A School to Remember: Analyzing School Best Practices in the Perspective of Digital Transformation of Schools

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Abstract. The digital transformation of schools aims to ensure a systematic process for adapting primary and secondary education to the level of technology innovations, preparing the next generation for new opportunities and demands. At the same time, digital transformation has to ensure complex organizational alignments beyond simple equipment implementation. School education is a conservative and slow-moving system, so a more in-depth analysis of the existing best practices can provide smooth digital transformation paths.

The present research aims to explore and analyze best practices from the perspective of digital transformation in schools. Using a bottom-up approach, in total 436 best practices are collected from 120 students enrolled in Computer Science programs at Sofia University. These students surmounted one of the most competitive university entrance exams in the country, ensuring the validity and relevance of their best practices. The study covers experiences from 85 primary and secondary schools in 42 locations in Bulgaria. The structuring of the paper is as follows. It starts with a literature overview of school digital transformation and presents the DigiLEAD project approach. Then, the methodology of the study is discussed and best practices are classified by origin (teacher, school or policy-level practices) and by impact (five-level model of quality education). The discussion part proposes different models for adopting digital technologies in schools, taking in consideration that almost 60% of the best practices come from individual teachers, teaching approaches and personal commitment. In the conclusions are summarized the key lessons learned and the limitations of the study.

Keywords: Digital Transformation · School Education · Best Practices

1 Introduction

The digital transformation is becoming an omnipresent trend, often connected to technology innovations and expected tremendous changes in the society and economy. School leaders have to consider how disruptive technologies such as Artificial Intelligence,

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autonomous and collaborative robots, the Internet of things, cloud computing, additive manufacturing, augmented and virtual reality, big data analytics and others can successfully add value to their programs [1]. The digital transformation in education is often discussed from the perspective of higher education and new strategies of teaching and learning [2, 3]. However, in secondary and primary education, digital transformation has to play an even more important role in preparing society and the new generations of pupils for the new skills and competencies, needed for the future of work. It should provide systematic change management programs and instruments, aligning new technology innovations to the school organizations, teacher professional development and value-adding processes of high-quality teaching and learning. In this perspective, the ERASMUS+ DigiLEAD project engaged to develop tools for school leaders, allowing them to prepare to stay at the forefront of new digital changes, conforming to the expectations of students, teachers and society.

The present research steps on the bottom-up approach and based on best practices from school education aims to analyze the digital transformation paths. Focusing on the analysis of meaningful and efficient teaching and schooling approaches, this study aims to propose more teacher and student-focused perspective for aligning digital technologies in schools.

The paper is structured as follows. First, it outlines some challenges of the digital transformation in schools and presents the main approach of the DigiLEAD project. Next, it presents the methodology of the study, analyzing the most common approaches and practices for sourcing best practices in schools. The main criteria for content analysis, evaluation and structuring of the best practices are discussed and the results are presented. The discussion part proposes a more in-depth analysis of how the outcomes of the best practices' analysis provide models for successful digital transformation paths. At the end are identified study limitations and future directions.

2 Theoretical Background

2.1 Digital Transformation in Schools

Presently, organizations are faced with a need to adapt to the changes in the networked economy, market volatility and the fast speed of adoption of digital technologies by people and organizations worldwide. The wide use of information and communication technologies (ICT) in the economy and society has resulted in new business models, management and working processes, and new users experience – described as a digital transformation [4]. Digital transformation is understood as a change of the entire operating model of the organization – requiring reengineering of internal business processes, and the way of interaction not only among employees but also with external stakeholders – partners, suppliers, distributors, clients, etc. [3].

As outlined in [3], it is essential to develop a vision and strategy for digital transformation, and to ensure leadership capabilities to communicate it, commit employees, and guide and support its implementation and the changes in organizational processes – ways of operation and control. Subsequently, critical for the success are the readiness of the staff and its skills and knowledge. Further issues are related to the availability of appropriate tools and infrastructure.

While specific efforts were taken for the digital transformation of the economy, the educational institutions were lagging behind, and during the COVID pandemic they faced the need to rapidly change their operational procedures in order to continue smooth teaching and learning processes. Teachers had to gain new competences and adapt to digital ways of teaching and communicating with students so as to maintain the educational process [5]. Similarly, school leaders were not prepared and had to find their own ways to *"upholding a sense of normalcy and care for children and families"* [6]. While several actions were taken by educational authorities to facilitate online teaching, e.g. providing computers and other devices, educational platforms and software tools, as well as training teachers, the digital transformation of schools is still a challenge in many countries. Subsequently, in Europe was approved a Digital Education Action plan as a comprehensive initiative for *"policies and actions on several fronts, including infrastructure, strategy and leadership, teacher skills, learner skills, content, curricula, assessment and national legal frameworks"* [7].

The digital transformation of educational institutions should comprise the following processes: administration, communication, teaching and preparing lessons, students learning, reviews and examination [3]. Regarding digital learning in schools, in [8] are discussed several dimensions: technical facilities and availability of ICTs in schools; students learning activities involving ICTs, and digital educational resources; abilities of teachers to fully exploit ICT opportunities, and the use of new teaching methods and learning approaches. The availability of sufficient digital technologies is not related to their frequent use in classrooms. More important are teachers and their equipment with basic digital skills for general technology usage, research, communication, collaboration, production of content and learning via technology. Technology-related teaching skills are essential to provide students with a large variety of learning activities and facilitate their problem-solving skills. Such skills are based on knowledge of technologies and specific technological pedagogical competencies which are used for creating educational resources (pedagogical content), planning, implementing and evaluating technology use in class, and sharing experiences of technology use. Subsequently, in the education of future teachers should be placed more emphasis on the usage of technologies to enable student learning activities [8].

Most educational systems in Europe lack a strategic planning [9]. This is due to a certain extent to their centralized structure which limits the autonomy and flexibility of schools, and the role of school leaders, mainly focused on the administrative management of day-to-day activities and decision making. Moreover, school leaders lack a digital transformation mind-set and proactivity, and often are not able to understand that the primary place and purpose of technology in schools is that it can be used to transform how people think, work and communicate [10, 11].

Many studies reveal also the interactions of teachers and students during online education after the COVID pandemic. For example, [14] summarized the factors influencing the establishment of a teaching presence – related to teachers' pedagogical approach, the learning design and the facilitation. Putting the learner in the center, and teachers taking the role of facilitators helps students to engage and commit. Besides, the personalized, flexible, contextualized learning design and the use of appropriate technologies and tools help effective online learning. Digital pedagogical innovation and the changing role of

teachers and students in the future are considered in [15]. The study suggests that distance learning brings greater student autonomy and higher responsibility for learning. However, digital inclusion and students wellbeing should be also taken into account by digital learning.

2.2 The DigiLEAD Approach

Partners from 5 EU member states within the DigiLEAD project considered how to support school leaders to design and implement a digital transformation strategy and Action Plans. A Strategy Toolkit on Digital transformation for School leaders was recently developed by the consortium [9] following desk research by all partners and involving focus groups with national stakeholders (researchers, teachers, school leaders, and educational authorities). The Toolkit considers specific processes in schools, and the need to support them when designing a Digital Transformation strategy:

- Creating a school vision and setting strategic objectives are of great importance in creating a successful digital transformation strategy.
- Conducting a SWOT analysis for the school is needed for analysis of the internal and external environment of schools.
- Curriculum alignment is an important section in the final school strategy as it ensures that the learning content, learning objectives, study programs, attainment targets, assessment guidelines or syllabi are aligned with the possibilities of digital education.
- Assessment plays a crucial role in how students learn, their level of motivation, and how teachers teach.
- Innovative teaching and learning strategies are essential in the overall transformation of education towards more efficient, personalized and student-oriented teaching and learning by using digital technologies.
- Infrastructure needs and adaptations focus on developing adequate and reliable infrastructure and up-to-date equipment as a prerequisite for the digital transformation in education.
- Timelines, scheduling, and ongoing monitoring are at the center of the planning and implementation of the digital transformation strategy.
- Continuous evaluation and support help to understand whether the plan is progressing within the foreseen timeframe and according to the predefined objectives, ensuring that the actions are being implemented as planned.
- Support for teachers is vital for a successful and qualitative digitalization of education, as teachers act as architects of the teaching-learning processes.
- Support for students and parents focuses on the involvement of students and parents in the digital transformation of a school.
- Privacy, health and well-being for teachers and students are pillars of digital transformation as they ensure the actors' capacity to realize their full potential.

In addition, the project team prepared a digital transformation checklist, adapted from the SELFIE tool that was produced by the European Commission [12] and the TET-SAT tool prepared within the Erasmus+project MENTEP [13]. This checklist will help school leaders with the collection of quantitative data and will enable them to first identify gaps, reflect on the current digital readiness of their school, and then evaluate the progress in the process of digital transformation.

3 Methodology Overview and Best Practices

3.1 Study Methodology

The best practices in school education are mainly presented and discussed from the top-down perspective. During the last few years, a short overview of the numerous resources of school best practices in the Bulgarian internet environment shows the common practice of teachers to present their pedagogical work at conferences and forums, conference proceedings and publications. Many collections of good practices are available through public websites (often hosted by NGOs) or as part of initiatives in specific fields (f. ex. Collection of best practices on project-based learning, best practices for integrating children from minorities and others). Furthermore, there miss a more critical analysis or academic studies of best practices, collected or sourced by bottom-up approach. This hinder the possibility to identify and further popularize the most effective and efficient good teaching and learning methods in school education.

From the perspective of new trends for digital transformation in schools, the following methodology is applied. The best practices in school education are collected from university students at the Faculty of Mathematics and Informatics (FMI) at Sofia University, Bulgaria. It should be noticed that the entrance exams on Mathematics at the FMI are among the most difficult and competitive in the country. Therefore, students revealing the best practices have a strong academic background and represent some of the best schools and teachers in Bulgaria. But more importantly, in the scope of their course work on the elective course "Knowledge Management", students are asked to carefully reflect and share personal and memorable school experiences and to analyze them from the perspective of "the school of the future".

After collecting the best practices, a content analysis is performed and the best practices are classified into three main areas (teacher initiative, school practice or policy-level initiative). Then, best practices are clustered, conforming to the five categories of quality education, as identified in [16]. More specifically, this model addresses the five key groups of criteria for quality primary and secondary education, as emerging from theoretical research [16]: (1) learning environment (psychosocial elements, physical elements, respect for diversity, collaboration, sharing and team spirit), (2) learning content (student-centered pedagogy, well-structured knowledge base, continuous curriculum improvement, interest in all students, and life skills), (3) processes (teaching, learning, assessment, support, and supervision), (4) students (involvement/participation, feedback, challenging learning activities, and improved learning outcomes), (5) teachers (knowledge of educational context, content, curriculum, and pedagogy, pedagogical skills, emotional/management/reflection skills, and teacher professional development).

3.2 Overview of the Best Practices

In total 120 BSc students in their third and fourth year took part in the best practices sourcing. All of the students were enrolled in the elective course on "Knowledge Management" and at the end of the semester, they prepared and presented a course work about the future of schools, covering both individual best practices from their own school experience and ideas about the future. The descriptive analysis shows that about 436 best

practices are identified from 85 secondary and primary schools from 42 locations in Bulgaria. Responding to their study profile, most of the schools are professional or specialized mathematical high schools: in total 30 mathematical and STEM-oriented high schools, 11 Foreign language gymnasiums and 8 professional high schools, specialized in the fields of mathematics or informatics. All of the schools are public.

The good practices are not evenly distributed as some of the schools are better represented among students. As students had the freedom to emphasize and share specific experiences, all their best practices are counted separately. For example, the Pleven Mathematical High School has 52 best practices from 13 students, the National Mathematical High School has 22 best practices from 5 students, and the Sofia Mathematical High School has 13 best practices from 5 students. A significant part of the good practices covers specific school subjects and school disciplines (198 or 45%), and another (144 or 33%) of them are linked to school activities and initiatives outside the school curriculum.

3.3 Analysis of the Results

Teacher Level Best Practices

Most of the best practices can be directly linked to individual teachers' initiatives and teaching approaches. In total 264 of the best practices or about 61% of them are related to teachers' personal involvement, innovative teaching activities, personal attitude, support and mentoring to the students' success. Table 1 presents the 5 main groups of best practices on teaching level, summarized by dominating concepts.

Table 1. Individual teachers' best practices topics.

Level	Description	Number/share of best practices (n = 264)
1	Personal attitude, discipline and personalized teaching approach	38 (14%)
2	Active teaching methods	32 (12%)
3	Public discussions and debates	26 (10%)
4	Using ICT in class	24 (9%)
5	Using games and gamification techniques	21 (8%)
6	Evaluation and feedback	21 (8%)

Personal attitude and discipline – almost 38 best practices are related to the personality of the teacher, his or her personal involvement in the subject and in the role, personal examples, high requirements, strong discipline and high expectations from the students. In this group can be reported as well personalized approaches for different students (5), covering practices such as defining personalized goals, using differentiation techniques in class and organizing additional activities.

Active learning and teaching methods were discussed in 32 practices, focusing on the role of project-based learning (14), the use of active learning methods such as mind-maps and brainstorming (8), teamwork (5), a shift of the roles (student teachers) (5) and others.

Public discussions and debates are highlighted in 26 best practices, reporting different situations and forms of discussions or public debates. Students recognize that these activities challenged them to think critically, to argue better their positions, to better prepare and learn additional facts, as well as to consider the arguments of both sides and to make their own judgements. Some teachers organized public debates and discussions after showing a movie or video, for completing the literature analysis and others. These techniques are commonly linked to humanities subjects such as history (9), Bulgarian language and literature (7), foreign languages (4), philosophical studies (2) and others.

The use of **ICT in class** is reflected on several levels. About 24 practices are reported, covering the use of technologies to facilitate knowledge sharing - teachers using online platforms and repositories (7); interactive whiteboards (6) used for presenting and visualizing complex chemistry or geometry relationships. Considering specific software programs, students reported MS PowerPoint for individual and group projects, allowing them to present and raise public speaking skills (4). Specific software examples include Google Maps in Geography classes, Biology software solution Zygote Body, Khan Academy for self-learning, Duolingo in foreign language classes, Quizlet and Kahoot, along with specific tools for automatic testing of ICT tasks.

The games and gamification techniques are recognized as a substantial part of the best practices (21) covering both traditional and online games in class. Quizzes and online games (such as Kahoot!) are used by language teachers (9), as well in history, biology, mathematics and others, often for short tests and revisions before or after the class. The organized in-class competitions (10), feedback and evaluation techniques (21), allowed students to learn revisions, increased interest in the new topics or created a more relaxed atmosphere, provoking students with funny questions and humor (5).

Among the other best practices, used by the teachers to make their classes more engaging and efficient for the students are: practical experiments in class (17): STEM sciences, writing scientific protocols, work on real-life cases and experiments. Some teachers used to organize outdoor activities (14) such as visits to museums and galleries, short class excursions and trips, but in general, these practices are organized on the school level, requiring more efforts by the school administration.

School Level Best Practices

At the school level are identified about 152 best practices (35%). Conforming to the students' view, schools have to ensure additional opportunities to raise their academic skills and talents. About 35 of the best practices on the school level cover some forms

of clubs, complementary classes for talented students (such as training and preparation for national competitions), or specific extra-curriculum activities such as theatre, art and debates. Other substantial groups of school initiatives cover different types of travelling (28), international excursions, student exchange, short-term student trips, school visits to the theatre and performances, other outdoor activities. Attracting interesting experts, guest lecturers and especially foreign teachers for practicing different languages in class are mentioned in 26 practices. The school infrastructure or access to learning environments and specific digital equipment and technologies are identified in 18 practices. Festivals and school-level celebrations, school-level competitions, and sports events are also part of the good practices, creating lasting memories.

On Table 2 are displayed the clusters of best practices on school level.

Table 2. School level best practices.

Level	Description	Number/ share of best practices (n = 152)
1	School-level clubs, additional classes, trainings	35 (23%)
2	Excursions, outdoor activities, trips, visits	28 (18%)
3	Guest lecturers – alumni, foreign teachers	26 (17%)
4	Infrastructure (ICT, cabinets, classes)	18 (12%)
5	Sports activities	15 (9%)
6	Festivals and school celebrations	12 (8%)

It is worth noticing that the school learning environment and access to class infrastructure mostly include ICT infrastructure (individual PC, tablets, or access to specific equipment such as the robotics lab). Some students remember good practices such as access to classrooms and school learning environments for organizing teamwork, innovative classroom arrangements and decorations such as stickers on the walls (with appropriate formulas), students' choice decoration of the corridors, and appropriate environment for individual work.

Policy Level Best Practices

Many best practices cover general educational practices, adopted on a national level. In many cases, students cannot refer if one practice is organized by the school or by the national-level administration and policy recommendations. However, in this analysis, only 20 best practices can refer to the policy level. These cover mostly practices, related to national competitions and hackathons on different school subjects (Olympiads), compulsory internships in companies, study programs, allowing additional classes and extra curriculum activities, policies for encouraging the best students with national scholarships for academic achievements and others.

4 Discussion

4.1 The Five-Level Model

Considering the five-level model of [16], the best practices are analyzed and distributed according to one or more of the following key groups of criteria: (1) learning environment, (2) learning content, (3) learning processes, (4) focus on students, (5) focus on teachers. First, every practice is assessed following the five categories, considering how students reflect and describe their impact and their influence on the overall learning process. For example, a good practice for learning methods of a specific teacher can cover all of the five criteria: teacher used interactive screens (environment), to make presentations, videos or games (content), organizing discussions and debates (processes), focusing on students' achievement (students) and adapting and personalizing his or her teaching methods upon the results (teacher). Therefore, the presented summary of the five-level model can be reflected as a general overview of best practices' impact. As presented in Table 3, most of the best practices are reflected on the student level (355), where teachers play the dominant role. The learning environment is mainly the responsibility of the schools, along with students' activities concerning additional learning activities, excursions and competitions. On the policy level, best practices are focused on National level competitions and practice-oriented internships, examinations and curricula.

Table 3. Best practices distribution among key categories as of [16].

	Description	Overall n = 436	Teacher n = 264	School n = 152	Policy n = 20
1	Learning environment	74	28	46	0
2	Learning content	330	250	65	15
3	Learning processes	292	212	77	3
4	Focus on students	355	223	114	18
5	Focus on teachers	235	209	22	4

The visualization in Fig. 1 clearly illustrates that teacher-level best practices cover learning content, student-centered activities, learning processes and teaching improvement. At the same time, school-level activities are student-oriented, covering the learning environment and learning processes. The policy-level activities are oriented to students and learning content.

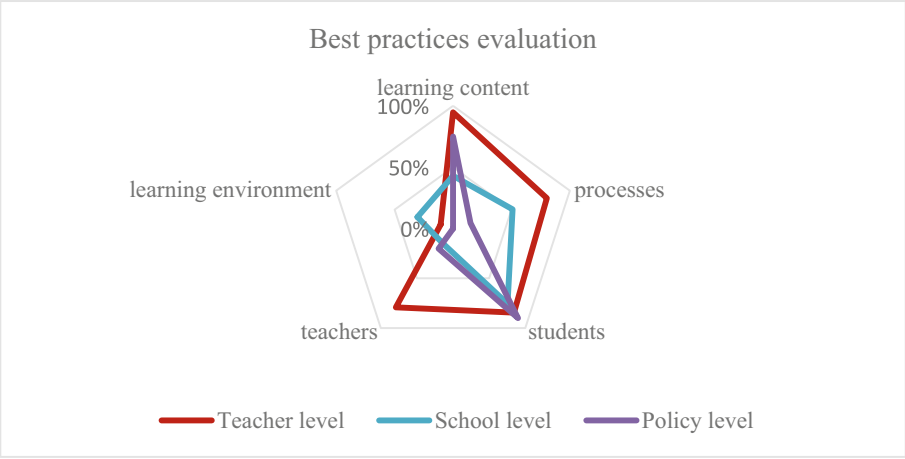

Fig. 1. Best practices evaluation and assessment by categories, following the model of [16].

4.2 Digital Transformation of Schools and Best Practices

The analysis of the best practices clearly demonstrates that students appreciate the best practices on the individual teacher level. Many students directly mention their beloved teachers' names, often speaking with respect and gratitude for people who personally motivated them and worked additionally to support their students' extra-curriculum assignments and academic interests. Students often recognize that their favorite teachers used traditional methods of teaching, making regular tests, imposing strict discipline and presenting always well prepared in class. The best teachers are proud in their profession and make a difference through demonstrating personal commitment, manifesting respect, responsibility and strong discipline in their work. At the same time, the best teachers are encouraging, open to questions and accessible, providing a personalized approach to explain, visualize and present interestingly the learning material. They are used to challenge their students, engage them in numerous activities, put high expectations and raise their confidence and resilience, motivation for self-learning and development.

In this perspective, in the first place, digital transformation in schools should support teachers to operate with more engaging tools and techniques for designing more complex learning experiences. Interactive tools can enable teachers to improve, on the one side, learning content visualization and explanation, and on the another side, to combine the online content with engaging class debates and discussions, personalizing teaching practices to students' level and applying tools for immediate feedback of the student's progress. In the DigiLEAD guidelines materials are specifically described good practices of using innovative teaching and learning methods, emphasizing on the role of both digital and in-presence activities [9]. This way, teachers should focus to design learning experiences through a complex sequence of "phygital" activities, adapting learning content and learning processes in a personalized manner [17].

More specifically, the DigiLEAD guidelines provide practical steps and action plan how school leaders and teachers can promote the use of innovative pedagogies (flipped classroom, IBL, game-based learning), techniques for learning experience

design (learning personalization), competence-based learning, and design of inclusive learning activities, learning materials and assessment models [9].

At the school level, digital transformation concerns school infrastructure, learning and teaching processes, directed to students' personal and academic development. Students mention in many cases the importance of additional classes, clubs and learning competitions, raising their motivation and challenging them to learn more, applying their knowledge in practice, to network and develop soft skills, which are hardly addressed in the school curriculum. Young people clearly evaluate their limits to prepare alone for the new coming challenges. Therefore, they demand better support at the teacher and at school level – additional practice works, robotics clubs and ICT hackathons, guest-lecturers from industry and internships in companies, career counselling services and opportunities for raising skills and competences. In the DigiLEAD guidelines are addressed good practices and specific strategies for dealing with digital infrastructure needs. More resources and focus should be put on building strong communities and managing the needs of the young people to be better prepared for the new coming economy and society [9].

On the policy level, data reveal that digital transformation processes should encourage more initiatives to support new generation of students and young people in schools. It is important to highlight that students are not aware of the efforts and strategies on policy level and how they transform into school-level practices. Learning and training in the digital world require increasing personal involvement, long-term commitment and persistence from teachers and schools. Thus, policy initiatives should reflect strategies and combine different approaches for ensure successful digital transformation in secondary education.

5 Conclusion

The present study discusses good practices identified in primary and secondary education and reflects on the value-creation processes for the learners in schools. The analysis of the best practices proves that a school's digital transformation should mainly focus on students' potential to form skills and competencies in the digital world, building self-confidence and resilience.

The DigiLEAD approach for the digital transformation of schools is aligned with the main findings of the present research and proposes practical guidelines for school leaders and teachers. More importantly, the research outlines that in many cases the policy efforts remain invisible to students, but it should provide the general strategy, plan the directions and digital transformation paths, ensuring the right culture and teacher' engagement for a high-quality future education.

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