



Navigating the Digital Age: A Study on E-Payment Systems at a Comprehensive University in Manila

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Abstract- Adopting electronic payment (e-payment) systems has become imperative for higher education institutions (HEIs) to advance financial transaction efficiency, security, and user convenience. This study evaluates the effectiveness and challenges of implementing an e-payment system at a comprehensive private university in Manila. Specifically, it examines how system quality—defined by security, reliability, usability, and responsiveness—affects operational efficiency, system effectiveness, and user satisfaction. Employing a mixed-methods design, the research gathered quantitative data from 378 student respondents across three major faculties (Arts and Letters, Engineering, and Pharmacy) and qualitative insights through semi-structured interviews and focus group discussions. The Technology Acceptance Model (TAM) and the DeLone and McLean Information Systems Success Model (D&M) were theoretical frameworks. Analytical techniques included descriptive and inferential statistics (regression analysis, ANOVA, Pearson correlation) alongside thematic analysis. Findings reveal that system quality predicts reduced transaction times, lower error rates, and higher user satisfaction. Nevertheless, technical and behavioral barriers—such as system downtime, cybersecurity risks, and resistance to digital innovation—hamper complete optimization. Operational efficiency and system effectiveness were identified as mediators enhancing the relationship between system quality and user satisfaction. This research offers original contributions by situating e-payment adoption within the Philippine HEI context, addressing a critical gap in localized scholarship. It also advances national digital transformation objectives and aligns with the Sustainable Development Goals (SDGs), particularly Goals 4 (Quality Education) and 9 (Industry, Innovation, and Infrastructure). Practical recommendations include enhancing system responsiveness, strengthening cybersecurity infrastructure, and implementing digital literacy programs to support inclusive, resilient digital ecosystems in HEIs.

Keywords: E-Payment System, Higher Education, Operational Efficiency, User Satisfaction, Digital Transformation, System Effectiveness.

I. Introduction

Digital transformation has reshaped multiple sectors globally, with the education and financial industries experiencing some of the most significant shifts. The rise of Electronic Payment (E-Payment) systems in Higher Education Institutions (HEIs) reflects this transformation. These systems have evolved as essential tools for simplifying financial transactions, enhancing institutional transparency, reducing manual workload, and improving student engagement with administrative services. In developing nations like the Philippines, the need for accessible, secure, and reliable digital payment infrastructures is especially critical. The COVID-19 pandemic underscored this necessity, propelling the adoption of digital platforms to facilitate the continuity of education and essential services.

While the advantages of e-payment systems are evident, several barriers often challenge their practical implementation in educational settings. Cybersecurity threats, intermittent system outages, varying degrees of digital literacy, and resistance to technological change remain prevalent concerns. In particular, institutional capacity to respond to technical difficulties, ensure inclusive user training, and adapt to evolving user needs determines whether the system becomes an enabler or an obstacle.

This study focuses on a private comprehensive university in Manila, exploring the impact of its e-payment system on operational efficiency, perceived effectiveness, and user satisfaction. The research evaluates system quality indicators such as usability, security, reliability, and responsiveness based on the Technology Acceptance Model (TAM) and the DeLone and McLean Information Systems



Success Model. Employing a mixed-methods design, this study integrates student feedback through quantitative and qualitative data to formulate actionable insights.

The central research question asks: How can higher education institutions optimize E-Payment systems to improve operational efficiency, effectiveness, and user satisfaction? The study offers evidence-based recommendations with relevance for institutions aiming to improve service delivery in digitally transforming contexts, particularly across Southeast Asia and other emerging educational economies.

II. Literature review/Study site

2.1 System Quality and Related Constructs in E-Payment Systems

The success of Electronic Payment (E-Payment) Systems in Higher Education Institutions (HEIs) hinges on multiple interrelated dimensions that define system quality and operational effectiveness. Core elements like security, reliability, usability, responsiveness, and system effectiveness influence key outcomes like operational efficiency and user satisfaction. This section reviews contemporary literature to provide a theoretical and empirical foundation for assessing these constructs within the context of digital payment adoption in HEIs.

2.1.1 Security

Security is a fundamental prerequisite for digital trust and system adoption. Encryption, two-factor authentication, and fraud detection protocols have significantly reduced cyber threats in university payment platforms (Khan et al., 2020; Althunibat, 2021). Institutions that regularly update systems and conduct security audits are more resilient against breaches (Hassan & Rahman, 2022). In the Philippines, an underdeveloped cybersecurity infrastructure remains a challenge, necessitating the formation of dedicated cybersecurity teams and improved user education (Patil et al., 2021; Zhang et al., 2023).

2.1.2 Reliability

Reliability refers to consistent system performance, especially during peak usage periods. Frequent downtimes, errors, or delayed processing negatively affect trust and satisfaction (Hassan & Rahman, 2022). Proactive maintenance and redundancy protocols increase system uptime, particularly during enrollment and fee payment periods (Zhou & Chen, 2023).

2.1.3 Usability

Usability encompasses how intuitively users can interact with the system. User-centered designs with simple interfaces, mobile compatibility, and multilingual support significantly boost adoption (Tella & Abdulmumin, 2019; Salloum et al., 2020). Studies in the Philippine setting (Raon et al., 2021; Lastrollo & Sario, 2023) confirm that usability enhances transaction success rates and reduces support service dependency.

2.1.4 Responsiveness

Responsiveness relates to the system's speed and support quality. Real-time transaction confirmations, chatbots, and 24/7 support improve the user experience (Bhattacharya & Srinivasan, 2020; Jones & Smith, 2021). Local challenges, such as limited server capacity and reduced responsiveness, suggest the need for infrastructure scaling (Gomez & Bautista, 2022).

2.1.5 Operational Efficiency

Operational efficiency reflects how well the E-Payment System reduces manual workload and enhances institutional financial workflows. Automation of reconciliation processes and real-time tracking reduces processing errors and administrative costs (Bhattacharya, 2020; Raon et al., 2021; Villanueva et al., 2023). However, infrastructure limitations and policy gaps can reduce potential gains, especially in developing countries (Nasir et al., 2020).

2.1.6 User Satisfaction

User satisfaction is a key outcome variable, reflecting the perceived success of an E-Payment system. Patil et al. (2021) argue that ease of use, reliability, and security strongly influence student satisfaction. Visconti-Caparrós and Campos-Blázquez (2021) recommend incorporating real-time



confirmation and simplified refund processes to improve user trust. In the Philippine context, structured training programs have been shown to enhance user experience and satisfaction (Sison & Cruz, 2022).

2.1.7 System Effectiveness

System effectiveness encompasses the system's alignment with institutional goals and its ability to deliver secure, efficient, and satisfactory user experiences. Effective systems minimize downtime, enhance adoption, and integrate with existing financial systems (Zhou & Chen, 2023; Bhattacharya, 2020). Indicators include strong performance, high user adoption, regulatory compliance, and improved operational efficiency (Hassan & Rahman, 2022; Gupta et al., 2021). Patil et al. (2021) emphasize that intuitiveness and usability are crucial for sustained engagement. Salloum et al. (2020) further advocate for regular monitoring, adaptive improvements, and feedback mechanisms to maintain system relevance and reliability.

2.1.8 Implementation Challenges

Technical, behavioral, and policy-related barriers can inhibit successful E-Payment implementation. These include unreliable internet connectivity, outdated software, integration issues, and cybersecurity risks (Nasir et al., 2020; Gupta et al., 2021; Bhattacharya, 2020). Digital illiteracy and resistance to change also delay adoption (Kamau & Maina, 2020; Hassan & Rahman, 2022). Regulatory compliance issues further complicate deployment, particularly in institutions lacking clear policies or digital infrastructure (Zhou & Chen, 2023; Patil et al., 2021). Overcoming these challenges requires strategic investment, stakeholder engagement, and policy alignment.

2.2 Study Site

The research was conducted at a private, AUN-certified, and PACUCOA/PAASCU-accredited university in Manila. The institution offers many academic programs and caters to a large and diverse student population. The colleges of Engineering, Pharmacy, and Arts and Letters were selected for this study to provide varied insights into the adoption and user experience of the institution's centralized e-payment system.

III. Materials and Methods/Methodology

3.1 Research Design

A mixed-methods research design was adopted to provide a comprehensive view of the e-payment system's performance. Quantitative components were used to measure user perceptions of system quality, effectiveness, and satisfaction, while qualitative components explored user narratives to understand nuanced experiences and perceived challenges.

3.2 Participants and Sampling

Three hundred seventy-two students from the three identified faculties were surveyed using stratified random sampling. This ensured demographic and academic representation. For the qualitative portion, purposive sampling was employed to identify student users with extensive experience using the platform who could articulate their concerns, insights, and suggestions in greater detail.

3.3 Instruments

The quantitative instrument utilized a structured questionnaire with a six-point Likert scale ranging from Strongly Disagree to Agree Strongly. Key constructs included system quality (usability, security, reliability, responsiveness), operational efficiency, implementation challenges, system effectiveness, and user satisfaction. For the qualitative component, semi-structured interviews and FGDs were used to elicit open-ended responses.

3.4 Data Analysis

Descriptive statistics summarized key patterns, while inferential statistics such as t-tests, ANOVA, Pearson correlation, and multiple regression provided insights into relationships between variables. Qualitative data underwent thematic coding and triangulation to support or challenge the quantitative findings, ensuring a robust analysis framework.



IV. Results and Discussion

This section presents the findings organized by each research question, integrating quantitative and qualitative analyses. The combination of statistical evaluation and thematic interpretation allows a deeper understanding of the system's performance.

4.1 Demographic Profile of Respondents

A total of 378 respondents completed the survey. The majority of participants, approximately 99.74%, were aged between 18 and 25 years. In terms of gender, 59.79% identified as female students, suggesting there may be gender differences in preferences and experiences related to digital payments. Regarding digital payment usage, most participants, about 64.29%, were categorized as intermediate users of e-payment systems. This indicates they are somewhat familiar with these technologies but have not yet achieved complete digital fluency. The respondents came from a variety of academic disciplines. The largest groups were from Engineering, which comprised 35.45% of participants, followed closely by Arts and Letters at 34.66%, and Pharmacy at 29.89%. Respondents were distributed across all four academic year levels, with first-year students representing the largest group at 34.66%. Most respondents were first- or second-year students, reflecting their recent exposure to institutional systems. The survey highlights important demographic insights and students' usage patterns of digital payment systems. Understanding these trends can help us tailor solutions that effectively meet the needs of this demographic. These demographics reflect a digitally literate and academically diverse population, ensuring robust generalizability of the study's findings.

Table 1: Frequency Table of Demographics

Variable	Categories	Frequency	Percentage
Age	18-25	377	99.74%
	26-35	1	0.26%
Gender	Male	152	40.21%
	Female	226	59.79%
Familiarity with E-Payment System	Beginner	118	31.22%
	Intermediate	243	64.29%
	Expert	17	4.50%
Year Level	First Year	131	34.66%
	Second Year	113	29.89%
	Third Year	80	21.16%
	Fourth Year	54	14.29%
College/Faculty	Arts and Letters	131	34.66%
	Engineering	134	35.45%
	Pharmacy	113	29.89%

4.2 RQ1: Impact of E-Payment System Quality on Transaction Time, Error Rates, and User Satisfaction

Quantitative Findings: A multiple regression model ($R^2 = .63$) showed that usability ($\beta = .41$, $p < .001$), reliability ($\beta = .35$, $p < .01$), and responsiveness ($\beta = .28$, $p < .05$) significantly predicted performance outcomes. Security was not statistically significant. Usability emerged as the most influential factor in improving key performance indicators.

Table 2: Multiple Regression Analysis: System Quality vs. KPIs

Predictor	Unstandardized Coefficient (B)	Standard Coefficient (β)	t-value	Sig. (p)
Usability	0.52	.41	6.23	<.001
Reliability	0.44	.35	5.41	<0.1
Responsiveness	0.33	.28	4.02	<.05
Security	0.12	.08	1.45	.15
$R^2 = .63$				

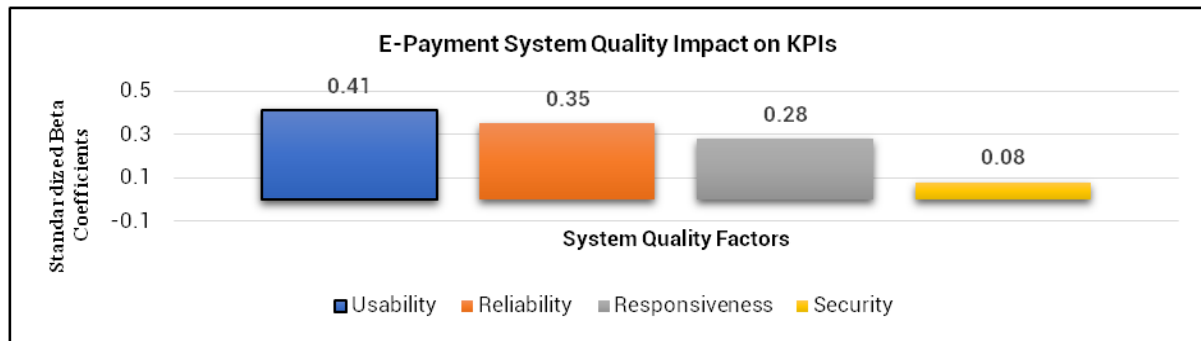


Figure 1: Standardized Beta Coefficients for System Quality Predicting KPIs

Figure 1 illustrates the relative impact of each quality dimension on KPIs. The graph emphasizes usability as the most significant factor, indicating how system design and user interface directly influence user experience and task efficiency.

Qualitative Insights: Participants consistently highlighted the importance of usability and feedback mechanisms in their experiences. Positive remarks included a student from Engineering who expressed increased trust in a system that "does not crash and loads instantly." In contrast, a Pharmacy student noted frustration with the system's failure to load during busy enrollment periods. Another student from Arts and Letters appreciated the reassurance provided by receiving confirmation at each step, contrasting with a fellow student who felt anxious when confirmations were lacking. Overall themes identified from the feedback included ease of navigation, the necessity of feedback and confirmation, and the establishment of trust through system responsiveness.

Integrated Discussion: The importance of usability and responsiveness is highlighted in research by Chen et al. (2021), which found that an intuitive interface and effective system feedback loops are crucial for fostering digital trust. Similarly, Al-Sharafi et al. (2022) noted that students tend to quickly disengage from platforms that lack transparency and provide insufficient immediate feedback. These findings are consistent with ISO/IEC 25010, which recommends evaluating systems based on usability and operability, not just security protocols.

4.3 RQ2: Effects of Implementation Challenges on Operational Efficiency and System Effectiveness

Quantitative Findings: ANOVA results ($F = 8.73$, $p < .01$) confirmed that challenges in implementation significantly affect system performance. Respondents who reported frequent system errors or insufficient guidance scored notably lower in operational efficiency and system effectiveness.

Table 3: ANOVA: Impact of Implementation Challenges on System Performance

Source	Sum of Squares	Df	Mean Square	F	Sig. (p)
Between Groups (Challenges)	5.78	2	2.89	8.73	<.01
Within Groups	12.43	75	0.17		
Total	18.21	77			

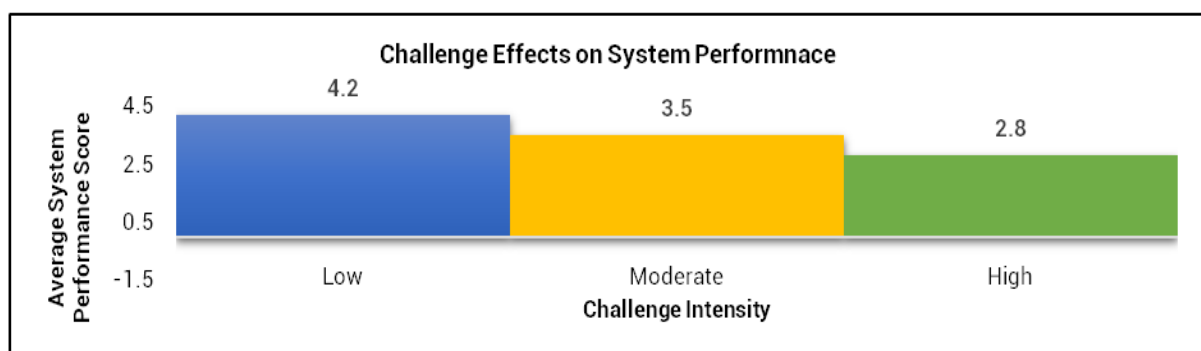


Figure 2: Mean System Performance by Implementation Challenge Group

Figure 2 categorizes respondents based on perceived challenge intensity (low, moderate, high) and illustrates the decline in system performance as challenge levels increase.

Qualitative Insights: The qualitative insights reveal several recurring issues, including system outages, inadequate technical support, and unclear procedures. One student from the Arts and Letters department noted, "The interface is decent when it works, and I appreciate the mobile access." However, other students raised concerns about the training provided. A student from Engineering mentioned, "The training was insufficient, which led to errors that delayed payments," while another student added, "It's confusing when there is no guidance on how to use it." Overall, the main themes that emerged include insufficient user training, unclear instructions, and frequent downtime during peak periods.

Integrated Discussion: Kusuma and Wang (2023) pointed out that inadequate implementation can undermine well-designed systems, particularly when institutions do not adequately prepare students. According to Musleh et al. (2021), system performance is closely linked to user competence and the support infrastructure provided. When students are uncertain about procedures or experience frequent technical disruptions, their perception of the entire system declines, even if its essential functions remain stable.

4.4 RQ3: Relationship Between Operational Efficiency and System Effectiveness

Quantitative Findings: Regression analysis revealed a strong and statistically significant relationship ($\beta = .59$, $R^2 = .52$, $p < .001$). This indicates that when systems operate efficiently—processing transactions quickly and accurately—users are more likely to view them as effective.

Table 4: Simple Linear Regression: Effect of Operational Efficiency on System Effectiveness

Predictor	Unstandardized Coefficient (B)	Standardized Coefficient (β)	t-value	Sig. (p)
Operational Efficiency	0.62	.59	8.01	<.001
$R^2 = .52$				

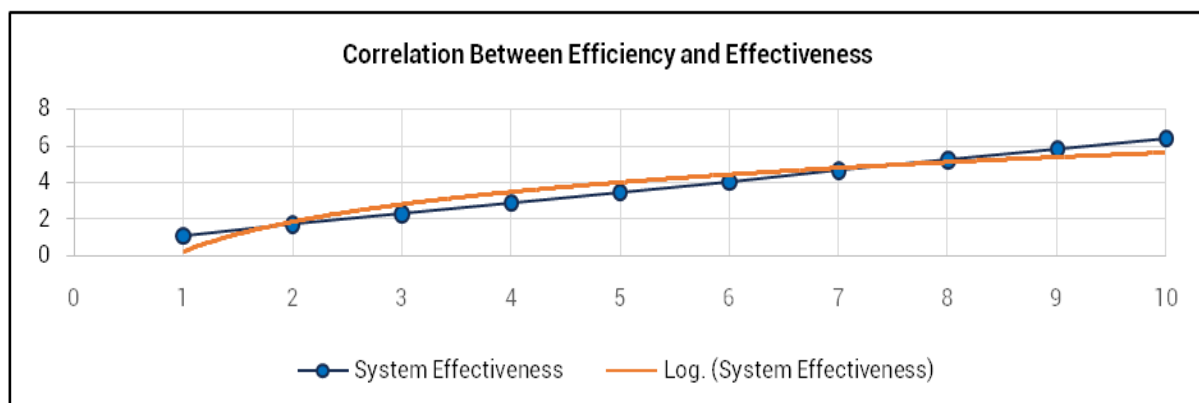


Figure 3: Relationship Between Operational Efficiency and System Effectiveness.

Figure 3 presents a scatter plot illustrating the positive correlation between these two variables.

Qualitative Insights: Students highlighted that effective systems minimize both steps and errors, with one student from Arts and Letters noting, "Fewer clicks and faster confirmations allow me to focus on my schoolwork," while a Pharmacy student criticized, "It's efficient only when the system is functioning properly; otherwise, it's chaos." The key themes identified in their feedback include speed and simplicity, reduced cognitive load, and error-free completion.

Integrated Discussion: These findings align with those of Musleh et al. (2021), who connected the efficiency of digital services to perceived usefulness and trust. Students perceive a system as effective when it involves fewer steps, shorter wait times, and consistent performance, particularly when these factors save time and reduce stress.

4.5 RQ4: Impact of Operational Efficiency on User Satisfaction

Quantitative Findings: Regression results indicated a strong positive influence ($\beta = .65$, $r = .74$, $p < .001$). Efficiency was a key driver of satisfaction, highlighting the significance of minimal wait times and effective error handling.



Table 5: Simple Linear Regression: Effect of Operational Efficiency on User Satisfaction

Predictor	Unstandardized Coefficient (B)	Standardized Coefficient (β)	t-value	Sig. (p)
Operational Efficiency	0.74	.65	9.34	<.001
r = .74				

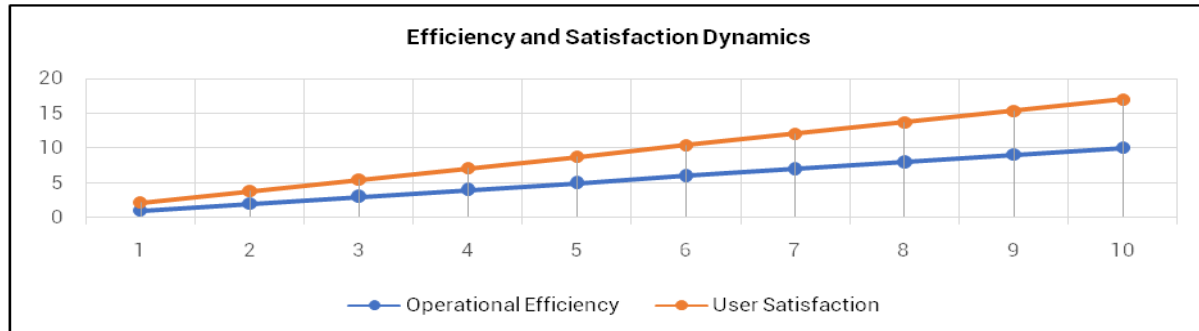


Figure 4: Efficiency and Satisfaction Dynamics

Figure 4 shows a line graph representing the increasing satisfaction as operational efficiency improves.

Qualitative Insights: Students expressed frustration with systems that were slow or required repeated inputs, highlighting two contrasting experiences. On the positive side, one student from the Pharmacy program noted, "If I finish a payment in seconds and receive a confirmation, that's convenience." On the other hand, a student from Engineering remarked, "It's not satisfying if I have to refresh the page three times just to get through." These comments underscore key themes of convenience, ease of completion, and time-saving design.

Integrated Discussion: Tian and Yu (2020) found that smooth operation and minimal effort required from users are crucial predictors of satisfaction. In higher education, where students often multitask and face strict deadlines, seamless digital services are essential. These findings support the idea that student satisfaction encompasses not only emotional aspects but also functional ones.

4.6 RQ5: Effectiveness of the E-Payment System Effectiveness and User Satisfaction

Quantitative Findings: The regression results presented in Table 6 indicate that both reliability ($\beta = .44$, $p < .001$) and usability ($\beta = .36$, $p < .01$) are significant predictors of user satisfaction. The model demonstrated a strong fit, with an R^2 value of .65, emphasizing the importance of consistent system performance.

Table 6: Multiple Linear Regression: Predicting Satisfaction Based on System Effectiveness Dimensions

Predictor	Unstandardized Coefficient (B)	Standard Coefficient (β)	t-value	Sig. (p)
Reliability	0.48	.44	7.22	<.001
Usability	0.36	.36	6.11	<.01
$R^2 = .65$				

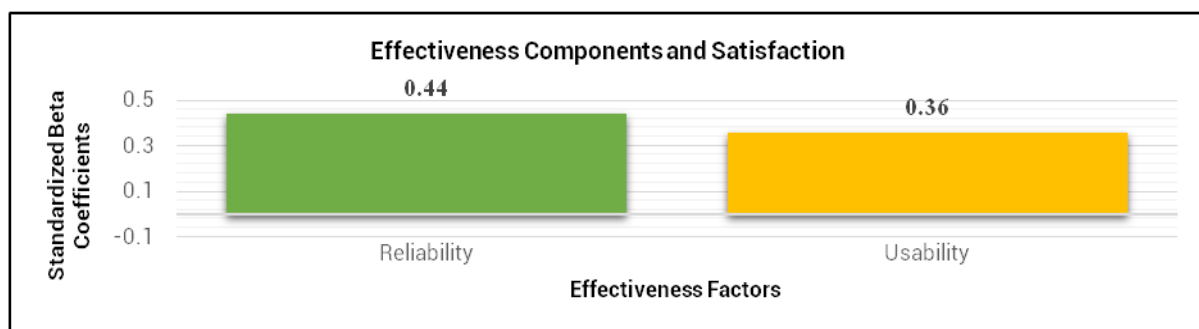


Figure 5: Effectiveness Components and Satisfaction



Figure 5 outlines these effectiveness components and their respective impact on satisfaction.

Qualitative Insights: Students directly associate their satisfaction with a system's ability to deliver reliable and error-free results. For instance, one student from Pharmacy stated, "Reliability makes the experience stress-free," highlighting a positive aspect of the system. Conversely, a student from Engineering expressed frustration, saying, "It's frustrating when the page freezes right after I input my details." These responses reflect key themes of consistency, task completion, and the importance of trust through reliability.

Integrated Discussion: Venkatesh and Davis (2021) argued that satisfaction with technology use is influenced by the ability to perform tasks consistently and with minimal cognitive effort. Their findings emphasize that students require systems that are not only functional but also effective in providing reliable outcomes.

V. Conclusion

This study concludes that the successful implementation and sustained use of e-payment systems in higher education requires more than technological capability. It demands a holistic, institution-wide approach integrating robust system design, consistent user support, well-defined operational policies, and a culture prioritizing responsiveness and transparency. The e-payment platform, therefore, functions not only as a financial tool but as a visible marker of institutional credibility, digital readiness, and service quality.

Findings affirm that students place high value on user-friendly, consistently available, and responsive systems. Digital trust is initially established through system reliability and usability, but is maintained through clear communication, feedback mechanisms, and a demonstrated presence of institutional support. Conversely, unresolved implementation challenges—poor infrastructure, limited technical support, and lack of training—undermine even the most technically sound systems, diminishing functionality and user confidence.

The study contributes to the literature by extending the Technology Acceptance Model (TAM) through empirical evidence showing that usability and reliability are not only predictors of acceptance but also essential for operational efficiency and emotional satisfaction. The qualitative findings reinforce that digital service breakdowns impact convenience and student trust in institutional competence.

Ultimately, e-payment systems serve as a nexus between technology and service delivery. As such, institutions must invest in their continuous improvement to streamline transactions and signal their broader commitment to innovation, accountability, and student-centered digital transformation.

VI. Ethical Approval

This study was conducted following ethical standards. Ethical clearance was granted by the University of Santo Tomas Research Ethics Committee (REC Code: GS2025-009). Informed consent was obtained from all participants, ensuring confidentiality and voluntary participation.

VII. Data Availability

All data supporting this study's findings—including anonymized survey responses, interview transcripts, and thematic codes—are available on Figshare at: [<https://figshare.com/>] under DOI: [Insert DOI here].

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