Digital Student Identity Systems and Sustainable Governance in Higher Education: An Empirical Study Using the Technology Acceptance Model

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Digital identity systems are becoming an important component of higher education institutions' digital transformation, enabling more efficient administrative processes and improved access to campus services. This study examines students' acceptance of digital student identification cards using the Technology Acceptance Model (TAM). An extended TAM framework incorporating trust in system security was applied to analyse the relationships between perceived usefulness, perceived ease of use, attitude toward use, behavioural intention, and trust. Empirical data were collected through a survey of students enrolled at three Slovenian universities. Factor analysis revealed that perceived usefulness consists of two dimensions: administrative functions and student services. Regression analysis showed that perceived ease of use and the perceived usefulness of administrative functions significantly influence students' attitudes toward digital student identification cards. Trust in system security also positively affects the perceived usefulness of administrative functions. The study contributes to understanding the role of digital identity systems within the digital transformation of higher education institutions.

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1 Introduction

Digital transformation has become a central driver of change in contemporary organisations and institutions. These developments are increasingly linked with broader sustainability objectives, particularly within the framework of environmental, social, and governance (ESG) principles. Organisations are therefore expected not only to adopt digital technologies but also to ensure that digital innovation contributes to more sustainable, efficient, and transparent organisational processes (Vial, 2019).

Higher education institutions are no exception to these developments. Universities are increasingly integrating digital technologies into administrative, educational, and service processes to improve institutional efficiency and enhance the student experience. Digital transformation in higher education is increasingly viewed as an important mechanism for supporting sustainable institutional governance. Digital solutions may contribute to environmental sustainability by reducing consumption of physical resources, while simultaneously supporting social inclusion through improved service accessibility and strengthening governance transparency through more reliable, traceable digital processes.

Within this broader context, digital student identity systems represent an important component of modern universities' digital infrastructure. Among these solutions, digital student identification cards have emerged as a key tool for secure identification, access management, and the integration of various student services within the digital campus environment. In contrast to traditional physical student identification cards, digital solutions offer greater flexibility, integration with mobile devices, and the ability to update student information dynamically. At the same time, digital credentials may enable more efficient service delivery and reduce the administrative burden of issuing and managing physical cards. Furthermore, they reduce material consumption and plastic waste while enabling more transparent, traceable, and accountable institutional processes, thereby supporting the broader sustainability objectives of higher education institutions.

The development of digital student identification systems is also closely linked to broader European initiatives to advance the digital transformation of higher education. One of the most important initiatives in this context is the European

Student Card Initiative, which aims to simplify administrative procedures for student mobility and enable more efficient digital student identification across European higher education institutions (European Commission, 2024a). By integrating digital identification infrastructures, these initiatives contribute to creating a more interconnected and digitally supported European higher education ecosystem.

Despite the technological maturity and potential benefits of digital student identification cards, their successful implementation depends not only on technological capabilities but also on user acceptance. The adoption and effective use of digital systems largely depend on users' willingness to accept and actively use the technology. Even technologically advanced systems may face limited adoption if users perceive them as difficult to use, insufficiently useful, or potentially insecure.

Understanding the determinants of technology acceptance has therefore become an important area of research in information systems. One of the most widely applied theoretical frameworks for explaining user acceptance of information technology is the Technology Acceptance Model (TAM), which proposes that users' behavioural intentions to adopt a technology are primarily influenced by their perceptions of the system's usefulness and ease of use (Davis, 1989). Subsequent research has extended the model by incorporating additional factors that may influence technology adoption, such as trust in system security or institutional context (Venkatesh & Davis, 2000).

However, a limitation of existing TAM literature is its predominant focus on voluntary usage contexts, such as e-mail or basic office software (Sternad Zabukovšek & Samo, 2023). In such settings, users have the discretion to reject a technology they find difficult or unhelpful. In contrast, digital student identification cards often represent a mandatory technological shift within university digital infrastructures. Academic research suggests that in mandatory environments, the traditional dynamics of technology acceptance are significantly altered. For instance, while perceived ease of use (PEOU) is a hallmark of voluntary adoption, it may become statistically non-significant in mandatory settings, as users are required to utilise the system to perform essential tasks regardless of its perceived complexity (Sternad Zabukovšek & Samo, 2023).

Despite the fact that TAM has been widely applied in studies examining the adoption of various digital technologies, empirical research on students' acceptance of mandatory digital identification cards in higher education remains limited. In particular, there is a lack of empirical studies examining how students perceive the usefulness, usability, and security of digital student identification systems within university digital infrastructures where usage is not optional. This represents an important research gap, especially considering the growing role of digital identity systems in university governance and digital campus environments. This study addresses this gap by examining students' acceptance within a mandatory institutional framework, thereby providing academic added value beyond a standard context-application of TAM. It investigates how traditional acceptance constructs behave when technology becomes a prerequisite for participation in the university ecosystem, specifically testing if factors like perceived ease of use remain significant when users have no discretion to reject the system.

Building on this research gap, this study aims to examine the factors influencing students' acceptance of digital student identification cards using selected TAM constructs. In particular, the study investigates how perceived usefulness and perceived ease of use influence students' attitudes toward the use of digital student identification cards and their behavioural intention to use them. In addition, the study incorporates trust in the security of the digital student identification card as an additional factor that may influence students' perceptions of the system.

The empirical analysis is based on survey data collected from students at Slovenian universities (Hajdenkumer, 2025). By examining the determinants of students' acceptance of digital student identification cards, the study contributes to a better understanding of how digital identity systems may support the digital transformation and sustainable governance of higher education institutions.

The remainder of the paper is structured as follows. The next section presents the theoretical background and literature review on digital student identity systems and the Technology Acceptance Model. The description of the research methodology and empirical analysis follows this. The subsequent section discusses the study's results, and the final section presents the main conclusions, limitations, and directions for future research.

2 Theoretical background

2.1 Student identification systems in higher education

Student identification systems are an essential component of the administrative and service infrastructure within higher education institutions. Universities rely on identification systems to verify students' identities and academic status, and to enable secure access to various institutional services and facilities. These systems support the efficient management of student records, access rights, and service provision within increasingly digitalised campus environments.

Traditionally, student identification systems have been implemented through physical student identification cards that function as official institutional credentials (University of Maribor, 2013). Over time, these systems have evolved from simple identification tools into multifunctional platforms that support a wide range of academic, administrative, and service-related functions. As higher education institutions continue to integrate digital technologies into their operations, student identification systems are becoming increasingly important components of modern universities' broader digital infrastructure.

Student identification cards primarily serve as official credentials that confirm a student's identity and enrollment status within a higher education institution (University of Maribor, 2013). In their basic form, such cards contain key personal and institutional information, including the student's name, student identification number, photograph, and the issuing university's name (Ludwig-Maximilians-Universität München, 2025), as shown in Figure 1.

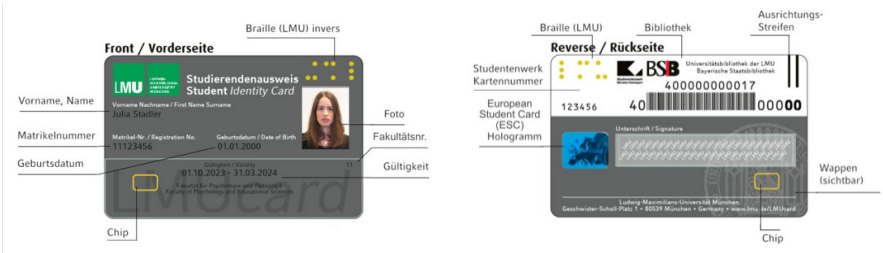

Figure 1: Student identification card of the Ludwig-Maximilians-Universität München
Source: (Ludwig-Maximilians-Universität München, 2025).

In addition to their identification function, student identification cards are widely used to enable access to various university services and facilities. These may include entry to lecture halls, laboratories, libraries, and other campus buildings (Maribor University Library, 2025). Student identification cards may also be used for administrative and service purposes, such as borrowing library materials, accessing study rooms, recording attendance, or verifying eligibility for student benefits, as shown in Figure 2.

Figure 2: Student identification card of the University of Maribor
Source: (University of Maribor, 2013).

Many universities also integrate additional functionalities into their identification systems, enabling student cards to serve as authentication tools within institutional information systems. For example, student identification cards may be used for subsidised student meal systems, cashless payments in campus cafeterias, printing and copying services, or access to public transportation schemes associated with student mobility programs (Bajić & Orel, 2025). Due to these diverse functionalities, student identification cards represent an important operational element of the administrative and service infrastructure of higher education institutions.

As universities increasingly adopt integrated digital infrastructures, student identification systems are becoming part of broader digital campus ecosystems that connect physical access control, administrative systems, and digital services into a unified identification environment. In such environments, a single student credential can enable access to multiple institutional services, thereby improving service delivery efficiency and supporting more coordinated management of campus processes.

From a technological perspective, student identification systems have evolved significantly over time, reflecting broader developments in identification technologies and digital campus infrastructures. Early versions of student identification cards were primarily designed as simple visual identification documents containing basic personal information and photographs. Verification was therefore limited to manual inspection, and such cards did not support integration with digital systems (Loechel, Alves, & Persson, 2022).

Subsequent technological developments introduced cards with machine-readable elements, such as barcodes or QR codes. These technologies enable automated identification through optical scanning and allow the integration of identification cards with certain institutional services. Although such solutions represent a technological improvement compared with purely visual identification cards, their interoperability and functional flexibility remain limited.

More advanced solutions include identification cards equipped with embedded chips that enable electronic authentication through specialised card readers. Chip-based cards support a broader range of services, including access control systems, electronic payments, and integration with institutional databases. These cards represent an intermediate step toward the development of multifunctional campus identification systems (Loechel, Alves, & Persson, 2022)

The most technologically advanced physical solutions are smart cards that incorporate multifunctional chips capable of supporting multiple authentication methods, including contact and contactless communication technologies. Smart cards enable greater interoperability and allow universities to expand services associated with student identification cards dynamically. Such solutions have become a central component of modern digital campus infrastructures.

Recent developments have further expanded these systems by introducing virtual or mobile identification solutions implemented through smartphones. Mobile-based identification systems eliminate the need for physical card production and instead rely on digital credentials stored on mobile devices. These systems may integrate multiple authentication mechanisms, including QR codes, near-field communication (NFC), and biometric verification, thereby enabling flexible and secure identification within digital campus environments (Loechel, Alves, & Persson, 2022).

The transition from traditional physical cards to digital identification solutions reflects a broader trend toward the digitalisation of administrative processes and services within higher education institutions. As universities increasingly adopt integrated digital infrastructures, student identification systems are evolving from simple identification documents into multifunctional digital credentials that support a wide range of academic and administrative services.

2.2 Digital student identification cards

Digital student identification cards represent the digital evolution of traditional student identification systems used within higher education institutions. While physical student identification cards have long served as official credentials confirming student identity and status, digital student identification cards extend these functions into the digital environment by enabling electronic identification, authentication, and integration with various digital services.

A digital student identification card is a digital credential containing verified information about a student and issued by a higher education institution. Such credentials typically store key identification attributes, including the student's name, photograph, institutional affiliation, and student identification number. In addition to basic personal data, a digital card may also contain other types of information, such as health-related data, academic history, and similar records (Zahlimar, Bakar, Permana, Siswoyo, & Hamirul, 2023). In contrast to physical cards, digital credentials are typically stored and accessed on mobile devices in digital wallets, enabling students to present their identification electronically when accessing institutional services.

Digital student identification cards are often integrated into broader university information systems and digital campus infrastructures. Through such integration, they enable students to authenticate their identity when accessing campus facilities, borrowing library materials, or using university services. In addition, digital credentials may support various authentication mechanisms, such as QR-code verification, near-field communication (NFC), or biometric authentication on mobile devices, thereby enhancing both usability and security.

In many cases, digital student identification cards function as part of a broader digital identity ecosystem that connects institutional databases, access management systems, and service platforms. Within such ecosystems, digital credentials enable universities to manage student identities more efficiently while simultaneously simplifying student access to services.

Although the adoption of digital identification systems varies across countries and institutions, many higher education systems have begun introducing regulatory frameworks to support the transition from physical to digital student credentials. For example, in Slovenia, the Act Regulating the Status of Students allows higher education institutions to issue student identification cards in digital form, thereby formally enabling the development of mobile-based student identification solutions (ZUPŠ-1, 2022). Similar developments can also be observed in other higher education systems that are gradually introducing digital credentials as part of broader digital transformation strategies (Bajić & Orel, 2025). Figure 3 presents the Croatian national digital student identification card.

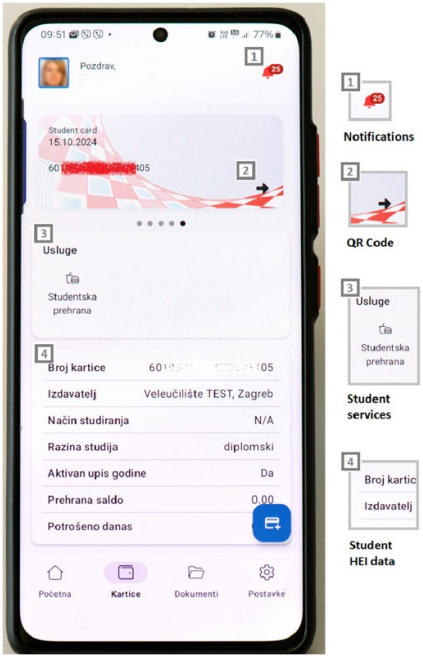

Figure 2: Digital student identification card of Croatia
Source: (Bajić & Orel, 2025)

The growing adoption of digital student identification cards reflects broader developments in digital identity management and the increasing importance of secure digital credentials within higher education environments.

Digital identification cards not only address key limitations of physical cards, such as inconvenience, the cost of reprinting, and susceptibility to wear, but also provide multiple benefits ranging from operational cost savings to improvements in the student experience. The most important advantages are outlined below.

The issuance and management of digital identification cards can be centralised and completed within minutes. Administrators can update or revoke access rights in real time through a web interface, without requiring students to physically visit the card office (ScreenCheck Europe B.V., 2025). As a result, the issuance process can be reduced from several days to a matter of seconds, significantly reducing the administrative workload.

Digital solutions also eliminate costs associated with plastic materials, printing, card personalisation printers, and distribution logistics. Each card that is not made from polyvinyl chloride (PVC) reduces plastic waste and lowers the supply chain's carbon footprint. Higher education institutions that have adopted mobile identification cards report measurable reductions in plastic use and emissions associated with card distribution (Emerald Expositions, 2025).

Darmawan and Santoso (2018) similarly highlighted that printing large quantities of physical cards is environmentally unsustainable, although they note that biodegradable materials could represent a partial solution to this issue.

Digital identification cards also employ advanced security mechanisms, such as encryption, biometric authentication, and multi-factor authentication, which reduce the risk of counterfeiting and unauthorised access (Emerald Expositions, 2025). In addition, if a mobile device is lost, the digital card can be immediately deactivated, significantly reducing the risk of misuse, a common problem associated with physical cards.

Whereas changes to personal information, such as address or academic status, require the reprinting of a physical card, digital identification cards can automatically update stored information as soon as changes are made within the university information system.

From a strategic perspective, digital student identification cards represent an investment that combines sustainability, economic efficiency, and cybersecurity with an enhanced user experience. For higher education institutions, they provide measurable financial savings and greater operational agility, while for students, they represent a unified, secure, and environmentally responsible gateway to academic and extracurricular services.

However, digital student identification cards also present several potential disadvantages. Implementing digital identification assumes that all students have a smartphone with a sufficiently modern operating system, which may not always be the case. In addition, the usability of mobile identification cards depends directly on the mobile device's functionality. If the device becomes unavailable, for example, due to a depleted battery, malfunction, or theft, students may temporarily lose access to university facilities, student services, or public transport. Digital identification systems also expand the potential attack surface by incorporating mobile operating systems, network infrastructure, and cloud services, thereby introducing additional cybersecurity risks. Although digital solutions may reduce long-term operational costs, their implementation typically requires substantial initial investments in licensed software, certified readers, upgrades to access control systems, and staff training. Furthermore, the implementation of such systems must ensure full compliance with the European General Data Protection Regulation and relevant national data protection legislation. Changes to operational processes, including the digital revocation of access rights or the storage of access logs, often require revisions of internal regulations, privacy impact assessments, and the establishment of new incident management procedures.

2.3 European Student Card

The development of digital student identification systems in Europe is closely connected with broader initiatives aimed at supporting the digital transformation of higher education and facilitating international student mobility. One of the most

important initiatives in this context is the European Student Card Initiative (ESCI), launched by the European Commission as part of the Erasmus+ programme. Its objective is to strengthen individuals' knowledge and skills while promoting employability, social inclusion, and active citizenship. The programme facilitates mobility for students, learners, and staff, as well as cooperation between educational institutions and organisations. In recent years, particular emphasis has been placed on digital transformation, inclusion, and sustainability (European Commission, 2024a).

The European Student Card Initiative comprises three main components that support the digitalisation of student mobility within the European Higher Education Area. The European Student Card represents a digital extension of existing student identification cards and enables students to use a single credential during international mobility to access rights and services both at host higher education institutions and within the surrounding local environment (European Commission, 2025a). The Erasmus+ Mobile App serves as a unified digital tool that supports students throughout all administrative processes related to mobility, including the phases before departure, during their stay abroad, and after completing the programme, by providing access to relevant information, enabling the submission of documentation, and allowing students to monitor the progress of their mobility in a single user-friendly environment. In addition, Erasmus Without Paper enables the digital integration of existing higher education information systems to support the fully electronic management of all phases of Erasmus+ mobility. Through standardised application programming interfaces (APIs), the system enables the secure exchange of student data between institutions, thereby reducing the need for paper documentation and analogue administrative procedures (European Commission, 2025a). An example of a physical and digital student identification card that includes elements of the European Student Card is presented in Figure 4.

Overall, the initiative aims to support the sustainable and digital transformation of the Erasmus+ programme by introducing paperless administrative processes. It is based on the "once-only" principle, meaning that data should be entered only once and subsequently reused across systems, thereby enabling more efficient management of mobility processes. In addition, the initiative promotes greater student engagement through targeted and proactive communication, thereby improving the programme's accessibility. Comprehensive digital support also

enables a smoother and more integrated mobility experience and strengthens the sense of a shared European student identity (European Commission, 2025c).

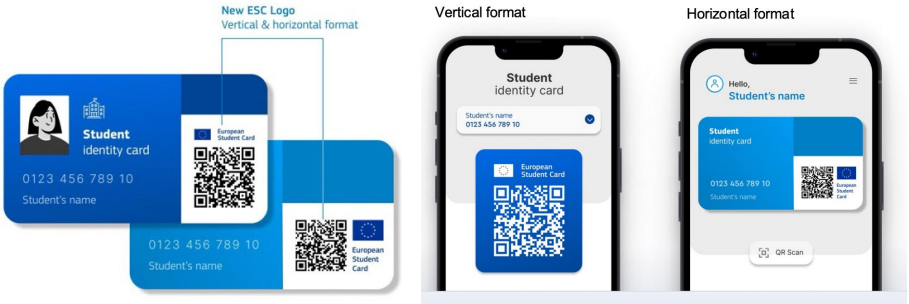

Figure 4: Example of a physical and digital student identification card that includes elements of the European Student Card

Source: (European Commission, 2025b; European Commission, 2024b)

The functionality of the European Student Card is supported by a standardized technical infrastructure designed to ensure interoperability between higher education institutions. One of the central elements of this infrastructure is the European Student Card Number (ESCN), which serves as a unique identifier for each student card (European Commission, 2025b). The identifier enables reliable identification and verification of student status across institutional systems.

In addition to the ESCN, the European Student Identifier (ESI) plays an important role in the digital identification of students within the European higher education ecosystem. The ESI enables the consistent identification of students participating in international mobility programmes and supports the secure exchange of identity-related information between universities (European Commission, 2025b).

The issuance and management of European Student Cards are supported through the ESC Router, a centralised digital platform that enables higher education institutions to issue and verify student credentials. It allows higher education institutions and other authorised issuers to manage student cards efficiently. In addition, the system supports real-time verification of student status, thereby enabling providers of student services to securely and reliably identify users. The platform is designed in accordance with European data protection standards. It

represents the technical core of the European Student Card infrastructure (European Commission, 2024b).

Higher education institutions across Europe are gradually integrating the European Student Card into their identification systems. The implementation of the initiative varies across countries and institutions, depending on the level of digital infrastructure and institutional readiness for digital transformation.

Some countries have introduced national solutions that fully comply with the requirements of the European Student Card Initiative. For example, Croatia has implemented a digital student identification system that integrates both physical and mobile versions of student identification cards. These cards enable students to access various university services and student benefits while ensuring compatibility with the European Student Card infrastructure (Bajić & Orel, 2025).

Similar developments can be observed at the institutional level across Europe. Universities such as the Complutense University of Madrid have integrated the European Student Card into their existing student identification systems, enabling students to identify themselves digitally when accessing institutional services or participating in mobility programmes (2025). Another example is Ludwig-Maximilians-Universität München (LMU) in Germany, which has implemented the European Student Card by integrating ESC elements into its existing physical student card. The ESC logo has been added to the LMUcard, symbolising compliance with European standards and enabling participation in the broader European digital identification ecosystem (Ludwig-Maximilians-Universität München, 2025).

The continued development of digital student identity systems is closely linked with broader efforts to create integrated digital infrastructures within the European Higher Education Area. Future developments are expected to focus on increasing interoperability between institutional systems, expanding the functionality of digital credentials, and improving the user experience for students participating in international mobility programmes.

An example of such developments is eduTAP, which represents an important advancement in the European Student Card ecosystem. The initiative addresses key challenges in student mobility, access to services, and digital identity management across the European Higher Education Area. It contributes to the digital transformation of higher education institutions, particularly through the transition from physical cards to digital wallets on students' smartphones (EUGLOH, 2025).

Overall, projects like eduTap represent an important step toward the digital integration of higher education systems in Europe. By enabling interoperable digital identification systems and supporting the digitalisation of mobility processes, the project contributes to the development of a more connected, efficient, and sustainable European higher education environment.

2.4 Technology Acceptance Model

The adoption and effective use of digital technologies depend not only on technological capabilities but also on users' willingness to accept and use such systems. Understanding the determinants of technology acceptance has therefore become an important area of research in information systems. One of the most widely applied theoretical frameworks for explaining user acceptance of information technology is the Technology Acceptance Model (TAM), originally proposed by Davis (Sternad Zabukovšek, Tominc, Štrukelj, & Bobek, 2020).

Fred D. Davis developed the model as an extension of the Theory of Reasoned Action (TRA), adapted specifically to the context of information systems use (Sternad Zabukovšek, Tominc, Štrukelj, & Bobek, 2020). Davis (1993) sought to explain why individuals accept or reject the use of an information system and how system design characteristics influence user acceptance. Perceived usefulness (PU) is defined as the degree to which an individual believes that using a particular system will improve their job performance. This definition is rooted in an organisational context in which individuals are rewarded for higher work performance, thereby increasing the importance of the technology's perceived usefulness (Davis, 1989; Pfeffer, 1982; Schein, 1980; Vroom, 1964). Perceived ease of use (PEOU) is defined as the degree to which an individual believes that using a system requires little effort. Davis emphasises that effort is a limited resource; consequently, users are more likely to accept systems that require less cognitive and physical effort (Davis, 1989).

Furthermore, TAM emphasises that actual system use is also determined by the user's behavioural intention to use the system (BI) (Sternad Zabukovšek, Tominc, Štrukelj, & Bobek, 2020). Behavioural intention represents the direct antecedent of actual use and reflects an individual's willingness to use the technology. This intention is formed based on the user's attitude toward using the system (AT) and the perceived usefulness of the system (Sternad Zabukovšek, Tominc, Štrukelj, & Bobek, 2020; Sternad Zabukovšek & Bobek, 2025).

It is also important to highlight the existence of external variables, which indirectly affect the use of an information system through perceived usefulness and perceived ease of use (Sternad Zabukovšek, Tominc, Štrukelj, & Bobek, 2020). These external variables are not specified in advance, as their selection depends on the research context and the type of technology under investigation (Sternad Zabukovšek & Bobek, 2025).

Beyond external variables, an important limitation of the original TAM in institutional contexts is its assumption of voluntary use. The model was originally developed for basic office software adoption in the workplace in voluntary-use contexts, and its core construct of BI presupposes that users freely choose how and to what degree they engage with a technology (Sternad Zabukovšek & Samo, 2023). The absence of subjective norms, that is, the influence of social and institutional pressures, is considered one of the primary weaknesses of the basic TAM model (Sternad Zabukovšek & Samo, 2023). This is directly relevant to the context of digital student identification cards, where institutional adoption may be partially or fully mandatory: students may be required to use the system regardless of their personal attitudes or intentions. In such contexts of mandatory use, the decision to select and implement the technology is typically made at the organisational or institutional level, and users are expected to comply in their daily activities. The fundamental TAM assumption that users have a genuine choice over the extent to which they will adopt a technology therefore, does not hold under conditions of mandatory institutional use (Sternad Zabukovšek & Samo, 2023).

Furthermore, empirical research in mandatory use contexts has confirmed that important differences exist between voluntary and mandatory use contexts in terms of the relationships between TAM constructs. Perceived ease of use is not always statistically significantly associated with attitude toward use or perceived usefulness,

a pattern observed across multiple ERP implementation studies, suggesting that when system use is compulsory, ease of use loses its predictive relevance (Sternad Zabukovšek & Samo, 2023).

Subsequent research has extended the original TAM framework by incorporating additional factors that may influence technology adoption in different contexts. For example, Venkatesh and Davis (2000) proposed an extension of the model (TAM2) that introduced additional determinants of perceived usefulness (PU) and behavioural intention (BI). Later, the Unified Theory of Acceptance and Use of Technology (UTAUT) integrated several existing technology acceptance models, including TAM, in order to explain user adoption of information systems across different organisational contexts (Venkatesh, Morris, Davis, & Davis, 2003). In addition to these theoretical developments, researchers have increasingly emphasized the importance of contextual factors, such as trust in the security and reliability of digital systems, particularly in environments where technologies process personal or identity-related data (Sternad Zabukovšek & Bobek, 2025).

In the context of digital student identification cards, trust is particularly relevant because such systems handle identity-related information and may be integrated with various institutional services and access control mechanisms. If users perceive the system as secure and trustworthy, they may be more likely to view the technology as useful and to adopt it in practice.

Based on these theoretical foundations, TAM provides an appropriate framework for examining students' acceptance of digital student identification cards. The model enables the analysis of relationships between perceived usefulness, perceived ease of use, attitudes toward use, behavioural intention, and trust in the security of the digital system. These constructs form the basis for the research model and hypotheses presented in the following sections of the chapter.

The growing adoption of digital identity systems in higher education institutions raises important questions about students' acceptance and use of such technologies. Although digital student identification cards offer various operational and technological advantages, their successful implementation depends largely on users' willingness to adopt and use the system. Understanding the factors that influence

students' acceptance of digital student identification cards is therefore essential for the effective implementation of such solutions within university environments.

2.5 Methods and research process

Based on a review of the literature on information technology adoption, particularly the Technology Acceptance Model (TAM), a research model was developed to examine the factors influencing students' adoption of digital student identification cards. The research model used in this study is presented in Figure 5 and is grounded in the core structure of TAM. However, the model was conceptually adapted to the specific context of digital student identification cards and extended to include an additional construct representing trust in the system's security. The inclusion of this construct aims to capture the dimension of perceived security, which is frequently identified in the literature as an important determinant of technology adoption, particularly in the context of digital identities and digital services.

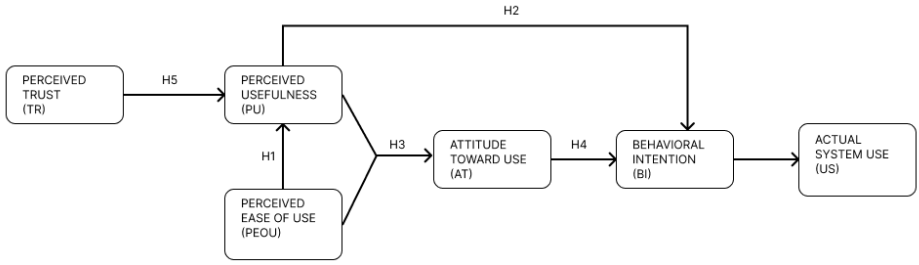

Figure 5: Research model
Source: Author's own work.

Within the model, perceived ease of use (PEOU) represents the degree to which users believe that using the digital student identification card is effortless and requires minimal additional effort. Perceived usefulness (PU) reflects users' beliefs that using the digital student identification card improves their efficiency or provides tangible benefits in everyday student life. Attitude toward use (AT) represents the overall positive or negative evaluation of using the digital student identification card, while behavioural intention (BI) indicates users' willingness to use the solution. The outcome construct of the model is the actual use of the system (US).

Based on the theoretical foundations of TAM and the conceptual research model presented above (Figure 5), the following hypotheses are formulated and tested in the empirical part of the study.

H_1: Perceived ease of use of the digital student identification card (PEOU) has a statistically significant positive effect on perceived usefulness of the digital student identification card (PU).

H_2: Perceived usefulness of the digital student identification card (PU) has a statistically significant positive effect on behavioural intention to use the digital student identification card (BI).

H_3: Perceived usefulness and perceived ease of use of the digital student identification card (PU, PEOU) have a statistically significant positive effect on attitude toward using the digital student identification card (AT).

H_4: Attitude toward using the digital student identification card (AT) has a statistically significant positive effect on behavioural intention to use the digital student identification card (BI).

H_5: Trust in the security of the digital student identification card (TR) has a statistically significant positive effect on perceived usefulness of the digital student identification card (PU).

The proposed research model assumes several direct and indirect relationships between the constructs. In accordance with TAM, perceived ease of use (PEOU) is expected to positively influence perceived usefulness (PU), and both are assumed to affect users' attitudes toward use (AT). Furthermore, attitudes toward use (AT) and perceived usefulness (PU) are expected to influence behavioural intention (BI), which serves as the immediate antecedent of actual system use (US). Additionally, trust in the security of the digital student identification card is assumed to positively influence perceived usefulness (PU), as users tend to perceive secure systems as more reliable and beneficial.

This study adopts a quantitative research approach to examine the factors influencing students' acceptance of digital student identification cards. A structured survey questionnaire was used as the primary data collection instrument. The questionnaire was designed to measure students' perceptions of the key constructs included in the research model, namely perceived usefulness (PU), perceived ease of use (PEOU), attitude toward use (AT), behavioural intention to use (BI), trust in the security of the digital student identification card (TR), and actual system use (US).

The empirical data were collected from students enrolled in higher education institutions. Participation in the survey was voluntary and anonymous, and no personal or demographic data were collected in order to ensure full respondent anonymity. The collected data were analysed using quantitative statistical methods to evaluate relationships among the constructs in the research model and test the proposed research hypotheses.

The questionnaire consisted of several items corresponding to the constructs defined in the research model. The measurement items were designed to capture students' perceptions of perceived usefulness, perceived ease of use, attitude toward using the system, behavioural intention to use the system, and trust in the security of the digital student identification card. In addition, the questionnaire included a question measuring the actual use of the student identification card, distinguishing between the physical and digital forms of the card.

The constructs of perceived usefulness (PU) and perceived ease of use (PEOU) were derived from the Technology Acceptance Model (Davis, 1989), while the trust construct was included due to the importance of security perceptions in digital identity systems (Sternad Zabukovšek & Bobek, 2025). The measurement items were adapted to reflect the specific context of digital student identification cards and the services associated with their use.

Most questionnaire items were measured using a five-point Likert scale ranging from 1 ("very low") to 5 ("very high"), allowing respondents to indicate the extent to which they perceive benefits and ease of use associated with digital student identification cards. In addition, the questionnaire included selected single-item measures and a question asking respondents to identify the form of student identification card they most frequently use.

In this study, several constructs were measured using single-item indicators. Although multi-item scales are commonly recommended for measuring TAM constructs, single-item measures can be acceptable in exploratory studies and when the research objective is to capture respondents' general perceptions of a specific system feature (Hair, Black, Babin, & Anderson, 2019). Given the exploratory nature of this study and the relatively short questionnaire designed to encourage participation, selected constructs were therefore operationalised using single-item indicators. The measurement constructs and questionnaire items used in the study are presented in Table 1.

Table 1: Measurement constructs and questionnaire items

Construct	Code	Measurement item	Source
Actual system use	US1	Which form of student identification card do you use most frequently?	(Davis, 1989).
Behavioural intention to use	BI1	How likely would you be to recommend the use of a digital student identification card to students who currently use a physical card?	(Davis, 1989).
Attitude toward using the system	AT1	I prefer the digital student identification card to the physical one.	(Davis, 1989).
Perceived ease of use	PEOU1	Ease of use.	(Davis, 1989).
Perceived usefulness	PU1	Benefit: identification	(Davis, 1989).
	PU2	Benefit: borrowing books	(Davis, 1989).
	PU3	Benefit: student discounts	(Davis, 1989).
	PU4	Benefit: access to study rooms or other facilities	(Davis, 1989).
	PU5	Benefit: use of subsidized student meals	(Davis, 1989).
	PU6	Benefit: attendance recording	(Davis, 1989).
Perceived trust	TR1	Do you trust the security of the digital student identification card?	(Sternad Zabukovšek & Bobek, 2025)

Source: Author's own work.

3 Research results

3.1 Sample description

The target population of this study consisted of students enrolled at three major public universities in Slovenia: the University of Ljubljana, the University of Maribor, and the University of Primorska. These institutions represent the largest higher education providers in the country and cover a wide range of study programmes and academic disciplines.

The survey was distributed via the university's mobile applications, accessible only to users with valid university digital identities. This distribution channel ensured that only authenticated university users could access the questionnaire, thereby providing a reliable mechanism for reaching the intended student population.

In total, the questionnaire was opened by 560 students, of whom 198 respondents completed the survey in full, resulting in a completion rate of approximately 35%. Given the voluntary nature of participation and the relatively short questionnaire, the achieved response rate is satisfactory.

An initial screening question was used to identify the most frequently used form of student identification card among respondents. Out of the 198 respondents who completed the questionnaire, 64 indicated that they primarily use a digital student identification card. Since the objective of this study is to examine the acceptance of digital student identification cards, only these respondents were included in the subsequent empirical analysis. Consequently, the final analytical sample consisted of 64 students.

This relatively small sample represents a significant methodological limitation. It reduces the statistical power of the regression analyses, meaning that some hypothesised relationships may not have reached significance due to insufficient power rather than a true absence of effect. The findings should therefore be interpreted with caution and cannot be generalised to the broader student population without replication in larger and more diverse samples.

The collected dataset was subsequently used for statistical analyses to examine the relationships among the constructs included in the research model.

3.2 Factor analysis

An exploratory factor analysis (EFA) was used to examine the instrument's internal structure and assess the internal structure of the constructs included in the study. The purpose of factor analysis is to evaluate whether the observed variables used to operationalise a construct converge into one or more latent dimensions (Tominc, Čančer, & Rožman, 2018). According to Hair et al. (2019), constructs included in factor analysis should ideally be measured using at least five observed variables.

It should be noted that the factor analysis and subsequent hypothesis testing were conducted on a subsample of N = 64 respondents who actively use digital student identification cards. These respondents therefore provided relevant evaluations of the constructs examined in this study. Although the sample size is relatively small, it meets the commonly recommended minimum ratio of observations to variables in the factor analysis (Hair, Black, Babin, & Anderson, 2019).

Among the constructs included in the Technology Acceptance Model (TAM) presented in Table 1, only the Perceived usefulness (PU) construct met the requirement of at least 5 measurement items, with 6 items (PU1–PU6). Other constructs in the research model (such as Perceived ease of use and Behavioural Intention) were measured with fewer items and were therefore excluded from the factor analysis. For this reason, the factor analysis was conducted only for the construct Perceived Usefulness, which contained a sufficient number of measurement items to allow an exploratory examination of its internal structure. The analysis, therefore, served primarily as a preliminary assessment of the measurement instrument, rather than a full validation of the measurement model.

The primary objective of the factor analysis was to determine whether the items PU1–PU6 empirically converge into a latent factor representing Perceived usefulness. For this purpose, an exploratory factor analysis was conducted on the six measurement items using Principal Component Analysis with Varimax rotation.

Correlation analysis indicated that most variables were moderately and positively correlated, suggesting that the data were suitable for factor analysis. The suitability of the data was further confirmed by the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy (KMO = 0.614) and Bartlett's test of sphericity, which was statistically significant ($p < 0.001$).

The initial analysis indicated that one item (PU3) had a communality below the recommended threshold of 0.40 and was therefore excluded from further analysis. After removing this item, the factor analysis was repeated using the remaining variables. The revised dataset continued to meet the assumptions for factor analysis (KMO = 0.589; Bartlett's test $p < 0.001$).

The results revealed a two-factor structure, as indicated by the KMO criterion (eigenvalues > 1), accounting for 68.667% of the total variance. To improve interpretability, the factor solution was rotated using the Varimax rotation method. The rotated factor matrix showed a clear distinction between the two item groups. The first factor included items PU1, PU2, and PU6, which reflect the perceived usefulness of the administrative functions of the student identification card. The second factor consisted of items PU4 and PU5, which relate to the perceived usefulness of student services.

These findings indicate that students perceive the usefulness of digital student identification cards as a multidimensional construct, distinguishing between administrative and service-related benefits. The identified two-factor structure also suggests that students differentiate between the usefulness of digital student identification cards for administrative purposes and their usefulness for accessing various student services.

Finally, reliability analysis of the perceived usefulness (PU1, PU2, PU4, PU5, PU6) yielded a Cronbach's alpha of 0.655, indicating moderate internal consistency. This suggests that the items included in the construct measure the perceived usefulness of digital student identification cards in a reasonably consistent manner. Although the reliability coefficient is slightly below the commonly recommended threshold of 0.70, it can be considered acceptable for exploratory research and preliminary measurement scales, particularly in studies with relatively small samples (Hair, Black, Babin, & Anderson, 2019).

3.3 Hypothesis testing

To test the proposed hypotheses, regression analysis was conducted using SPSS. The relationships among the constructs in the research model were analysed to determine whether the hypothesised effects were statistically significant.

Because the exploratory factor analysis revealed two distinct dimensions of perceived usefulness, namely perceived usefulness of administrative functions and perceived usefulness of student services, the hypotheses involving perceived usefulness were tested separately for these two dimensions. Consequently, several hypotheses were divided into sub-hypotheses in order to account for this multidimensional structure.

Hypothesis H_1 examined whether perceived ease of use (PEOU) of the digital student identification card influences perceived usefulness (PU). Two regression analyses were conducted for the two dimensions of perceived usefulness. The results indicated that perceived ease of use did not have a statistically significant effect on either the perceived usefulness of administrative functions ($\beta = 0.035$, $R^2 = 0.001$, $p = 0.787$) or the perceived usefulness of student services ($\beta = 0.176$, $R^2 = 0.031$, $p = 0.163$). Therefore, hypotheses H_{1a} and H_{1b} were not supported.

Hypothesis H_2 investigated whether perceived usefulness influences behavioural intention (BI) to use the digital student identification card. Separate regression analyses were conducted for the two dimensions of perceived usefulness. The results showed that neither the perceived usefulness of administrative functions ($\beta = -0.120$, $R^2 = 0.014$, $p = 0.344$) nor that of student services ($\beta = 0.011$, $R^2 = 0.000$, $p = 0.932$) had a statistically significant effect on behavioural intention. Consequently, hypotheses H_{2a} and H_{2b} were not supported.

Hypothesis H_3 examined the influence of perceived ease of use (PEOU) and perceived usefulness (PU) on attitudes toward using the digital student identification card (AT). The overall regression model (H_{3a}) was statistically significant ($R^2 = 0.232$, $p = 0.001$). More specifically, perceived ease of use had a statistically significant positive effect on attitudes toward use ($\beta = 0.311$, $R^2 = 0.097$, $p = 0.012$), as did perceived usefulness of administrative functions ($\beta = 0.369$, $R^2 = 0.136$, $p = 0.003$). In contrast, perceived usefulness of student services did not have a statistically

significant effect on attitudes toward use (β = 0.132, R^2 = 0.018, p = 0.297). Consequently, hypotheses H_{3b} and H_{3c} were supported, while H3d was not supported.

Hypothesis H_4 analysed whether attitudes toward using the digital student identification card influence behavioural intention to use it. The regression analysis showed no statistically significant relationship between attitudes toward use and behavioural intention (β = 0.000, R^2 = 0.000, p = 0.998). Therefore, H_4 was not supported.

Finally, Hypothesis H_5 examined whether trust in the security of the digital student identification card influences perceived usefulness. Two regression analyses were again conducted for the two dimensions of perceived usefulness. The results indicated that trust in security had a statistically significant positive effect on the perceived usefulness of administrative functions (β = 0.369, R^2 = 0.136, p = 0.003). However, no statistically significant effect was observed for the perceived usefulness of student services (β = 0.132, R^2 = 0.018, p = 0.297). Consequently, H_{5a} was supported, whereas H_{5b} was not supported.

The detailed results of the regression analyses are presented in Table 2.

Table 2: Results of hypothesis testing

Hypothesis	Relationship	Beta (β)	R^2	p-value	Result
H_{1a}	PEOU → PU (Administrative functions)	0.035	0.001	0.787	Not supported
H_{1b}	PEOU → PU (Student services)	0.176	0.031	0.163	Not supported
H_{2a}	PU (Administrative functions) → BI	-0.120	0.014	0.344	Not supported
H_{2b}	PU (Student services) → BI	0.011	0.000	0.932	Not supported
H_{3a}	PEOU + PU (Admin) + PU (Services) → AT	–	0.232	0.001	Supported
H_{3b}	PEOU → AT	0.311	0.097	0.012	Supported
H_{3c}	PU (Administrative functions) → AT	0.369	0.136	0.003	Supported
H_{3d}	PU (Student services) → AT	0.132	0.018	0.297	Not supported
H_4	AT → BI	0.000	0.000	0.998	Not supported

Hypothesis	Relationship	Beta (β)	R^2	p-value	Result
H_{5a}	Trust (Security) → PU (Administrative functions)	0.369	0.136	0.003	Supported
H_{5b}	Trust (Security) → PU (Student services)	0.132	0.018	0.297	Not supported

Source: Author's own work.

Overall, the results indicate that perceived ease of use and the perceived usefulness of administrative functions play the most important role in shaping students' attitudes toward digital student identification cards. In contrast, several other relationships proposed by the Technology Acceptance Model were not statistically supported in the analysed sample.

4 Discussion

The aim of this study was to examine the factors influencing students' acceptance of digital student identification cards in higher education institutions using the Technology Acceptance Model. The results of the empirical analysis provide several important insights into how students perceive the usefulness, usability, and security of digital identity systems, which are increasingly part of universities' digital infrastructure.

The exploratory factor analysis revealed that students do not perceive the usefulness of digital student identification cards as a strictly one-dimensional construct. Instead, the results indicate a distinction between the administrative usefulness of the card, related to identification and access management functions, and its service-related usefulness, associated with access to various student services. This finding suggests that digital student identification systems simultaneously fulfil two complementary roles within higher education institutions. On the one hand, they serve as part of the core digital identity infrastructure, enabling secure authentication, access control, and institutional governance. On the other hand, they may act as a platform for integrating various student services, facilitating access to campus facilities, transportation systems, and other student benefits. Interestingly, the results further suggest that students assign greater importance to the administrative functions of the digital student identification card than to its service-related functionalities.

The results of the hypothesis testing further reveal an interesting pattern in the relationships proposed by the Technology Acceptance Model. While perceived ease of use and the perceived usefulness of administrative functions significantly influenced students' attitudes toward the use of digital student identification cards, several relationships commonly observed in TAM studies were not supported. In particular, perceived usefulness did not significantly influence behavioural intention, and attitudes toward use did not significantly predict behavioural intention. One possible explanation for these results lies in the specific institutional context in which digital student identification systems are used. Unlike many digital technologies examined in previous TAM studies, the use of student identification systems is often embedded within institutional processes and may therefore not be entirely voluntary. Students may rely on the system regardless of their behavioural intentions because it is required for accessing university facilities, services, or administrative procedures. Similar patterns have been observed in studies of organisational information systems, where system use is integrated into institutional processes and behavioural intention may therefore play a less significant role in explaining actual system use (Davis, 1989; Sternad Zabukovšek et al., 2020; Sternad & Bobek, 2023, 2025).

Further analysis of the results shows that perceived ease of use has a statistically significant positive influence on students' attitudes toward the use of digital student identification cards. This finding is consistent with the core assumptions of the Technology Acceptance Model (Davis, 1989) and its later extensions (Venkatesh & Davis, 2000), which emphasise the importance of usability and simplicity in shaping users' perceptions of new technologies. In the context of higher education, this suggests that students are more likely to develop positive attitudes toward digital identity solutions when these systems are intuitive and easy to use. Since digital student identification cards are typically implemented through mobile applications or integrated campus systems, the usability of these platforms plays an important role in shaping students' perceptions and acceptance.

The results also indicate that only the perceived usefulness of administrative functions significantly influences students' attitudes toward the use of digital student identification cards. In contrast, the perceived usefulness of student services does not have a statistically significant effect. This suggests that students primarily perceive digital identification systems as tools that facilitate administrative and institutional processes, such as identification, access to facilities, or authentication

procedures, rather than as platforms that provide additional service-oriented functionalities. In addition, the findings show that trust in the security of the digital student identification card significantly influences the perceived usefulness of administrative functions. Since digital identity systems process sensitive personal data and play a central role in identity verification and access management, trust in system security appears to be an important factor shaping students' perceptions of their usefulness. This finding suggests that students primarily perceive digital student identification cards as instruments that support institutional and administrative processes rather than as platforms for accessing additional digital services. In this sense, the usefulness of digital student identity systems appears to be driven mainly by their role in facilitating core identification and access management functions within the university environment.

From a broader perspective, these findings can be interpreted within the context of the ongoing digital transformation of higher education institutions. Universities increasingly rely on integrated digital infrastructures that support administrative processes, identity management, and access to institutional services. Digital student identification systems represent an important component of this infrastructure, enabling secure identification, service integration, and more efficient governance processes within universities. Digital student identity systems can therefore also be interpreted as governance technologies that support more transparent and accountable institutional processes. By enabling reliable digital authentication and traceability of service access, such systems may strengthen institutional governance mechanisms and support compliance with regulatory frameworks. In this sense, digital student identity infrastructures contribute not only to operational efficiency but also to the broader objectives of sustainable governance within higher education institutions.

The findings of this study also contribute to the existing literature on technology acceptance by providing additional insights into the application of the Technology Acceptance Model in the context of digital identity systems in higher education. While TAM has been widely applied to examine the adoption of various digital technologies, the results of this study suggest that the relationships among its core constructs may differ when technologies constitute institutional digital infrastructure rather than purely voluntary systems. In such contexts, system use is often embedded in organisational processes, which may reduce the predictive value of behavioural

intention for technology adoption. Instead, factors such as system usability, trust in system security, and the perceived usefulness of administrative functions appear to play a more significant role in shaping users' perceptions and attitudes toward the system.

Several practical implications for higher education institutions implementing digital student identification systems follow from these findings. Universities should pay particular attention to the usability of digital student identification solutions, as perceived ease of use significantly influences students' attitudes toward the system. Digital identity systems integrated into mobile applications or campus platforms should therefore be designed to ensure simple, intuitive, and reliable user interaction. Furthermore, universities should ensure that digital identification systems effectively support core functions such as authentication, access management, and identification across institutional services. Finally, since digital identity solutions involve the management of sensitive personal data, higher education institutions should ensure high standards of data protection, transparent privacy policies, and robust cybersecurity measures to strengthen students' trust in the system and increase its perceived usefulness.

Overall, the findings highlight the importance of considering the institutional context when analysing the acceptance of digital technologies in higher education. Digital student identification cards are an integral component of universities' digital transformation, enabling secure identification, service access, and the integration of administrative and student support processes. As universities increasingly adopt integrated digital identity solutions, understanding the factors that influence users' perceptions of these systems becomes essential for ensuring their successful implementation and long-term sustainability.

This study adds to the existing literature on technology acceptance by examining TAM in a context where the technology constitutes institutional digital infrastructure rather than a purely voluntary system. While TAM has traditionally been applied to voluntary information systems used in organisational or consumer contexts, digital identity systems in higher education constitute a specific category of technologies often embedded within institutional processes. As a result, user behaviour may be influenced not only by individual perceptions of usefulness and ease of use, but also by institutional requirements and infrastructural dependencies. This suggests that

technology acceptance models may operate differently in contexts where system use is partially institutionalised.

Collectively, these findings advance the understanding of digital identity systems in higher education by providing empirical insights into the factors shaping students' perceptions of digital student identification cards. In particular, the findings highlight the importance of administrative usefulness, system usability, and trust in system security in shaping students' attitudes toward digital identity systems. By showing that traditional TAM relationships may operate differently in the context of institutional digital infrastructure, this study contributes to a better understanding of technology acceptance in organisational and governance-related digital systems.

5 Conclusion

The objective of this study was to examine the factors influencing students' acceptance of digital student identification cards in higher education institutions. Drawing on the TAM, the study analysed the relationships between perceived ease of use, perceived usefulness, trust in system security, attitudes toward using the system, and behavioural intention. The empirical analysis was based on survey data collected from students at three Slovenian universities.

The results indicate that perceived ease of use plays an important role in shaping students' attitudes toward the use of digital student identification cards. Students who perceive the system as simple and intuitive are more likely to develop positive attitudes toward its use. Furthermore, the study shows that perceived usefulness is not a single-dimensional construct. Two distinct dimensions were identified: the perceived usefulness of administrative functions and that of student services. The findings suggest that administrative functionalities of the digital student identification card have a stronger influence on students' attitudes than additional service-related features.

The analysis also revealed that trust in the security of the digital student identification card positively influences the perceived usefulness of administrative functions. This result highlights the importance of security and reliability in digital identity systems, particularly in institutional environments where such systems are used for identification and access management. Overall, the findings suggest that the

acceptance of digital student identification systems is influenced primarily by system usability, trust in system security, and the perceived usefulness of administrative functions.

From the perspective of higher education governance, digital student identification cards represent an important component of universities' digital infrastructure. These systems enable secure identification, facilitate access to institutional services and facilities, and support the integration of various digital platforms within the university environment. As universities continue to implement digital technologies across their administrative and academic processes, digital identity systems may increasingly play an important role in supporting efficient, transparent, and sustainable institutional governance. From an environmental perspective, such systems reduce the need for physical plastic cards and associated material resources, thereby lowering waste, while from a governance perspective, they support more transparent and traceable administrative processes, strengthen data integrity, and enable more effective institutional oversight. By reducing reliance on physical materials, simplifying administrative processes, and enabling integrated digital service ecosystems, such systems support more efficient resource management and environmentally responsible institutional practices. Consequently, digital student identification infrastructures represent an important element of the ongoing digital transformation of universities and their transition toward more sustainable and digitally enabled governance models.

Despite these contributions, this study has several limitations that should be considered when interpreting the results. First, the empirical analysis was conducted on a relatively small sample of students who actively use digital student identification cards. As the final analytical sample consisted of 64 respondents, the findings should be interpreted as indicative rather than fully representative of the broader student population.

Second, in order to ensure full anonymity and comply with ethical research principles, the questionnaire did not collect detailed demographic information about respondents. Consequently, the analysis could not examine potential differences between demographic groups. Finally, the survey instrument was originally developed for a different study (Hajdenkumer, 2025) and was not specifically

designed to measure TAM constructs, which limits the precision of their operationalisation.

Future research could address these limitations by including larger, more diverse student samples and collecting demographic data that enable subgroup analyses. In addition, future studies could employ measurement instruments specifically designed to capture TAM constructs using validated scales. Comparative studies across different universities or countries could also provide further insights into how digital student identification systems are implemented and accepted in different higher education environments.

Overall, this study contributes to a better understanding of how students perceive digital identity systems in higher education and highlights the importance of usability, trust, and administrative usefulness for the successful implementation of digital student identification infrastructures. In this context, digital student identity systems should not be viewed merely as technological tools for identification but rather as strategic digital infrastructures that support the integration of administrative processes, enhance service accessibility, and contribute to more efficient and sustainable governance in higher education institutions.

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