Bridging Vocational and Higher Education Through an Integrated Learning Management System: The eBánki Case

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Abstract

The integration of digital technologies at the interface of vocational and higher education has become a key issue in contemporary educational research, particularly in relation to learning continuity and permeability. While Learning Management Systems (LMSs) are widely studied, less attention has been paid to their role as inter-institutional infrastructures supporting curriculum alignment and credit recognition. This study aims to address this gap by presenting a Hungarian good practice within the eBánki project, focusing on how a shared digital platform can function as a boundary infrastructure between educational levels. The research adopts a descriptive case study approach, combining platform usage data with institutional and pedagogical analysis. The novelty of the study lies in examining how joint curriculum development, the recognition of prior learning (up to 30 ECTS credits), and the alignment of learning outcomes are operationalized within a single digital environment. The results indicate that the platform not only supports independent learning and improves learning efficiency, but also enables measurable curriculum harmonization and smoother student transition pathways. Early usage patterns confirm that the system has become embedded in students' learning practices. The study concludes that inter-institutional LMS-based infrastructures can play a strategic role in bridging vocational and higher education. Its theoretical contribution lies in conceptualizing LMS as a boundary infrastructure, while its practical significance is demonstrated through a scalable model supporting flexible learning pathways, credit mobility, and long-term educational cooperation.

Keywords: LMS; vocational training; higher education; blended learning; digital competence development

1. Introduction

Learning Management Systems (LMSs) have become central infrastructures of contemporary education, particularly in contexts where flexibility, accessibility, and continuity between different levels of education are required. LMSs became truly indispensable during the pandemic, when education was forced to transition to online platforms worldwide (Zhang, 2025). As a result, educational institutions and teachers began to adopt digital educational frameworks on a large scale, bringing with it both significant opportunities and complex challenges (Zhang, 2025; Dhawan, 2020). Beyond emergency remote teaching, these systems have since evolved into strategic tools for pedagogical innovation, institutional cooperation, and the reconfiguration of learning pathways.

In this context, the present study introduces a descriptive case study of an institutional good practice that demonstrates how a digitally supported collaboration between a technical school and a university can enhance educational continuity. The focus of the analysis is the eBánki platform, which is not only a shared LMS environment but also a structured framework for inter-institutional cooperation. The initiative is built on several key pillars: joint curriculum development, the alignment of technical and higher education learning outcomes, and the formal recognition of prior learning, including the possibility of credit transfer up to 30 ECTS. These elements together create a coherent system in which learning pathways become more transparent, flexible, and permeable for students.

A distinctive feature of the model lies in its integrative approach to curriculum design and pedagogical coordination. The jointly developed learning materials are not only aligned with vocational training output requirements but are also deliberately structured to meet higher education expectations. This alignment enables a smoother transition between educational levels and reduces redundancy in learning processes. At the same time, the system supports independent learning and continuous feedback, thereby strengthening students' preparedness for university studies.

Importantly, the platform can be interpreted as an infrastructure of learning permeability. Rather than functioning solely as a technological solution, it operates as a boundary infrastructure between vocational education and higher education, embedding institutional cooperation into everyday pedagogical practice. Through this integrative role, the platform supports curriculum harmonization, credit recognition, and the tracking of learning outcomes, while also enabling the pedagogical management of student transitions across institutional contexts.

The aim of the study is therefore to present the possibilities and benefits of digitally connecting technical school and university education through this Hungarian good practice. As a theoretical background, we discuss key dimensions of LMS-based educational integration, including digital competence development, generational differences, blended learning, edutainment, and gamification, as well as the evolving role of teachers at the interface of vocational and higher education. We argue that strengthening technical school training and fostering close cooperation with a university significantly contributes to students' willingness to continue their studies, while also providing a solid foundation for successful progression into higher education.

Within this framework, the study seeks to understand how an inter-institutional LMS can operate as a transitional infrastructure between vocational training and higher education, and through which organizational and pedagogical mechanisms it is able to support curriculum alignment, credit recognition, and the development of independent learning practices. At the same time, particular attention is paid to early usage patterns that may indicate whether the platform has become embedded in students' everyday learning activities. In this sense, the analysis not only describes a functioning model, but also reflects on the conditions under which such a system can meaningfully contribute to educational permeability and continuity.

2. Theoretical Background

2.1. Integration of LMS systems in education

Learning management systems (LMSs) have become essential infrastructural elements in education, encompassing both secondary vocational education and higher education. Their role extends beyond the mere storage of educational materials, as they provide interactive interfaces, communication tools, and learning analytics functions that can help improve the effectiveness of teaching and learning [Munisamy et al., (2025)]. The literature highlights that the successful implementation and use of LMSs depends largely on institutional readiness, infrastructure, and the attitudes and digital literacy of users – teachers and students [Zhang , K. (2025), Munisamy et al., (2025)]. In their comprehensive literature review, Munisamy et al. point out that although the use of LMSs is widespread in both vocational and higher education, problems with pedagogical fit and practical skills development are common in the vocational context. For example, some studies suggest that LMS integrated into hybrid (online and practical) training can enhance student engagement and facilitate curriculum customization; however, online platforms may face limitations in teaching purely practical skills [Hu, Z., Chang, YF, & Ho, MK (2024), Munisamy et al., (2025)]. The COVID-19 transition has also highlighted the fact that many institutions were not infrastructurally prepared for full online education: the lack of stable internet connectivity and the digital literacy gaps of teachers and students worldwide have made it difficult to use LMSs effectively (Somabut et al., 2025, cited by [Munisamy et al., (2025)]. Even in technologically advanced environments, users have experienced dissatisfaction with certain features of LMSs – such as limited interaction options, opaque interfaces, or delayed feedback – which has led them to seek alternative solutions (Simon et al., 2025; Mohammed et al., 2025, cited by [Munisamy et al., (2025)]. All this highlights that the integration of LMSs is not just a technical implementation, but also requires a pedagogical paradigm shift. Researchers emphasize that the effectiveness of LMS use depends on how well it is aligned with pedagogical methods and supported by appropriate training for teachers (Desai & Patwardhan, 2025, cited in [Munisamy et al., (2025)]. Overall, the appropriate use of LMSs can significantly improve the quality of education and student engagement, provided that institutions provide the necessary infrastructural and training conditions [Zhang , K. (2025), Munisamy et al., (2025)].

However, beyond their institutional use, LMS platforms are increasingly interpreted as inter-institutional infrastructures that can support curriculum alignment and learning permeability across educational levels.

2.2. Digital competence development

Digital competence has become a fundamental requirement for both students and teachers. Digital competence development is understood as the set of skills and knowledge that enable the confident, critical, and creative use of technologies [Cattaneo et al. (2022)]. This is particularly important at the interface between vocational education and higher education, as students need to be able to adapt to a rapidly digitalizing world, not only in school but also in the workplace. For example, the European Union's DigCompEdu framework defines 12 sub-areas of teachers' digital competence, ranging from managing digital resources to supporting students digitally. However, research shows that the digital preparedness of teachers working in vocational education has been little studied, and its importance is often underestimated [Diao , J.-F., & Yang , J. (2021)]. In a recent study, [Cattaneo et al. (2022)] demonstrated that the digital competence of teachers in vocational education varies significantly; several factors, such as age, prior industry experience, and technological attitudes, influence the extent to which teachers utilize digital tools. It has been found that the frequency of use of digital tools and a positive attitude towards technology play a crucial role in the development of teachers' digital competence. This suggests that the technopedagogical skills of future teachers should be developed from an early stage of teacher education [De Clercq et al. (2022)]. Additionally, an institutional strategic approach is crucial. According to Zhong and Juwaheer [Zhong , Z., & Juwaheer, S. (2024)], the development of digital competence should be approached from a comprehensive institutional perspective, involving the institution's leadership, teachers, and students. This means that it is not enough to focus solely on the skills of students; it is equally important to develop the digital competence of leaders and teachers at the institutional level. The COVID-19 pandemic has also highlighted the urgent need to address the gaps in teachers' technological and pedagogical knowledge: the sudden shift to distance learning has shown how great the need is for teachers to be trained in the use of digital tools, online and hybrid teaching methods [Coulombe et al. (2022)]. Since teachers' digital competence has a direct impact on students' digital skills, the literature agrees that comprehensive measures are needed to support competence development, including regular training, mentoring programs, and the sharing of good practices [Tondeur et al. (2017), Spante et al. (2018)].

The picture is similarly mixed when it comes to students’ digital competence. It is often assumed that today’s young generation, referred to as the “digital natives” [Prensky , M. (2001)], already possesses a high level of digital skills. However, research nuances this picture: although young people confidently use social media or entertainment applications, this does not mean that they have adequate information management, digital communication, or data security skills [Bennett et al. (2008), Ng , W. (2012)]. Ng points out that digital literacy – such as critical evaluation of information, productive digital content production – also needs to be learned by “digital natives”. Similarly, according to a comprehensive literature re-view by Spante et al. [Spante et al. (2018)], although there are many interpretations of the concept of digital competence, no generation is innately equipped with these skills; Formal education plays a key role in the purposeful development of digital competencies. This is especially true in vocational training, where digital competence is often interpreted in a professional context (e.g., the use of specialized software, industrial technologies).

In transitional contexts between vocational and higher education, digital competence becomes a key enabling factor for successful learning progression and adaptation to different academic expectations.

2.3. Generational differences in digital education

When examining the use of educational technologies, the issue of generational differences is often raised. According to popular belief, older teachers and even older students (e.g. in adult education) are less open or confident in using digital tools, while younger generations – Generation Y, Z and Alpha – are already “digital natives” and the online space is a natural environment for them [Prensky , M. (2001)]. However, research shows that generational differences are more complex. Bennett et al. [Bennett et al. (2008)] argue in a critical review that the belief in the homogenous proficiency of the “digital generation” is not sufficiently empirically supported; the digital skills and learning preferences of young people are very diverse, and individual interests, learning environment, and socio-economic background are often more important factors than age. A study of university students by Jones et al. [Jones et al. (2010)] also found that there is no sharp divide between the “net generation” and their predecessors in the way they use technology in learning; students have diverse attitudes towards e- learning , and many “digital immigrants” are also able to use the new tools at a high level.

As for teachers, several surveys show that older teachers are generally more un-certain about using technology and are more likely to worry about making a mistake [Culp -Roche et al. (2020)]. Culp-Roche et al. found in an American survey that Baby Boomer and Generation X educators had significantly lower comfort levels and higher levels of techno-logical anxiety regarding educational technology compared to their younger colleagues. However, the study also showed that these differences can be reduced with the right training and a supportive environment. Kirschner and De Bruyckere [Kirschner , PA, & De Bruyckere, P. (2017)] called the digital native concept a myth: they pointed out that just because someone was born after 1980 or 2000 does not make them digitally literate – everyone needs to consciously develop skills, and the ability to multitask is often overestimated in young people [Sanbonmatsu et al. (2013), Monsell , S. (2003)]. According to Kirschner and De Bruyckere, those involved in education – whether students or teachers – are more like digital immigrants who need to continuously learn how to use new technologies effectively, regardless of the generation to which they belong.

This is not to say that there are no typical differences. Today’s young learners have shorter attention spans during traditional lectures, but they are highly responsive to visual stimuli, interactivity, and rapid information retrieval [Prensky , M. (2001)]. For them, mobility and instant access are essential; an LMS or any learning platform is successful in their environment if it is mobile-friendly and information is immediately accessible [Bennett et al. (2008)]. Older generations, such as professionals in adult education, typically require different learning strategies. They value flexible scheduling, support for learning while working, and often appreciate personal tutoring or detailed instructions on how to use technology [Jones et al.(2010)]. Overall, taking generational differences into account can help tailor educational technology, but overgeneralizations are dangerous. There are both digital pioneers and laggards in every age group; therefore, educational strategies should adopt a diverse and flexible approach [Bennett et al. (2008), Kirschner , PA, & De Bruyckere, P. (2017)]. At the interface between vocational education and higher education, where practitioners may further their education in a university setting, particularly heterogeneous groups may emerge in terms of digital literacy. In response, educational institutions should support individual needs: for example, offering foundation courses for those who are less confident and advanced digital tasks for those who are more experienced.

2.4. Blended learning

Blended learning, or the combination of online and face-to-face education models, has become one of the most promising development directions in education over the last two decades. Its essence lies in combining traditional classroom sessions with online learning elements, thereby optimally utilizing the advantages of both forms [Bernard et al. (2014). The application of blended learning is particularly relevant at the border between vocational training and higher education. Due to the practice-oriented nature of vocational training, it requires personal presence and practical classes, whereas the theoretical content common in higher education can also be easily transmitted online.

Garrison and Kanuka [Garrison , DR, & Kanuka, H. (2004)] have demonstrated early on that blended learning, when used appropriately, has transformative potential in higher education – that is, it can create a fundamentally new synthesis of interactive and collaborative learning. The model enables the delivery of factual material and basic knowledge online (e.g., in the form of video lectures, e-learning modules), while valuable face-to-face time can be utilized for the development of higher-order skills, discussion, and problem-solving [Garrison , DR, & Kanuka, H. (2004)]. According to a meta-analysis by Bernard et al., blended learning approaches are, on average, more effective in improving student performance than purely traditional or purely online methods, provided they are well-designed. The reason for this is that the blended model offers both flexibility and structured support: students can learn online materials at their own pace, but at the same time, they are not isolated because in-person (or synchronous online) sessions provide community learning opportunities.

In vocational education, a particular advantage of blended learning is that it bridges the gap between school and workplace learning. For example, in technical vocational education, students can independently process theoretical material and simulations via an LMS and then apply what they have learned in practice in a school workshop. Hu and colleagues [Hu et al. (2024)] examined the effectiveness of physical-only, online-only, and blended training in a Chinese higher vocational education. According to their results, blended learning proved to be the most popular and effective among students: respondents considered this method to combine the best of both worlds. Interestingly, Hu et al. also pointed out that for certain functional skills (e.g. tasks requiring two-handed practice), students still found traditional, physical education to be the most effective, while few considered the purely online format to be ideal for skill development. This suggests that designing the right proportions of the blended model is crucial; careful consideration should be given to which elements can be effectively brought online and which should be kept in-person. Boelens et al. [Boelens et al. (2017)] identified four main challenges in designing blended learning: (1) providing flexibility for learners, (2) encouraging interaction both online and offline, (3) monitoring and supporting learning processes, and (4) maintaining learner motivation. If these challenges are addressed – for example, by utilizing appropriate LMS tools for communication, maintaining a clear schedule, and providing regular feedback – blended learning can significantly enhance effectiveness and satisfaction.

During the pandemic-forced online experiment, many institutions have gained experience with blended solutions. Zhang pointed out that in the future, the ex-tended use of digital platforms alongside traditional education is expected to become the norm in higher education – this represents a new level of blended learning, where classroom and online activities work in full synergy. Hybrid training programs are also increasingly appearing in vocational training, such as dual training, where the student's workplace practice is supplemented by e-learning content. According to most research, blended learning is not a panacea; however, when implemented effectively, it is an effective and student-friendly solution that meets the needs of 21st-century learners [Bernard et al. (2014), Boelens et al. (2017), and Hu et al. (2024)].

2.5. The changing role of the teacher in the digital age

The rise of digital technologies in education is not only transforming the student experience but also radically transforming the role of the teacher. In the traditional view, the teacher was the primary source of knowledge (sage on the stage), but in the digital age, it is increasingly becoming a facilitator of the learning process (guide on the side) [Baran et al. (2011)]. This role change can be observed in several dimensions.

First, the teacher's role is now less about simply communicating facts, as students can look up information in online sources at any time. Instead, the pedagogical competence of the teacher to guide and support students' independent knowledge acquisition, critical thinking, and information processing is becoming more valued [Mishra et al. (2006)]. Siemens'[Siemens, G. (2005)] connectivist learning theory explicitly emphasizes that knowledge now largely lies in networks and connections; the teacher's task is to help students navigate this networked wealth of knowledge, connect relevant sources, and develop their own knowledge network. In this model, the teacher serves as a curator or mentor, selecting reliable learning materials (e.g., recommending e-learning modules, videos, articles) and providing individual feedback and advice to help students progress.

Second, in the digital age, teachers need new technical and didactic skills. According to the Technology-Pedagogical-Content Knowledge (TPACK) framework [Mishra et al. (2006)], effective teaching requires teachers to combine their subject knowledge with pedagogical methodology and knowledge of technological tools. This means that teachers need to know which tools to use when and how. For example, when to use an online discussion forum to develop critical thinking, or how to use simulation software to illustrate a given professional problem. Baran et al. identified several new teacher roles in their literature review in the online space: the teacher as content developer (who creates or customizes digital learning materials), as moderator (who leads online discussions, intervenes in cases of conflict, and encourages students), as technical helper (often the teacher must also be the first to resolve students' technical problems), and as evaluator (who evaluates online activity, forum posts, and e-portfolios, not just closed spaces). These roles add to the traditional mentoring and knowledge transfer roles, which makes the teacher's work more complex overall.

Thirdly, the change in the teacher's role also affects the power relations between the teacher and the student. The combined effect of constructive pedagogical paradigms and digital tools is increasingly focusing on the cooperative teacher-student relation-ship, where the teacher is not the repository of all knowledge, but a partner in discovery [Bates, AW (2015)]. For example, during project-based and problem-based learning, the teacher often facilitates group work, provides guidance, but lets the students find solutions them-selves, even using online resources. In vocational training, this can be manifested in the master instructor not only demonstrating the technique but also directing the student to digital learning materials and reflecting on what they have seen together, or involving the student in the assessment process (such as self-assessment or peer assessment using online tools).

Digitalization has also underscored the importance of teachers becoming lifelong learners. Technology is constantly evolving, with new platforms and software emerging, and teachers must continually develop their skills to stay up-to-date. Innovative pedagogical practices often start with grassroots initiatives – for example, a teacher trying out a new gamification tool – and then spread at the institutional level. However, this requires openness and a willingness to experiment on the part of the teacher. Research indicates that teachers’ attitudes towards technology and their sense of self-efficacy are crucial to the extent to which they integrate digital tools into their teaching [Spante et al. (2018), Kirschner , PA, & De Bruyckere, P. (2017)]. Developing a positive attitude and innovative skills in teacher education and in-service training is essential, as is the creation of supportive professional communities where teachers can share their experiences [Prestridge , S. (2017)].

Finally, the changing role of the teacher is also worth highlighting in the context of the transition between vocational training and higher education. Teachers teaching in technical schools often have different qualifications, typically professionals with industrial experience who may not have received comprehensive pedagogical and digital methodological training. Teachers teaching in higher education are often more strongly tied to their research profile than to pedagogical innovations. As a result, transforming the role of teachers in programs in the border area presents a special challenge. In successful integrated programs, teachers work as part of an interdisciplinary team: methodological experts, technological supporters (e.g. e-learning specialists) help them digitize content and redesign teaching [Zhong , Z., & Juwaheer, S. (2024)]. The teacher thus becomes part of a learner-centered, collaborative ecosystem, rather than a solitary knowledge holder. This may, of course, involve giving up some control, which can be stressful if the teacher fears losing authority due to automated systems or online content. However, there is a consensus among researchers that the role of the teacher remains irreplaceable, but is changing: even in the digital age, there is a need for human support, guidance, and inspiration, which a good teacher can provide [Baran et al. (2011), Kirschner , PA, & De Bruyckere, P. (2017)]. Moreover, in the age of information abundance and AI-based tools, the expertise with which teachers help students critically evaluate knowledge and become ethical users is perhaps even more important.

In summary, the changing role of the teacher necessitates that educators continually reflect on their own practice, learn about new tools, and dare to experiment with teaching methods. This holds particularly exciting opportunities at the interface be-tween vocational training and higher education, and the key to success is for teachers to combine digital innovations with pedagogical wisdom to create real learning value [Siemens, G. (2005), Zhong , Z., & Juwaheer, S. (2024)].

Based on the reviewed literature, it is evident that the integration of digital technologies is bringing about significant changes in the fields of vocational training and higher education. Effective educational integration of LMS systems is crucial: with appropriate institutional support and pedagogical alignment, LMSs can increase student engagement, provide a tailored learning experience, and provide learning data that help ensure the quality of education. At the same time, infrastructure deficiencies and differences in digital literacy can hinder potential, which is why developing digital competence among both teachers and students is essential. These competences are not given to digital natives as a matter of course, but can be developed through consistent development work, training, and a supportive environment.

3. Context

In Hungary, the new structure introduced by Act LXXX of 2019 on vocational training features certified technician training as a prominent and advanced segment of the technical school offer, with the fundamental basis being the structural and content integration between secondary vocational training and higher education. The legal framework of this training form explicitly stipulates formalized, strategic cooperation between the vocational training institution (or center) and a partner higher education institution. This cooperation goes beyond declarative partnership; it includes the joint curriculum development of training programs (especially vocational education), the coordination of curriculum content, and the possible mutual use of teaching human resources, thereby ensuring that the output competences of technical school training are vertically aligned with the curriculum of the relevant university undergraduate programs.

Facilitating an effective transition to higher education is achieved through rigorous subject-specific validation of acquired knowledge and competencies, a process known as prior learning recognition, which is based on the principles of higher education legislation. Thanks to the jointly developed and accredited curricula, for students who obtain a certified technician qualification, the partner university, within the framework of a preliminary credit recognition procedure, credits the professional content acquired during the technical training with higher-level relevance in the form of a certain number of credit points to the corresponding undergraduate degree (BSc / BA). This knowledge crediting mechanism not only eliminates redundant knowledge transfer but also enables a significant reduction in the time required for higher education studies, thereby ensuring a more efficient and permeable academic life path for those entering higher education from vocational training.

Taking advantage of this opportunity, within the framework of the strategic co-operation between Dunaújváros University and the Dunaújváros University Bánki Donát Technical School operating under its management, the university made the certified technician training available to students of the Informatics and Telecommunications and Mechanical Engineering departments, in which, upon successful admission, the university automatically credits 30 credits upon mastering the advanced professional content, thus shortening the basic training.

To support this process, the university created the eBánki project, within the framework of which, in addition to the exchange of lecturers, the university and the technical school lecturers jointly developed 26 pieces of polymedia (an educational platform that explains the content of the course material in short videos and offers an interactive interface) based online curriculum, which offers advanced content to students studying at the technical school and undergoing certified technician training.

This institutional configuration provides a unique empirical setting in which curriculum alignment, credit recognition, and digital learning infrastructure are simultaneously implemented and can be analysed as an integrated system.

3.1. Details of key elements of the project

eBánki is the Bánki Donát Technikum's own, integrated online learning support system (LMS), designed to facilitate communication between students and instructors, share learning materials, and streamline administrative processes. Its functions are similar to those of a Moodle-based or KRÉTA-supplementary platform, but customized to incorporate institutional developments.

Main functions and features

- Access to teaching materials and lesson plans: subject modules, presentations, worksheets, videos.
- Digital assignment submission: documentation of homework, project assignments, oral and practical reports.
- Individual and group assessment: scores, rubrics, competency-based feed-back.
- Communication channels: teacher-student messaging, notifications, assignment reminders.
- Support for project-based learning: electronic portfolios, project interfaces, submission workflow.
- Connection to the KRÉTA system: merging of logging and attendance data, tickets, and administrative information.

In summary, E-Bánki is a digital learning support system that is a defining element of the educational practice at the Bánki Donát Technical School. It creates the digital infrastructure of the learning environment in line with the quality requirements of 21st-century vocational training. The platform primarily supports the application of a learning outcome-based approach: it enables continuous, transparent documentation of students' progress, while at the same time providing pedagogical tools (assignment of assignments, modular curriculum, project portfolio) that make students active, constructive participants in their own learning process. Digital tracking is suitable for level-based measurement of competencies and for supporting formative assessment, which is of particular pedagogical importance in the new structure of vocational training, especially in practice-oriented subjects that prepare students for the qualifying exam.

The system also strongly supports project-based and dual learning forms, which are among the strategic goals of the 2019 vocational education reform. Through digital portfolios, students can create, display, and archive complex works that reflect re-al-world problems; this is especially important in certified technician programs, where the coordination and validation of technical school and higher education learning out-comes require the traceability of student performance. E-Bánki is thus an integrated learning space that simultaneously serves differentiated education, personalized development, and the professional foundations of higher education credit transfer. Based on all this, the platform is a key player in the digital ecosystem of the technical school and has become an indispensable pedagogical infrastructure for modern, competency-based vocational training in the institution. In this sense, the platform functions not only as a pedagogical support system, but as an operational infrastructure of learning permeability between vocational and higher education.

In addition to platform development, complex subject content development was also carried out, as previously mentioned. These teaching materials serve the interoperability between the university and the technical school. The online teaching materials are based on the basic training profile of the technical school, with a special focus on advanced subjects in the fields of mechanical engineering, IT, and management, as well as nuclear and carbon-free energy knowledge. The developed areas are organized into the following main categories:

1. Mechanical engineering subjects (Materials and manufacturing technology, Technical representation, Technical measurement, Mechanics, Machine elements, etc.) – These subjects form the traditional backbone of technician training. Digital curriculum development builds on visual explanations, interactive modeling, and application-focused tasks, which help students understand abstract technical concepts and solve problems independently.

2. IT and programming subjects (Programming Fundamentals, Web Programming, Frontend Programming, Database Management, IT and Telecommunications Fundamentals) – The developments here strengthen the practical orientation, with the integration of code experiments, online development environments, task banks, and sample projects. This increases student activity and fits the competence expectations of Industry 4.0.

3. Business and Management subjects (Communication, Economic and Legal Knowledge, Basic Business Knowledge, Digital Applications) – Content development is one of the key competencies, especially in the field of software. It focuses on developing skills and entrepreneurial competencies. The digital platform supports simulations, situational tasks, case studies, and conscious career guidance modules.

4. Nuclear and carbon-free energy supplementary curriculum (Nuclear energy production, Nuclear power plant maintenance, Environmental protection, Electricity systems) – These contents uniquely provide foundational knowledge at the technical school level that can be directly linked to the related BSc training at DUE. This is crucial for validation, as it enables students to have relevant pre-qualifications in higher education.

The system and the teaching materials were handed over and introduced to the technical school in September 2024. The primary focus of use was for grades 11, 12, and 13. Following the test mode of the first year, the technical school is already using the platform live this year. Based on feedback from the past two years and statistics extracted from the system, it can be said that the use of the eBánki system is stable, widespread, and varies in intensity per subject. The access numbers indicate that technical and IT subjects generate the highest load, which aligns with the structure of technical school training. Particularly high activity can be observed, for example, in the Mechanics I. and Web Programming modules (80+ accesses each), which are good indicators that students are actively using the digital teaching materials related to the subject. These high values indicate that students are not just working in the system occasionally, but regularly and thematically.

Subjects in the middle range – such as CNC programming basics – are specialized areas where students participate in smaller numbers, but the intensity of use is still relatively high. Access patterns suggest that in the case of professional subjects, students use the platform as a substitute and additional function: to make up for missing class notes, retrieve practice tasks, and prepare for exams.

4. Findings

The findings of the case study confirm that the eBánki system operates as more than a digital learning platform: it functions as an embedded pedagogical and institutional infrastructure supporting learning permeability.

1. Significant and sustained learning activity

In particularly high-achieving subjects, the practice of weekly content uploads has proven to be effective: students not only access but actively engage with the uploaded materials. This continuous interaction indicates that the platform supports formative assessment processes and enables the structuring of individualized learning pathways. The regularity of access further suggests that the system has become integrated into students' weekly learning routines, rather than functioning as an occasional supplementary resource.

2. Effective support for independent learning

The high number of accesses demonstrates that the platform operates not merely as a repository, but as an embedded pedagogical environment. Students rely on it for preparation, practice, and knowledge consolidation, particularly in complex technical and IT-related subjects where iterative learning is essential. This confirms that the LMS contributes to the development of self-regulated learning, aligning with one of the core pedagogical objectives of both vocational and higher education.

3. Subject-dependent but structurally stable usage patterns

Usage statistics reveal that system activity is driven primarily by subjects with a high number of contact hours, substantial theoretical content, and a strong need for practice-oriented learning. In these areas, the digital task banks and structured learning materials provide clear added value. At the same time, the overall pattern of use remains stable across the system, indicating that engagement is not random but linked to well-defined curricular and pedagogical demands.

4. The system enables monitoring of learning outcomes and progression

Access data show a balanced and continuous usage pattern throughout the academic year, suggesting that students engage with the platform consistently rather than episodically. This provides a basis for tracking learning progress and indirectly validating learning outcomes. The system therefore supports not only content delivery but also the monitoring of student development, which is essential for aligning vocational and higher education expectations.

5. Contribution to curriculum alignment and credit recognition

Beyond usage patterns, an important finding is that the platform supports the harmonization of technical and university-level curricula through jointly developed learning materials. This alignment creates the conditions for the formal recognition of prior learning, including the structured accreditation of up to 30 ECTS credits. The LMS thus functions as an operational tool for implementing credit transfer, reducing redundancy in learning and facilitating smoother transitions between educational levels.

6. The emergence of a boundary infrastructure for learning pathways

Taken together, the results indicate that the system functions as more than a technological solution: it operates as a boundary infrastructure between vocational education and higher education. By integrating curriculum alignment, learning outcome tracking, and credit recognition within a single digital environment, the platform enables the pedagogical management of learning transitions. This positions the LMS as a key mechanism in supporting educational permeability, institutional cooperation, and long-term student mobility.

5. Discussion

Based on the statistics, it can be said that E-Bánki functions as a real learning environment among the students of the Bánki Donát Technical School. The high-achieving subjects confirm that the teaching materials are relevant, and the platform provides real added value to the students in preparation, practice, and systematization of knowledge. The introduction of the system is therefore not only a technological innovation, but also a development with measurable pedagogical results: it supports independent learning, reduces student lag, and increases the efficiency of mastering professional subjects.

Overall, E-Bánki is not just a digital platform, but a profound pedagogical modernization of technician and certified technician training. The developed subject content aligns with the Training Output Requirements of vocational training, while also providing a transition to higher education studies, laying the foundation for credit recognition and the flexible shaping of learning paths. The system, with its pedagogical functions supporting student activity, high-quality content development, and structured cooperation with DUE, creates an innovative educational ecosystem that can respond to the region's long-term vocational training and economic needs.

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