

STUDENT SATISFACTION AS A MEDIATOR BETWEEN ADMINISTRATIVE E-SYSTEM QUALITY AND UNIVERSITY REPUTATION: AN EMPIRICAL ANALYSIS FROM POLAND

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Abstract: *This study examines how administrative e-system quality influences student satisfaction and university reputation, addressing a research gap: most studies analyse the reverse relationship, where reputation drives satisfaction, and rarely consider administrative e-systems. Drawing on survey data from nearly 7,500 students at Polish universities collected in 2019 and 2020, eight features were evaluated - functionality, implementation, intuitiveness, interface layout, responsiveness/speed, reliability and availability, security and data protection, and mobile accessibility - using regression and Structural Equation Modelling. In 2019, satisfaction mediated the relationship between e-system quality and reputation. In 2020, during the COVID-19 pandemic, this mediation weakened, while direct effects of functionality and reliability on reputation strengthened, reflecting a shift from satisfaction-based to performance-based evaluations. Security also influenced reputation more strongly than satisfaction. Factor analysis grouped the eight indicators into three latent dimensions. Findings demonstrate that administrative e-systems, often overlooked, play a strategic role in shaping both satisfaction and reputation.*

Keywords: *e-system, satisfaction, reputation, universities, digitalization, higher education*

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INTRODUCTION

Although several years have passed since the outbreak of the COVID-19 pandemic, the changes it caused still require careful analysis of the challenges that emerged or intensified during that time. One of the key challenges was the rapid digitization of services in various sectors, including higher education. Universities had to implement both technological and organizational changes almost overnight to continue educational and administrative operations remotely (Pokhrel, Chhetri 2021; Webb et al. 2021; Jackson & Konczos, 2022).

The enforced shift to online education and remote administrative services significantly altered the dynamics of student-university interactions. Platforms such as Teams, Zoom, and Webex became the norm, demanding a rapid improvement in digital competencies among students, lecturers, and administrative staff (Strielkowski, 2020; Larbie, 2024). In particular, the student experience was redefined - not only in the learning process but also in the handling of administrative tasks, such as submitting documentation or receiving grades, which now relied heavily on institutional e-systems (Hudrea, 2023; Webb et al. 2021).

One way to assess how well universities were prepared for this sudden transition is to evaluate the quality of their administrative e-systems and their impact on students. While the pandemic served as a catalyst, the long-term implications of digitized administration merit thorough investigation. A Web of Science query for articles containing the terms "digital education" or "online learning" and "higher education" revealed 6,605 publications between 1998 and 2024, with a notable spike during the pandemic years (4,387 articles published from 2019–2024). However, when narrowing the search with the term "satisfaction," only 828 articles appeared, and when further adding "reputation," this number dropped to just 5, with only one based on empirical research (Bouranta et al., 2025). These results point to a significant research gap regarding the empirical analysis of the relationship between administrative e-system quality, student satisfaction, and university reputation.

This gap in literature leads to the core research problem of this study: Does the quality of a university's administrative e-system influence students' satisfaction, and does this satisfaction, in turn, affect the university's reputation? To answer this question, the study aims to (1) assess students' satisfaction with university e-systems, (2) identify the features of e-systems that most significantly impact satisfaction, and (3) evaluate the relationship between satisfaction and the university's reputation. The analysis spans two academic years - 2018/2019 (pre-pandemic) and 2019/2020 (onset of the pandemic) - to provide a comparative perspective and explore how the role of e-systems evolved in response to external pressures. By doing so, the study not only addresses an empirical research gap but also offers insights into how universities can better align digital administrative services with students' expectations.

THEORETICAL FRAMEWORK

Student Satisfaction and University Reputation

In the context of higher education, student satisfaction is widely recognized as a key determinant of institutional success. It influences student loyalty (Helgesen & Nettet, 2007),

alumni engagement (Sung & Yang, 2009), and postgraduate decisions (Priporas & Kamenidou, 2011). Satisfaction stems from the perceived value of services offered in relation to expectations and costs (Coulter & Coulter, 2003; Staniec et al., 2023) and reflects the overall student experience, including both academic and organizational dimensions (Kireyeva et al., 2024).

University reputation, in turn, is shaped by stakeholder perceptions (Aras et al., 2017; Lacmanović & Škare, 2024; Maama, 2024) and has been found to influence students' initial university choice (Crispell, 1993; Dennis et al., 2016; Samoliuk et al., 2024), brand attachment (Dennis et al., 2016), and competitive positioning (Brown & Mazzarol, 2009; Kichurchak et al., 2024). Several studies demonstrate a bidirectional relationship, where satisfaction can reinforce reputation and vice versa (Gruber et al., 2010; Qazi et al., 2021). Despite this, the role of non-academic factors - particularly digital administrative services - in shaping both satisfaction and reputation has received limited attention.

Role of Administrative E-Systems in Higher Education: Quality Indicators

The digitalization of academic administration has become an integral part of the student experience, especially following the COVID-19 pandemic, which forced universities to accelerate the adoption of remote services (Bánhidi & Lacza, 2020; Hudrea et al., 2023; Pokhrel & Chhetri, 2021; Sułkowski et al., 2024). Administrative e-systems - responsible for processes such as enrolment, grade reporting, and formal documentation - support the academic journey alongside teaching platforms. However, while teaching-related systems have been thoroughly explored in literature, digital administration tools remain underexamined.

This oversight may be due to the traditional view of administrative systems as background infrastructure. However, as students increasingly interact with universities through digital channels, including non-academic tasks, these systems become more visible and impactful. As noted by Sofroniou et al. (2020), the quality-of-service organization and administrative support significantly influence overall student satisfaction. Similarly, Ramirez (2025) and Chandra et al. (2019) indicate that service quality across all university operations - educational and administrative - contributes to university reputation.

In the absence of a rich body of literature focused specifically on university administrative e-systems, this study draws upon well-established frameworks from research on university e-learning platforms. It is reasonable to hypothesize that the quality dimensions critical to educational technologies - such as ease of use, responsiveness, and data security - are also relevant in evaluating administrative tools. Students may not distinguish sharply between systems used for learning and those used for managing their academic status; rather, they expect both to meet high standards of usability and accessibility.

Based on this rationale, the study adapts eight quality dimensions from prior literature to assess administrative e-systems. These include:

1. **Functionality:** the extent to which a system enables students to complete key tasks (Harfoushi & Obiedat, 2011; Farid et al., 2018; Omona et al., 2011).
2. **Intuitiveness:** ease of navigation and clarity of system design (Garrett, 2010; Peltekova et al., 2015; Idkhan & Idris, 2023).

3. Interface layout: visual and structural organization (Hofer & Halman, 2005; Sharma et al., 2015).
4. Responsiveness/speed: system performance and efficiency (Kadry & El Hami, 2019).
5. Task integration: how comprehensively student affairs are managed within the system (Ibarrientos, 2015; Schuh et al., 2016).
6. Reliability and availability: system uptime and consistency (Immonen & Niemelä, 2008; Malkawi, 2013).
7. Security and data protection: legal and ethical safeguards, particularly considering GDPR (Phuoc et al., 2016; GDPR, 2016).
8. Mobile accessibility: adaptation to student use on mobile devices (Zhezhnych et al., 2020; Huang & Ma, 2020).

These indicators provide a comprehensive framework for evaluating how administrative systems affect students' perceptions and, by extension, their overall satisfaction and view of the institution.

Identified Research Gap

Despite their practical importance, administrative e-systems remain largely absent from theoretical models linking service quality to student satisfaction and university reputation. Most frameworks concentrate on teaching performance and branding (Gruber et al., 2010; Helgesen & Nasset, 2007; Davidavičiene et al., 2023; Potjanajaruwit, 2023), while back-office digital tools - despite their growing visibility - are overlooked. The limited empirical attention to administrative digital systems constitutes a significant research gap.

Moreover, much of the existing research predates the pandemic (e.g., Arbaugh, 2000; Hofer & Halman, 2005), failing to capture the expectations of digitally native student cohorts. The forced transition to remote administration has amplified the relevance of these systems, yet their evaluation remains under-theorized.

This study addresses this gap by investigating whether and how administrative e-system features influence student satisfaction and university reputation. It proposes a model integrating established quality dimensions and tests it empirically using data from Polish universities through correlation analysis and structural equation modelling (SEM).

METHODS

Research Methodology and Measurement Model

This study follows a quantitative design within a pragmatic mixed-method paradigm (Maarouf, 2019), combining empirical measurement with theoretical grounding. The conceptual model guiding the analysis was constructed prior to data collection and reflects the hypothesized relationships between system quality, student satisfaction, and perceived university reputation. Data was gathered through a structured online survey, which allowed for standardized assessment across a large and diverse student sample in Poland. The questionnaire included eight dimensions used to evaluate administrative e-systems, which

were operationalized as independent variables. Students were asked to rate each dimension using a 10-point Likert scale (1 = very low, 10 = very high). The assessed features were:

1. Functionality
2. Implementation
3. Intuitiveness
4. Speed
5. Interface
6. Reliability and availability
7. Data security
8. Adaptation

Two additional variables were measured: general satisfaction with the e-system and the student's perception of the university's reputation. These served respectively as a mediating and a dependent variable in the analytical model.

The data analysis was performed in several stages. Descriptive statistics were used to examine central tendencies and distributions. Nonparametric tests assessed differences across groups and periods. Correlation analyses and multiple regression models were applied to explore associations between variables. Finally, Structural Equation Modelling (SEM) was used to assess both direct and indirect effects within the conceptual model, particularly the mediating role of student satisfaction between system features and university reputation.

Demographics analysis

Data collection was conducted in two phases to capture both pre-pandemic and pandemic-era experiences:

- 2019: 2528 valid responses from 24 universities
- 2020: 4952 valid responses from 41 universities

The sample included students from a wide range of institutional profiles (table 1) (technical, humanities, economics, medical, arts, and others) and levels of study (table 2) (bachelor's, master's, long-cycle master's, and doctoral programs) who participated in a variety of e-system device sessions (table 3). Purposeful sampling ensured the inclusion of universities with varied e-system maturity and administrative structures.

Table 1. Characteristic of the sample surveyed - University profile [Source: own developed]

	2019		2020	
Universities' profile	N=2528	%	N=4952	%
Technical Universities	676	26.74%	1356	27.38%
Universities of Humanities	628	24.84%	1826	36.87%
Universities of Economics	535	21.16%	520	10.50%
Nature Universities	376	14.87%	601	12.14%
Medical Universities	141	5.58%	101	2.04%
Art Universities	78	3.09%	100	2.02%
Others	63	2.49%	325	6.56%
Universities of Physical Education	31	1.23%	123	2.49%

Source: own developed

Table 2. Characteristics of the sample surveyed – number of years of studies [Source: own developed]

	2019		2020	
	N=2522		N=4952	
Number of years of studies	N	%	N	%
1 year (bachelor's degree or uniform master's studies)	1000	39.56%	1626	32.84%
2 years (bachelor's degree or uniform master's studies)	524	20.73%	1038	20.96%
3 years (bachelor's degree or uniform master's studies)	440	17.40%	885	17.87%
4 years (only in engineering bachelor's degree or uniform master's studies or 1st year of master's studies after bachelor's degree)	295	11.67%	831	16.78%
5 years (uniform master's studies or 2nd year of master's studies after bachelor's degree)	239	9.45%	493	9.96%
6 years and more (phd)	30	1.19%	79	1.59%

Source: own developed

Table 3. Device used to work with e-system¹ [Source: own developed]

	2019 N=2528		2020 N=4952	
	N	%	N	%
Device used to work with the e-system - computer	2231	88,4%	3957	79,91%
Device used to work with the e-system - tablet	188	7,4%	285	5,75%
Device used to work with the e-system - smartphone	1957	77,5%	3940	79,56%

¹ Respondents could indicate more than one answer.

RESULTS

Regression Results – Comparative Analysis 2019 and 2020

Regression models assessed the direct effects of individual e-system features on students' satisfaction and the perceived reputation of the university. Tables 4 and 5 show the results of the regressions. In both 2019 and 2020, functionality was the most powerful predictor of satisfaction ($\beta = 0.49$ in 2019; $\beta = 0.50$ in 2020). This indicates that the range and usefulness of system features were fundamental for student approval. The degree of implementation of student affairs remained the second most relevant factor ($\beta = 0.14$ in 2019; $\beta = 0.17$ in 2020), highlighting the value of integrated and task-oriented services. Intuitiveness ($\beta = 0.09$ in 2019; $\beta = 0.10$ in 2020) consistently influenced satisfaction, supporting the role of user-friendly design. Speed of operation showed moderate importance for satisfaction ($\beta \approx 0.08$ – 0.10), but its impact on reputation diminished in 2020 ($p = 0.388$). Interface layout was statistically significant in 2019 but less relevant in 2020 ($p = 0.140$), indicating a shift in students' priorities toward pragmatic rather than aesthetic attributes. Variables like reliability and security marginally affect satisfaction but have statistically significant effects on reputation, particularly in 2020. Interestingly, adaptation to mobile devices, which was not significant in 2019, gained slight importance in 2020, possibly due to increased reliance on smartphones during the pandemic.

The adjusted R^2 for the satisfaction model was stable across both years (Table 4 for 2019; Table 5 for 2020), indicating a strong explanatory power. The reputation model showed lower R^2 values (2019: 0.438; 2020: 0.393), as shown in the same tables, suggesting that other factors beyond e-system quality may shape perceptions of university reputation. Table 6 synthesizes the predictors' evolution from 2019 to 2020.

Table 4. Impact of predictors on students' satisfaction and the university's reputation in 2019 [Source: own developed]

<i>Predictors</i>	Overall level of student satisfaction with the e-system			The influence of predictors on reputation		
	<i>Estimates</i>	<i>CI (confidence level)</i>	<i>p</i>	<i>Estimates</i>	<i>CI (confidence level)</i>	<i>p</i>
(Intercept)	0.64	0.44 – 0.84	<0.001	1.89	1.62 – 2.15	<0.001
Functionality	0.49	0.46 – 0.53	<0.001	0.35	0.30 – 0.40	<0.001
Implementation	0.14	0.11 – 0.17	<0.001	0.11	0.07 – 0.15	<0.001
Intuitiveness	0.09	0.05 – 0.12	<0.001	0.11	0.06 – 0.16	<0.001
Speed	0.08	0.05 – 0.12	<0.001	0.05	0.00 – 0.09	0.035
Interface	0.06	0.03 – 0.09	<0.001	0.09	0.05 – 0.13	<0.001
Reliability	0.03	0.00 – 0.06	0.044	0.04	0.01 – 0.08	0.026
Security	0.03	0.00 – 0.07	0.024	0.06	0.02 – 0.10	0.006
Adaptation	-0.00	-0.03 – 0.02	0.784	-0.03	-0.06 – 0.01	0.142
Observations	2528			2528		
R ² / R ² adjusted	0.674 / 0.673			0.440 / 0.438		

Table 5. Impact of predictors on students' satisfaction and the university's reputation in 2020 [Source: own developed]

<i>Predictors</i>	Overall level of student satisfaction with the e-system			The influence of predictors on reputation		
	<i>Estimates</i>	<i>CI</i>	<i>p</i>	<i>Estimates</i>	<i>CI</i>	<i>p</i>
(Intercept)	0.45	0.31 – 0.59	<0.001	1.98	1.80 – 2.16	<0.001
Functionality	0.50	0.47 – 0.52	<0.001	0.36	0.33 – 0.40	<0.001
Implementation	0.17	0.15 – 0.19	<0.001	0.12	0.10 – 0.15	<0.001
Intuitiveness	0.10	0.07 – 0.12	<0.001	0.07	0.04 – 0.11	<0.001
Speed	0.10	0.07 – 0.12	<0.001	0.01	-0.02 – 0.05	0.388
Interface	0.06	0.04 – 0.09	<0.001	0.02	-0.01 – 0.05	0.140
Reliability	0.00	-0.02 – 0.03	0.838	0.04	0.01 – 0.07	0.006
Security	0.00	-0.02 – 0.03	0.721	0.05	0.02 – 0.08	0.001
Adaptation	0.01	-0.01 – 0.03	0.231	0.02	-0.01 – 0.04	0.192
Observations	4952			4952		
R ² / R ² adjusted	0.680 / 0.679			0.394 / 0.393		

Table 6. Predictors' evolution from 2019 to 2020 [Source: own developed]

Predictor	Satisfaction		Reputation	
	2019	2020	2019	2020
Functionality	0.49	0.5	0.35	0.36
Implementation	0.14	0.17	0.11	0.12
Intuitiveness	0.09	0.1	0.11	0.07
Speed	0.08	0.1	0.05	0.01
Interface	0.06	0.06	0.09	0.02
Reliability	0.03	0	0.04	0.04
Security	0.03	0	0.06	0.05
Adaptation	0	0,01	-0.03	0.02

Shifts in Student Priorities and Evaluations

A notable shift occurred between 2019 and 2020 (see Figure 1). In 2019, students placed relatively equal emphasis on visual layout and intuitive features. However, in 2020, priorities clearly shifted toward system responsiveness, functionality, and task integration. Visual or aesthetic attributes such as interface layout became less influential.

Although reliability and security did not significantly influence satisfaction in either year, their impact on the university's reputation became more pronounced in 2020. This suggests that, in times of crisis, these features have more potential to contribute to perceptions of institutional trustworthiness than to direct user satisfaction.

Conversely, features such as mobile compatibility, although not statistically significant in either year, showed trends in students' expectations upward. The lowered impact of visual appeal and speed in 2020 further confirms a transition in users' evaluation criteria, where practical performance outweighed style and surface-level design.

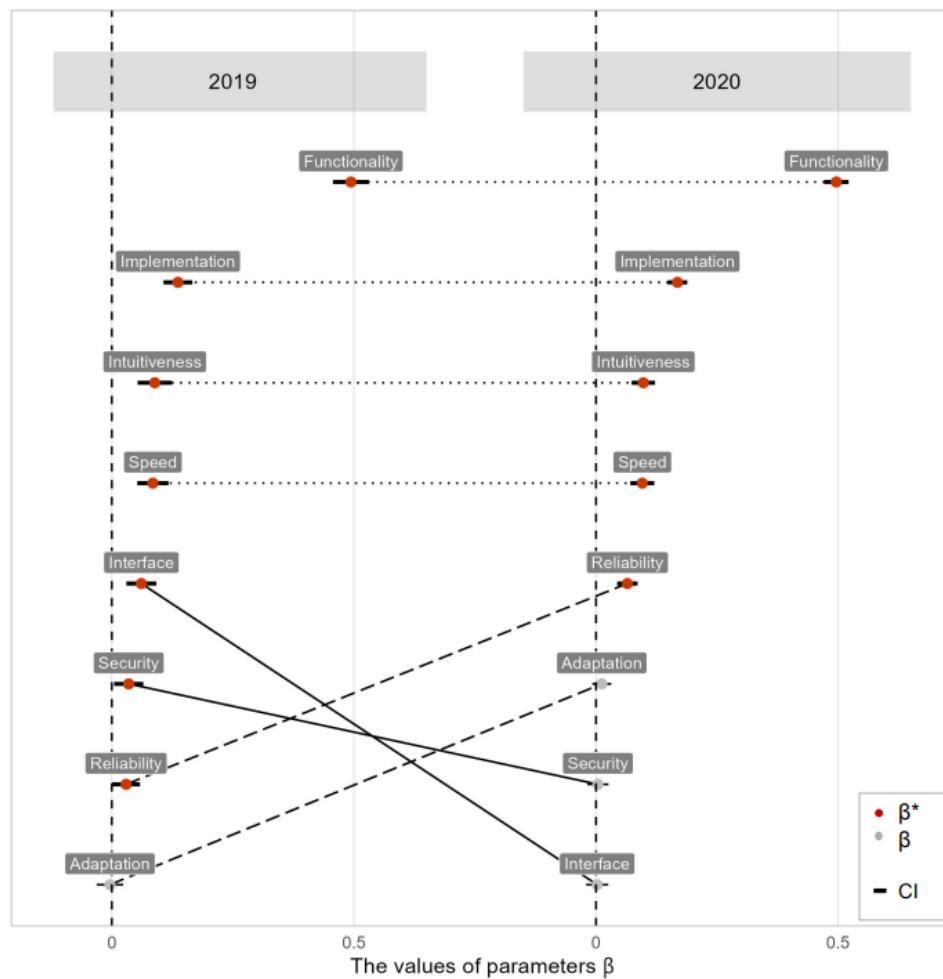


Figure 1. Changes in the assessment of the importance of selected E-system functions [Source: own developed]

Structural Equation Modelling (SEM) Findings

To provide a more nuanced understanding of how various e-system features affect perceived university reputation, Structural Equation Modelling (SEM) was applied for both the 2019 and 2020 datasets. The SEM allowed for testing both direct and indirect effects of e-system quality on reputation, with student satisfaction as a mediating variable.

Before proceeding, it is necessary to verify the adequacy of the sampled data using the KMO (Kaiser-Meyer-Olkin) and Bartlett's sphericity test. Table 7 shows the results performed by SPSS v. 27. All indicators are good, which means that the sampled data are adequate for both years. The limits are: (i) $KMO > 0.9$ for excellence; (ii) significance of the sphericity test < 0.05 , which means that the sampled data differs from an identity matrix.

Table 7. Assessment of adequacy of the sampled data. [Source: own developed]

Test		2019	2020
Sphericity test Approx. Chi-Square	KMO	0,910753	0,906676
	df	11205,04	21603,19
	Sig.	28	28
		0	0

In 2019, the model confirmed a strong mediating role of satisfaction. The influence of e-system features - such as functionality, implementation scope, and intuitiveness - was mostly indirect, operating through their impact on student satisfaction. The direct paths from these features to reputation were statistically weaker or non-significant. This suggests that in a pre-pandemic context, the way students felt about their administrative system largely shaped their perception of the university's reputation. Satisfaction served as a key transmission channel for reputational outcomes.

In contrast, the 2020 model revealed a shift in this dynamic. While satisfaction still played a role, the direct effects of e-system features on reputation became statistically significant and more substantial. Features like functionality and reliability began to affect students' perception of institutional reputation even when satisfaction was held constant. This shift indicates that in a crisis context - where digital infrastructure became a visible, essential element of the student experience - students began evaluating universities more directly on their technological responsiveness.

To validate the model fit and the reliability of conclusions, the following SEM quality indicators were assessed:

- Chi-square/df (χ^2/df): Values below 3.0 indicated acceptable model fit in both years.
- Comparative Fit Index (CFI): CFI was 0.932 in 2019 and 0.951 in 2020, both exceeding the 0.90 threshold for acceptable fit.
- Tucker–Lewis Index (TLI): TLI values of 0.921 (2019) and 0.944 (2020) confirmed a strong fit.
- Root Mean Square Error of Approximation (RMSEA): Values were 0.045 (2019) and 0.037 (2020), both below the commonly accepted cut-off of 0.06, indicating excellent approximation.
- Standardized Root Mean Square Residual (SRMR): Results below 0.08 in both years supported model validity.

These fit indices collectively indicate that both models adequately represent the empirical data, with slightly stronger performance in 2020. The standardized path coefficients for direct effects increased, while indirect coefficients via satisfaction slightly declined. The SEM thus captured a key behavioral shift: students transitioned from viewing digital systems as background utilities to treating them as frontline services that define institutional identity. The SEM findings reinforce the results of the regression analysis, but they also reveal more subtle dynamics. They show that context matters - in stable periods, satisfaction is a sufficient mediator; in uncertain times, system performance gains standalone reputational weight. This insight has important implications for digital strategy and student engagement in higher education.

Figures 2 to 5 show the measurement models considered for SEM analysis. Only loads greater than or very close to 0.707 were considered in the models. A loading of 0.707, when squared, results in 0.5, meaning that it explains 50% of the variance present in the sampled data. In practical terms, it reflects a moderate and positive relationship between two variables. A loading of this magnitude ensures the strength of a relationship, such as targeted in SEM applications or when a variable is associated or not with a particular construct, factor or component.

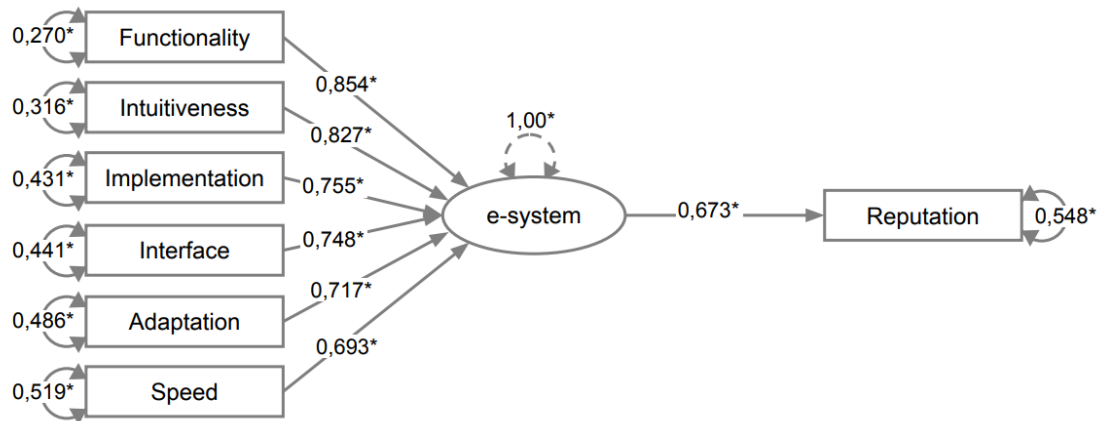


Figure 2. Direct impact of the hidden variable E-system on university reputation in 2019. [Source: own developed]

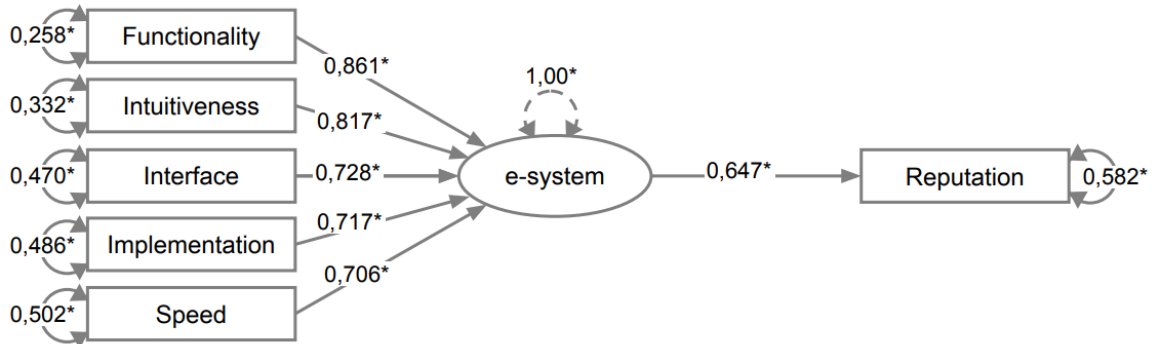


Figure 3. Direct impact of the hidden variable E-system on university reputation in 2020. [Source: own developed]

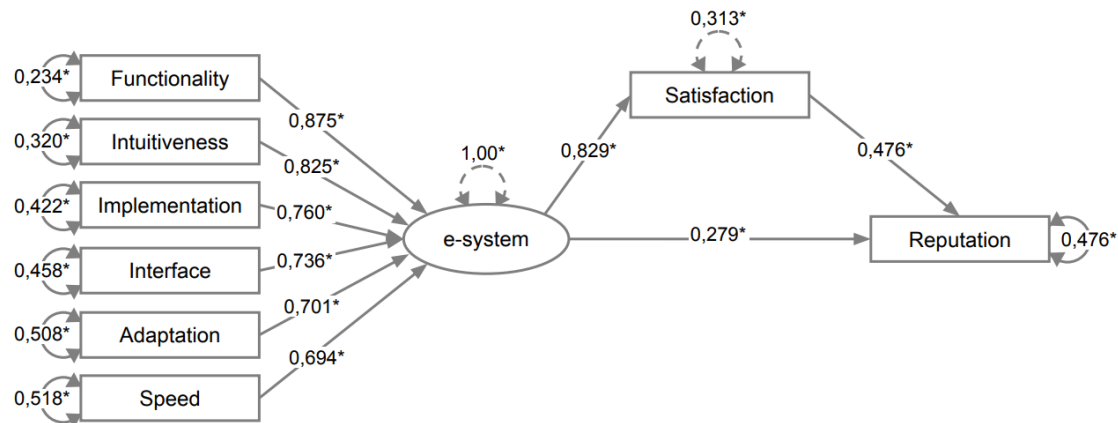


Figure 4. Indirect impact of the hidden variable E-system on university reputation in 2019. [Source: own developed]

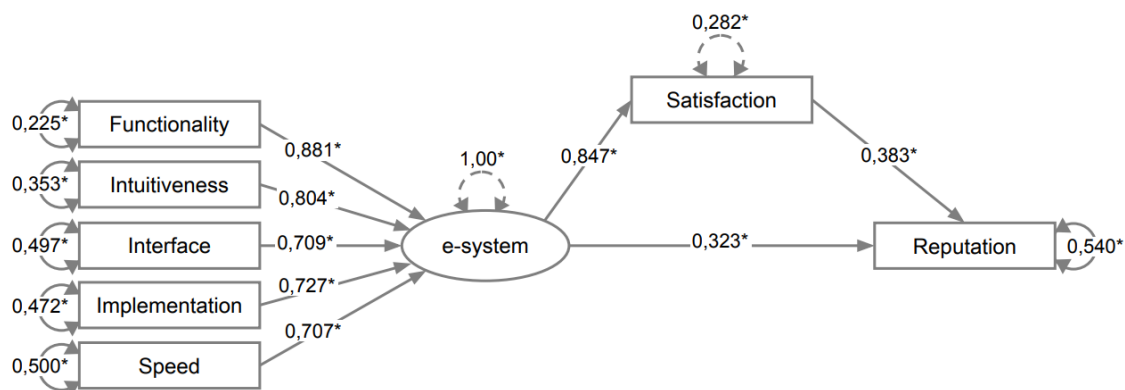


Figure 5. Indirect impact of the hidden variable E-system on university reputation in 2020. [Source: own developed]

KEY FINDINGS AND DISCUSSION

The study's findings address the role of digital administrative systems in higher education, specifically their influence on student satisfaction and institutional perception. Examination of these findings demonstrates several points for university operations.

Functionality, implementation, and intuitiveness represent factors driving student satisfaction with e-systems. Functionality, which encompasses the range and utility of system features, consistently showed the highest correlation with satisfaction in both 2019 and 2020. The degree of implementation, referring to the integration of student affairs processes within the system, also contributed to satisfaction. Intuitiveness, defined as the ease of navigation and clarity of system design, similarly relates to student approval. These three system attributes contribute to user experience and relate to student satisfaction.

Security and reliability exhibit a greater correlation with university reputation than with student satisfaction. In 2019, these features showed a statistical correlation with reputation. In 2020, their influence on the university's reputation increased. This observation indicates that system reliability and data security affect perceptions of institutional capability, particularly when reliance on digital services increases.

In 2019, student satisfaction mediated the relationship between e-system attributes and the university's reputation. In 2020, the direct impact of e-system features on reputation became more evident. This shift indicates a change in the evaluation process; e-system performance gained independent weight in reputation assessment, alongside the influence of satisfaction. This change occurred under conditions of increased digital dependency.

Mobile adaptation represents an emerging expectation. While its statistical correlation with satisfaction or reputation remained limited in both study periods, student expectations for mobile compatibility show an upward trend. This indicates a future demand for e-system accessibility and functionality across mobile devices.

University reputation correlates with student perception of system efficiency and broader institutional context. E-system attributes, including functionality and reliability, contribute to institutional perception. The R^2 values for the reputation model, lower than for the satisfaction model, indicate that other factors, such as academic programs, research output, faculty standing, facilities, and student life services, also affect a university's reputation. E-systems constitute a component of reputation development.

These key results confirm that e-system quality significantly contributes to students' overall academic experience and the public perception of institutional competence, especially during times of systemic disruption.

Regarding future implementations of the survey, the number of manifest variables may be reduced from eight to six without significant loss of content. This stage of the study aimed to simplify the complexity of the eight functional features of e-systems by identifying underlying structures. The best solution found involved grouping these eight manifest characteristics into three main latent (or non-manifest) factors, which represent broader dimensions of system quality.

A factor analysis can be a useful tool to perform such a reduction. With the extensive introduction of telematics devices and the diffusion of online activities, there is no meaning in focusing on the 2019 pattern. Therefore, this study focuses on the 2020 sampled data. Table 8 shows the factor analysis and the loading pattern of the manifested variables. The best solution found after a try-and-error approach was three factors, obtained by principal component analysis and after a varimax rotation with Kaiser normalization. The rotation converged in seven iterations. The extraction of the factors explained 76.4% of the total variance of the sample data. SPSS v. 27 was used.

Table 8. Factor analysis of the sampled data of 2020. [Source: own developed]

Predictor	Component		
	1	2	3
Functionality	0,73	0,29	0,38
Implementation	0,78	0,31	0,19
Intuitiveness	0,71	0,19	0,47
Speed	0,26	0,70	0,48
Interface	0,45	0,21	0,71
Reliability	0,15	0,79	0,38
Security	0,45	0,73	0,01
Adaptation	0,24	0,27	0,81

The first-factor groups functionality, implementation (of student affairs scope), and intuitiveness. This suggests that these three characteristics are perceived by students as intrinsically linked and, collectively, can be understood as application issues. The implication is that the core user experience with the e-system lies in its ability to perform tasks effectively and understandably. For university managers, the priority should be to ensure that systems are robust in their functionalities, comprehensive in their ability to integrate services, and simple to use, as these are the pillars of application-related satisfaction.

The second factor comprises speed, reliability, and security. These characteristics form a cohesive group that can be termed technical issues. This factor underscores the importance of the underlying technological infrastructure. The direct implication for university management is that investments in performance, stability, and data protection are crucial, as failures in any of these areas can undermine user trust and institutional reputation, regardless of functionality (Chiappetta, 2017). The perception that the system is technically sound is fundamental for its acceptance and continued use.

The third factor is composed of interface (layout) and adaptation (mobile accessibility). These two variables can be consolidated as user issues. This factor highlights the importance of design experience and flexibility of access. Although the study notes that interface layout became less relevant in 2020 compared to functionality, its combination with mobile adaptation indicates that ease of interaction and ubiquity of access are crucial aspects of the user experience. Universities' managers should, therefore, focus not only on aesthetics but also on usability and responsiveness across different devices to meet the expectations of a digitally native cohort.

By identifying these three latent factors, university managers can direct their improvement efforts more strategically. Instead of treating eight characteristics in isolation, they can focus on three broad areas of intervention: optimizing the application experience (tasks and usability), strengthening the technical foundation (performance and security), and enhancing the user interface and accessibility. This allows for more efficient resource allocation and more integrated project planning.

For example, an "application issues" problem suggests the need for process review, workflow design, and user training. In contrast, a "technical issues" problem would require interventions in IT infrastructure, servers, and security protocols.

It is possible to reduce the first and second factors by eliminating one of the manifested variables from both. One way to identify what indicator can, if deleted, produce less damage to the content is to measure Cronbach's alpha for the entire construct after removing one indicator at a time. The Cronbach's Alpha analysis for item deletion validates the integrity of the construct even with the exclusion of specific variables. This ensures that the representation of e-system quality remains valid and reliable but in a more concise manner. Maintaining a high Cronbach's Alpha after removing "Implementation" and "Security" confirms that the underlying constructs are still adequately measured by the remaining variables. Table 9 shows the result, which ensures that the best deletions are implementation and security.

Table 9. Cronbach's alpha if item deleted. [Source: own developed]

Predictor	Alpha if item deleted
Functionality	0.72
Implementation	0.83
Intuitiveness	0.77
Speed	0.67
Reliability	0.69
Security	0.82

The factor analysis also pointed to the possibility of reducing the number of manifest variables without significant loss of content. Specifically, the study suggests that Implementation and Security could be removed from future measurements, reducing the set from eight to six indicators. A reduced number of questions in future surveys would lessen the burden on respondents (students), potentially increasing response rates and data quality. Shorter questionnaires are less prone to causing respondent fatigue. For subsequent analyses (such as regression or SEM), variable reduction leads to more parsimonious models, which can facilitate the interpretation and replicability of results. By removing variables that are well-represented by others within the same factor or that have less impact on the explained variance, the measurement model becomes leaner and more robust.

In summary, the conclusions from the factor analysis and variable composition optimization offer a practical and conceptual roadmap for universities and researchers. They enable understanding of e-system quality not as a set of isolated elements but as interconnected dimensions. They also facilitate the development of more efficient and impactful evaluation tools that are aligned with student priorities in the digital age.

CONCLUSIONS AND LIMITATIONS

This study investigated the extent to which the perceived quality of administrative e-systems affects student satisfaction and the reputation of higher education institutions. The analysis responded to the core research problem: whether administrative e-system attributes contribute significantly to shaping institutional reputation and whether this relationship is mediated by student satisfaction.

The results clearly demonstrate that e-system functionality, degree of integration, and intuitiveness are consistently the most influential drivers of satisfaction. Furthermore, while in 2019, the effect of these features on reputation was mediated almost entirely through satisfaction, in 2020 - amid the COVID-19 pandemic - a significant direct relationship emerged. This shift signals that in times of heightened digital dependency, students form reputational judgments based more directly on their digital service experience.

However, several limitations must be acknowledged. First, the research is limited to Polish universities, and the findings may not be fully generalizable to other higher education systems. Second, the analysis relies on cross-sectional data from two distinct time points;

future longitudinal studies could capture more nuanced dynamics in student evaluations. Third, the study uses self-reported measures, which can be subject to perception bias.

IMPLICATIONS FOR RESEARCH

Our findings contribute to a growing body of literature by highlighting administrative digital services - not traditionally central in satisfaction-reputation frameworks - as meaningful determinants of student perception. They also illustrate how the structure of student evaluation evolves in response to external disruptions. In this regard, the study supports a more inclusive understanding of digital transformation in higher education, one that encompasses not only e-learning tools but also the usability and performance of administrative systems.

Despite its limitations, this research offers robust empirical support for integrating administrative e-system quality into broader models of student satisfaction and institutional reputation. The findings provide actionable insights for university management: improving digital service design and system responsiveness is not merely a matter of convenience - it is a strategic lever in shaping institutional standing in the eyes of digital-native students.

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