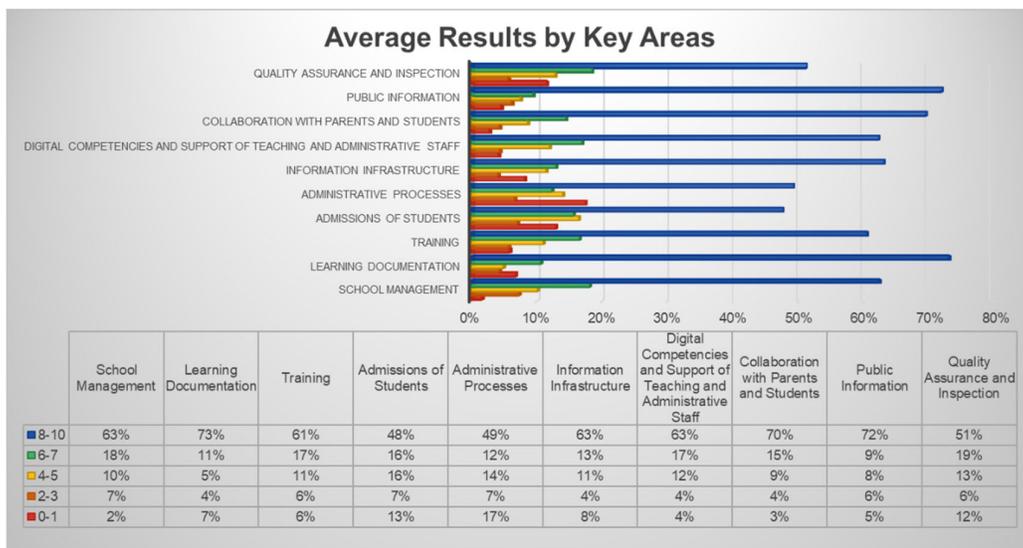


Figure 1: Average Results by Kea Area

For each of the 10th areas, the average value of the relative frequencies of the assessments of its indicators is calculated for each one of the five considered intervals. The summarized results presented in Figure 1 show that high average grades predominate in all areas (in the interval [8-10]). The schools are the most digitalized in Area 2. Learning Documentation (73% of average grades of indicators are in the range [8-10]), Area 9. Public Information (72% of the average assessments of indicators are in the range [8-10]) and Area 8. Relationships with students and parents (70% of the average assessments of indicators are in the range [8-10]). Although in the last school year, the COVID-19 pandemic led to the need for all schools to conduct e-learning, the high grades in this area are only 61%. The low results in this area at a national level are also determined by the lack of sufficient digital competencies among teachers and administrative staff (the high average grades of indicators in this area are 63%). At the national level, schools work at least to digitalize student admission processes and administrative processes (average grades of indicators in the areas in the interval [8-10] are 48% and 49%, respectively). These are both areas where the average grades of the indicators are the lowest – 13% of

the average assessments of indicators in Area 4. Admission of Students and 17% of the average assessments of indicators in Area 5. Administrative Processes are in the range [0-1]. The third area in which the results are the lowest is Area 10. Quality Assurance and Inspection – 12% of the average grades of indicators in the area are between 0 and 1.

3.3 Calculated digitalization indexes

Based on the received evaluations of the indicators and using the determined formula (see Section 2), the digital index of each school that participated in the pilot evaluation of the digital maturity level is calculated. Based on the calculated digital index, the digital maturity level of each school is determined. Figure 2 presents information about the name of each school, the province where it is situated and the calculated digital index. The background colour of data about each school depends on its digital index and digital maturity level: red background – schools with a digital index below 20 (Initial Level), orange – schools with a digital index between 21 and 40 (Pre-Intermediate Level), yellow – schools with a digital index between 41 and 60 (Intermediate Level), green – schools with a digital index between 61 and 80 (Advanced Level), blue – schools with a digital index between 81 and 100 (Expert Level). A good impression makes the fact that only one school (2% of the evaluated schools) is at the Initial Level, and 2 schools (4% of all evaluated schools) are at the Pre-Intermediate Level. The number of schools at the Intermediate Level is also small – 7 schools (14% of the evaluated schools). The figure clearly shows that most schools that participated in the pilot evaluation have high results – 18 of the schools (36%) are at the Advanced Level, and 22 of the schools (44%) have achieved the highest digital maturity level (Expert Level). Two schools have the highest digital index (100). This means that their top management recognizes the benefits of using digital solutions in school activities, invests in digitalizing of all activities and increasing digital competencies of staff, and require staff to use digital solutions in all activities.

PSSG - Plovdiv 15.90	PS "St. Kl. Ohridski" - V. Turnovo 25.50	PS "P. Bonev" - Plovdiv 29.10	PS "St. Kn. Boris I" - Burgas 42.40	PS "H. Smirnenski" - Kurdzhali 50.70	VSS "Acad. Koroliov" - Kuystendil 52.60	SS "V. Levski" - Plovdiv 53.40	73th SS "V. Gramatik" - Grad Sofia 54.30	SS "H. Botev" - Stara Zagora 57.20	PS "E. Antim I" - Plovdiv 59.70
SS "P. Volov" - Haskovo 62.10	SS "H. Botev" - Vratza 62.80	23th SS - Grad Sofia 63.40	4th PS "Prof. J. Atanasov" - Grad Sofia 64.40	PS "V. Levski" - Plovdiv 65.30	SS "N. Rilski" - Blagoevgrad 66.20	PS "Tzar Simeon I" - Varna 66.70	PS "H. Simirnenski" - Plovdiv 67.10	PS "K. Chestemenski" - Plovdiv 67.80	PS "P. R. Slaveykov" - Pazardzhik 72.20
SS "O. Paisii" - Burgas 72.20	Vocational school of transport - Blagoevgrad 73.70	PS "St. P. Evtimiy" - V. Turnovo 73.90	SS "G. Benkovski" - Pazardzhik 74.90	PS "L. Karavelov" - Plovdiv 75.30	PS "Knyaz Alexander I" - Plovdiv 77.10	SS "V. Levski" - Plovdiv 79.00	PS "R. Popovich" - Plovdiv 80.00	PS "O. Paisii" - Plovdiv 81.50	PS "G. Kartsov" - Plovdiv 82.50
PS "H. Smirnenski" - Haskovo 83.40	PS "A. Strashimirov" - Targovishte 83.50	PPMG "V. Levski" - Smolyan 83.70	SS "St. St. Cyril and Methodius" - Smolyan 87.00	132th SS - Grad Sofia 87.20	SS "H. Smirnenski" - Pazardzhik 88.60	SS "D. Marinov" - Montana 88.90	MHS "Acad. K. Popov" - Plovdiv 89.61	SS "Ch. Hrabar" - Plovdiv 90.85	SS "H. Botev" - Sofia 90.90
SS "Prof. A. Zlatarev" - Plovdiv 91.50	PGSD "Eng. N. Ranchev" - Stara Zagora 91.90	VSHS "Gen. V. Zaimov" - Plovdiv 92.56	PS "I. Vazov" - Plovdiv 93.40	PS "H. Botev" - Plovdiv 93.80	PVSHS "AK- Arkus" - V. Turnovo 94.40	PS "D. Talev" - Plovdiv 96.30	PS "P. Slaveikov" - Plovdiv 96.60	SS "E. Stanev" - V. Turnovo 100.00	SS "St. St. Cyril and Methodius" - Plovdiv 100.00

Figure 2: Schools' Digital Indexes

An analysis of the results shows no significant difference between the average value of digital indexes of schools with up to 50 employees, schools with a staff between 50 and 100 employees and schools with more than 100 employees (see Table 2). As expected, the lowest minimum index has a school with a staff of up to 50 employees, and the highest minimum indices are in large schools with more than 100 employees. In two of these school categories, there are schools with a maximum index (100), which shows that the size of the school and the number of employees is not the only determining factor for their development in the direction of digitalization of the ongoing educational and administrative processes.

Table 2: Average, Min and Max

Number of Employees	Number of Schools	Average Digital Index	Min. Digital Index	Max. Digital Index
0-50	25	73.2	15.9	100
50-100	19	74.6	25.5	96.3
above 100	6	77.2	53.4	100

Figure 3 shows the calculated average, maximum and minimum indices of schools in each province. The number of schools from each province that participated in the pilot evaluation of the digital maturity level is indicated in parentheses on the map legend. For provinces from which only one school participate in the pilot evaluation, only its digitization index is presented. The highest average index is in the schools of Smolyan Province (85.35), followed by Pazardzhik (78.57) and Plovdiv (76.95) provinces. It is noteworthy that the capital ranks 7th (excluding provinces with one evaluated school) according to the average digital index (67.33), which may be due in part to the low number of the evaluated schools in Sofia- City (4 schools). The lowest average digital index has schools in Burgas Province – 57.30. In 2 provinces (Plovdiv and Veliko Tarnovo), there are schools with a maximum digital index. These are both provinces where schools with the lowest minimum digital indexes are located – 15.90 in Plovdiv Province and 25.50 in Veliko Tarnovo province.

We will look in more detail at the results of the schools in Plovdiv Province. There are several reasons why the results of schools in Plovdiv Province are presented in more detail. On the one hand, this is the province from which the most schools of different categories are evaluated (22 schools – 44% of the evaluated schools) – 11 schools with staff up to 50 employees, 8 schools with staff between 50 and 100 employees and 3 schools with over 100 employees. On the other hand, here is located the school with the lowest digital index – 15.90. On the third hand, in Plovdiv Province, there is a school with a maximum score – 100.00.

Table 3 presents data on the number of employees, settlement and the calculated digital index for each evaluated school from Plovdiv Province. The background of the cells in the table is selected according to the digital maturity level of the school (red background – Initial Level, orange – Pre-Intermediate Level, yellow – Intermediate Level, green – Advanced Level, blue – Expert Level). The data in the table are sorted in ascending order by the number of employees and the calculated digital index. The results show that the only school in the so-called red zone is a small school with a staff of up to 50 employees, located in a small town in the district and where a small number of students are training. At the Pre-Intermediate Level, there is also a primary school with less than 50 employees. The only small school with Intermediate Digital Maturity Level, which is very close to moving to the Advanced Level, is located in Plovdiv. At the time of evaluation, 3 schools with a staff of up to 50 employees fall into the Advanced Level, and all three schools are located in small settlements in the province (Karnare, Novo Selo, Saedinenie). It is impressive that most small schools are at the Expert Level, as 4 of them are located in small settlements in Plovdiv Province (Rakovski, Hristo Danovo, Kaloyanovo, Belashtitsa), and only one of them is in the regional city of Plovdiv. From the evaluated schools with staff between 50 and 100 employees, 4 are at the Advanced Level and 2 at the Expert Level. There are schools from Plovdiv and small towns in the province (Karlovo, Sopot, Parvomay, Rakovski) at the Advanced and Expert levels. All schools with staff above 100 employees are situated in Plovdiv, as 1 of them has reached the Advanced Level and 2 to the highest Expert Level. Based on the results, we can conclude there are no significant differences between the achieved digital maturity level of schools in different settlements. The differences in the achieved digital level are mainly due to the motivation and commitment of the school top management and the realized projects in the field of digitalization. On the other hand, we will note that in all three categories of schools, the highest results are of schools in the regional city, as Secondary School "St. St. Cyril and Methodius" has a maximum digital index – 100.

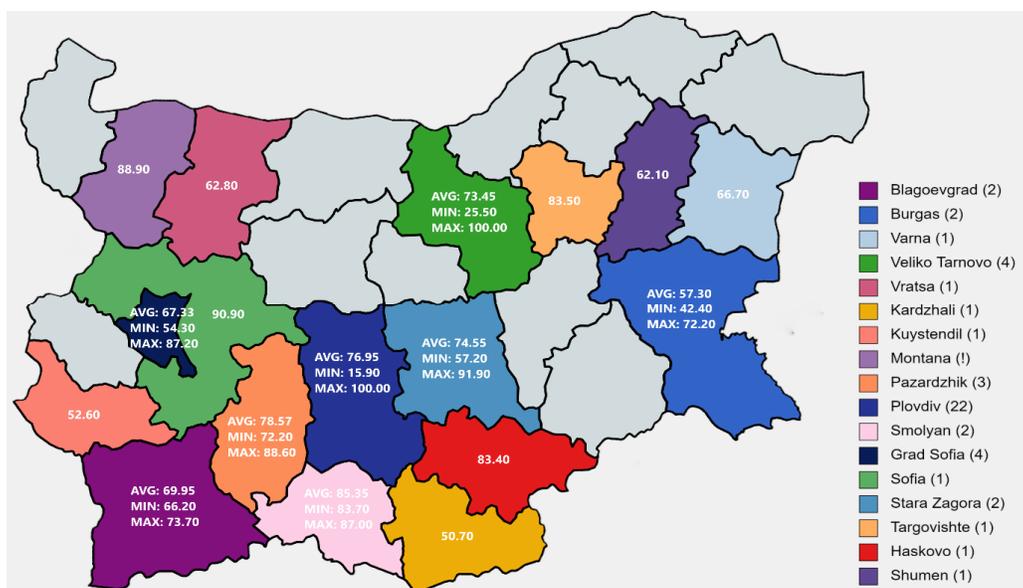


Figure 3: Average, Min and Max Digital Indexes by Provinces (created with <https://mapchart.net/>)

Table 3: Results – Plovdiv Province

School Name	Settlement (City, Town, Village)	Number of Employees	Digital Index
PSSG	Sadovo	0-50	15.9
Primary School “Peter Bonev”	Perushtitsa	0-50	29.1
Primary School “Ekzarh Antim I”	Plovdiv	0-50	59.7
Primary School “Vasil Levski”	Karnare	0-50	65.3
Primary School “Hristo Smirnenski”	Novo selo	0-50	67.1
Primary School “Luyben Karavelov”	Saedinenie	0-50	75.3
Primary School “Otets Paisii”	Rakovski	0-50	81.5
Primary School “General Kartsov”	Hristo Danovo	0-50	82.5
Primary School “Ivan Vazov”	Kaloyanovo	0-50	93.4
Primary School “Pencho Slaveykov”	Belashtitsa	0-50	96.6
Secondary School “St. St. Cyril and Methodius”	Plovdiv	0-50	100
Primary School “Kocho Chestemenski”	Plovdiv	50-100	67.8
Primary School “Knyaz Alexander I”	Plovdiv	50-100	77.1
Secondary School “Vasil Levski”	Karlovo	50-100	79
Primary School “Raino Popovich”	Karlovo	50-100	80
Secondary School “Prof. Asen Zlatarev”	Parvomay	50-100	91.5
Vocational High School “Gen. Vladimir Zaimov”	Sopot	50-100	92.56
Primary School “Hristo Botev”	Rakovski	50-100	93.8
Primary School “Dimitar Talev”	Plovdiv	50-100	96.3
Secondary School “Vasil Levski”	Plovdiv	над 100	53.4
High School of Mathematics “Acad. Kiril Popov”	Plovdiv	над 100	89.61
Secondary School “Chernorizets Harabar”	Plovdiv	над 100	90.85

3.4 Recommendations

Based on the assessments of the indicators, some recommendations for increasing the digital maturity level of schools can be made.

Weak grades¹ of indicators from the model for assessing the degree of digitalization of schools [12] at the national level show that in order to increase the level of digitalization, school managements must take measures to:

- provide appropriate information infrastructure, resources, budget and financial investments for digitalization of institutional processes;
- use of digital policies, electronic procedures and e-services in everyday institutional practice;
- expand and optimize the set of institutional processes (administrative and educational), implemented using e-services and ICT;
- implement digital solutions (including for intelligent data analysis) for information management, adoption and support of management decisions;
- participate in projects and involve in networks for cooperation related to ICT and digitalization of education;
- promote the use of electronic notebooks;
- implement digital solutions for filling in the material book, the personal students' cards and/or the general class book;
- implement software systems for creating a study schedule and control works in compliance with the requirements for the distribution of class hours and Ordinance 11;
- implement digital solutions for the analysis of test results of students, generation of weekly reports on student performance and absences and monitoring of students at risk of poor performance or dropping out of the school system, in order to intervene on time;
- create an organization and system for integration of digital solutions in the information infrastructure to provide and support the whole life cycle of training;
- encourage teachers to increase their digital competencies and maintain e-portfolios;
- provide teachers with access to specialized electronic libraries with electronic resources for conducting e-learning;
- encourage teachers to develop e-learning materials and conduct e-tests;
- encourage teachers to use digital solutions for teaching students with special educational needs and providing personalized support to students;
- implement software systems for organizing extracurricular activities;
- create an organization for informing and attracting students with remote access and implement a software system for organizing the admission of students;
- propose procedures and follow-up measures for enrolment, training and graduation of students supported by ICT;
- implement software systems for management of human resources, fixed and short-term assets, document flow;
- introduce a digitalized archive for storage of documents (for employees, training documentation, financial documents, etc.);
- implement digital solutions to maintain a register of graduates;
- implement a software system for ranking;
- provide opportunities for submission of documents by employees, students and graduates electronically;
- regular development of plans for the development of the information infrastructure;
- implement an effective access regime to buildings through the use of digital solutions;
- integrate schools' software systems with digital solutions at regional and national levels;
- use digital solutions for cooperation with stakeholders (employers, local communities, universities, etc.);
- provide public remote access to curricula and procurement information;

¹ Average grades in the range [0-3] are above 10%

- storage documents for inspection in a digital archive with authorized access;
- implement digital solutions for evaluation of satisfaction of stakeholders from the administrative service and the quality of the training;
- introduce data analytic tools for monitoring of the learning process and its results to improve learning and teaching;
- implement digital solutions for preparation of self-assessment reports on the quality of the conducted training;
- implement automated procedures and tools for management and analysis of information about the learning process;
- provide remote access for conducting external audits and reporting the results of audits related to assessments of the digital maturity level of the school when developing the institutional information infrastructure.

4 Conclusion

The presented study has some limitations. The pilot evaluation of the digital maturity level of schools was conducted in May-June 2021. The calls for participation were sent by e-mail and posted in groups on social networks. Due to the short time interval and a large number of the evaluated indicators, representatives of only 50 schools filled the questionnaire (from a total of 1948 schools in Bulgaria according to data from the National Statistical Institute [13]). Another limitation is a data collecting method – self-assessment of qualitative indicators by school representatives and the lack of quantitative indicators to allow objective assessment.

The future study will be focused on the design and development of a software system for assessment and monitoring of the degree of digitalization of schools in Bulgaria based on qualitative and quantitative indicators, which will allow:

- Self-assessment of the digital maturity level by representatives of assessed schools;
- Assessment of the digital maturity level by experts in the field;
- Automated calculation of digital index and digital maturity level;
- Generating recommendations for increasing the degree of digitalization;
- Comparison of results from the evaluation of indicators and summarized evaluations for key areas for selected periods;
- Benchmarking of schools based on indicator grades and calculated digital indexes.

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