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Impact of System, Information, and Service Quality on Student Outcomes in Higher Education Video Conferencing

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Abstract

This study examines the impact of various qualities of video conferencing platforms on student satisfaction and academic achievement within the context of higher education. With the increasing integration of technology in educational settings, understanding these dynamics becomes crucial. The purpose of this research is to assess how system quality, information quality, and service quality of video conferencing tools influence educational outcomes. Employing Partial Least Squares Structural Equation Modeling(PLS-SEM), we analyzed responses from 236 university students. The findings reveal that both system and information quality significantly enhance student satisfaction and academic achievement, whereas service quality shows no significant effect. Satisfactino positivley affects academic achievenment. This research contributes to the field by highlighting the paramount importance of system and information quality over service quality in educational technologies.

요 약

본 연구는 고등교육 맥락에서 화상회의 플랫폼의 다양한 속성이 학생의 만족도와 학업성취도에 미치는 영향을 분석한다. 교육 현장에서 기술의 융합이 증가함에 따라 교육 정보 기술의 주요 요인을 이해하는 것이 더욱 중요해졌다. 본 연구는 대학 비대면 실시간 수업에서 화상회의 플랫폼의 시스템 품질, 정보 품질, 서비스 품질이 교육성과에 미치는 영향을 분석하는 것을 목적으로 한다. 대학생 236명을 대상으로 한 설문조사는 부분최소제곱 구조모형방정식을 활용하여 분석하였다. 연구결과, 시스템과 정보 품질 모두 학생의 만족도와 학업성취도를 유의하게 높이는 것으로 나타났으며, 서비스 품질은 유의한 영향을 미치지 않는 것으로 나타났다. 만족도는 학업 성취도에 유의한 영향을 미쳤다. 본 연구는 교육공학 분야에서 서비스 품질보다 시스템과 정보 품질의 중요성을 강조함으로써 교육현장에 기여한다.

Keywords

academic achievement, information quality, satisfaction, service quality, system quality, video conferencing

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Ⅰ. Introduction

The adoption of video conferencing platforms in higher education has surged, primarily driven by the need for flexible learning environments that can adapt to varying student needs and the rapid evolution of digital technologies[1]. The effectiveness of these platforms critically influences educational quality, impacting key outcomes such as student satisfaction and academic achievement[2][3]. Crucially, the transition to online learning platforms has highlighted the necessity of robust, user-friendly technology that can facilitate an interactive and engaging learning experience[4][5]. Studies have shown that the strategic implementation of such technologies can significantly enhance both the delivery of education and the educational outcomes[6]-[8]. Therefore, a deeper understanding of the determinants of video conferencing success is vital for optimizing these educational outcomes and ensuring the technology's effective integration into teaching strategies.

System quality, information quality, and service quality are critical components acknowledged as determinants of information system success, influencing various user-centered outcomes[9]. System quality enhances operational efficiency and user satisfaction, crucial for the seamless adoption of technology[10]. Information quality, through its relevance and accuracy, ensures that educational content meets learning standards and objectives, directly impacting educational effectiveness. Service quality provides essential support, helping users navigate and effectively utilize the technology. While these factors have been extensively studied across diverse sectors[11]-[15], their specific roles and impacts within the context of video conferencing for educational purposes remain underexplored and warrant a more focused investigation. The present study investigates how these dimensions of system quality, information quality, and service quality influence student satisfaction and academic achievement within the context of video conferencing used in higher education. This inquiry is crucial, particularly in light of the shift towards more digital and remote learning environments spurred by global challenges such as the COVID-19 pandemic[16].

The research employs a quantitative methodology, using a survey distributed among university students to assess their perceptions of system quality, information quality, and service quality, and how these perceptions influence their satisfaction and academic achievements. The use of Partial Least Squares Structural Equation Modeling (PLS-SEM) provides a robust method for analyzing complex model structures and multiple constructs that influence each other[17].

The findings of this study are expected to contribute to the theoretical literature by enhancing the understanding of how specific qualities of video conferencing platforms impact educational outcomes. Furthermore, these insights will have practical implications for educational technologists, university administrators, and policymakers aiming to improve the effectiveness of digital learning environments. Through a comprehensive analysis of the constructs derived from validated studies, this research addresses a significant gap in the existing literature on educational technology by detailing the nuanced relationships between the quality of service delivery systems and their direct effects on user satisfaction and academic performance in higher education settings.

Ⅱ. Research Hypotheses

2.1 System quality

System quality in video conferencing platforms is crucial for supporting communication and learning in higher education[18]. Efficient, reliable, and user-friendly platforms enhance student satisfaction by reducing frustration associated with technical issues[19].

Furthermore confirm that system quality directly influences both user satisfaction and academic achievement by promoting a more interactive and engaging video learning environment[20]. Therefore, this study proposes the following hypotheses:

H1a. System quality positively influences Satisfaction.

H1b. System quality positively influences academic achievement.

2.2 Information quality

Information quality is pivotal in video conferencing platforms, encompassing the relevance, accuracy, and timeliness of the content delivered[21]. High information quality of e-learning enhances the video learning experience and student satisfaction by providing essential, timely information suited to educational needs[2]. Further, superior information quality of video learning can significantly improve academic outcomes by facilitating a better understanding and retention of course material[22]. Consequently, this study suggests the following hypotheses:

H2a. Information quality positively influences Satisfaction.

H2b. Information quality positively influences academic achievement.

2.3 Service quality

Service quality within video conferencing platforms involves the extent of support and functionality provided to facilitate educational processes[23]. High service quality of online video learning can dramatically improve user satisfaction by ensuring smooth interaction without disruptions[24]. Additionally, effective support services enhance academic achievement by allowing students to focus more on video learning rather than on navigating the technology[25]. This leads to the development of the following hypotheses:

H3a. Service quality positively influences satisfaction.

H3b. Service quality positively influences academic achievement.

2.4 Satisfaction

Satisfaction with video conferencing platforms in higher education is fundamentally linked to academic achievement[26]. Satisfied students are more engaged and motivated, directly correlating to higher academic performance. Satisfaction from effectively meeting educational needs can lead to deeper understanding and enhanced learning effectiveness[27]. Thus, this study proposes the following hypothesis:

H4. Satisfaction positively influences academic achievement.

III. Empirical Methodology

3.1 Instrument development

The instrument development for this study involved a meticulous process aimed at ensuring the robustness and relevance of the constructs derived from previous validated studies. The questionnaire was structured into three parts. The first part gathered data on general use patterns and demographic information. The second part assessed users' perceptions of the main constructs: system quality, information quality, service quality, satisfaction, and academic achievement. The third part contained additional questions regarding users' experiences with convenient or inconvenient features of the video conferencing platforms.

To ensure content validity, a pre-test was conducted with experts from both academia and industry. This step involved reviewing the questionnaire to confirm that the items were representative of the constructs they were intended to measure and were relevant to the context of video conferencing in higher education.

Each item in the questionnaire was measured using a seven-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), allowing for a nuanced capture of participant responses.

3.2 Subjects and data collection

The study employed a survey approach to collect data, chosen for its efficiency in gathering large quantities of data and its effectiveness in capturing the perceptions and attitudes of a target sample. The target sample consisted of university students, selected because of their frequent engagement with video conferencing platforms for educational purposes. An online survey was created using Naver Form to facilitate easy access and distribution among potential respondents.

The main purpose of the study was to examine the impacts of system quality, information quality, service quality, and overall satisfaction on academic achievement using video conferencing platforms in higher education. The survey emphasized anonymity and voluntariness to ensure that respondents felt comfortable providing honest feedback without any repercussions. Data collection occurred from June 20 to June 30, 2021.

Following the collection, a pre-processing procedure was implemented to ensure the quality and consistency of the data. Data filtering criteria were applied to exclude incomplete or outlier responses to maintain the integrity of the statistical analysis. The sample size for this study was determined using an A-priori Sample Size Calculator for Structural Equation Models[28]. The parameters set for the calculation included an anticipated effect size of 0.1, a desired statistical power level of 0.8, the inclusion of 5 latent variables, and 15 observed variables, with a probability level of 0.05. Based on these parameters, the minimum required sample size was calculated to be 200. The actual sample size used in the study was 236, which exceeds the minimum requirement, thereby providing sufficient power to detect the expected effects and ensure robustness in the analysis of the data. This careful consideration of sample size supports the reliability and validity of the study's findings.

Table 1 provides a detailed demographic and academic profile of 236 university students using video conferencing platforms. The distribution by grade level indicates a majority of respondents are in their 4th year (44.1%), with a significant number of graduates (21.2%). Gender-wise, males constitute 71.2% of the sample. Students' major fields vary, with the highest representations in humanities (30.9%) and engineering (29.2%). The data also show the number of courses attended remotely, with the majority attending 5-6 courses (30.1%). The preferred platform is overwhelmingly Zoom, used by 82.2% of respondents.

Table 1. Profile of the respondents

Category	Description	Frequency	%
Grade level	Freshman	18	7.6
	Sophomore	22	9.3
	Junior	42	17.8
	Senior	104	44.1
	Graduates	50	21.2
	Total	236	100
Gender	Male	168	71.2
	Female	68	28.8
	Total	236	100
Major field	Humanities	73	30.9
	Social sciences	47	19.9
	Education	3	1.3
	Engineering	69	29.2
	Natural sciences	18	7.6
	Medicine and pharmacy	6	2.5
	Arts and physical education	20	8.5
	Total	236	100
Number of courses attended remotely (Courses)	1-2	39	16.5
	3-4	64	27.1
	5-6	71	30.1
	7-8	31	13.1
	9+	31	13.1
Platform type	Zoom	194	82.2
	YouTube	4	1.7
	Google classroom	1	0.4
	LMS (Learning Management System)	23	9.7
	Others	14	5.9
	Total	236	100

IV. Analysis and Results

This study strategically utilized Partial Least Squares Structural Equation Modeling(PLS-SEM) to analyze the data. Unlike traditional covariance-based SEM methods commonly employed in previous studies, PLS-SEM offers enhanced flexibility and robustness in handling complex models and non-normal data distributions[29]. This attribute is particularly advantageous in exploratory research or multidimensional studies like ours, where the model includes multiple constructs and intricate pathways. PLS-SEM not only handles large sets of predictor variables efficiently but also provides reliable results even with smaller sample sizes, making it superior in terms of applicability to diverse educational settings[30]. Moreover, PLS-SEM's ability to estimate latent variable scores directly contributes to a more nuanced understanding of the data, thus offering a methodological improvement over traditional techniques which might fail to capture such complexity effectively.

4.1 Reliability and validity

The measurement model was evaluated to determine the reliability and validity of the constructs used in this study, referencing the results from Table 2, Table 3, and Table 4. Factor loadings, as shown in Table 2, were all above the recommended threshold of 0.6[31], indicating adequate indicator reliability. Cronbach's alpha values for each construct were above the acceptable limit of 0.7, suggesting good internal consistency[32]. Composite Reliability(CR) scores were also well above 0.7, further confirming the reliability of the constructs. In terms of validity, the Average Variance Extracted(AVE) for each construct exceeded the 0.5 threshold[33], indicating satisfactory convergent validity.

Table 3's diagonal elements represent the square root of AVE for each construct, and were greater than the inter-construct correlations, confirming discriminant validity according to the Fornell-Larcker criterion[33]. Additionally, the Heterotrait-Monotrait ratio(HTMT) values from Table 4 were below the conservative threshold of 0.85[34], providing further evidence of discriminant validity.

Table 2. Factor analysis and reliability

Construct	Item	Factor loading	Alpha	CR (rho_c)	AVE
System quality	SYQ1	0.902	0.748	0.854	0.665
	SYQ2	0.882			
	SYQ3	0.637			
Information quality	INQ1	0.836	0.799	0.882	0.713
	INQ2	0.845			
	INQ3	0.853			
Service quality	SEQ1	0.902	0.881	0.926	0.807
	SEQ2	0.901			
	SEQ3	0.892			
Satisfaction	SAT1	0.925	0.906	0.941	0.841
	SAT2	0.902			
	SAT3	0.924			
Academic achievement	ACH1	0.925	0.894	0.934	0.825
	ACH2	0.906			
	ACH3	0.892			

Table 3. Correlation matrix and discriminant assessment

Construct	1	2	3	4	5
1. System quality	0.816				
2. Information quality	0.496	0.845			
3. Service quality	0.479	0.464	0.899		
4. Satisfaction	0.596	0.564	0.318	0.917	
5. Academic achievement	0.608	0.553	0.343	0.632	0.908

Note: Diagonal elements are the square root of AVE.

Table 4. HTMT matrix

Construct	1	2	3	4
1. System quality				
2. Information quality	0.645			
3. Service quality	0.591	0.553		
4. Satisfaction	0.715	0.651	0.349	
5. Academic achievement	0.693	0.655	0.383	0.689

4.2 Hypothesis test

SEM analysis was conducted to test and confirm the hypothesized relationships among the constructs of this study.

A bootstrap resampling method with 5000 resamples was conducted to check the significance of the hypotheses within the research model. The analysis results are described in Figure 1 and Table 5.

Table 5. Significance testing results of the structural path coefficients

H	β	T	P	Result
H1a	0.443	6.931	0.000	Supported
H1b	0.309	3.596	0.000	Supported
H2a	0.376	6.671	0.000	Supported
H2b	0.221	3.014	0.001	Supported
H3a	-0.069	1.261	0.104	Not supported
H3b	-0.011	0.129	0.449	Not supported
H4	0.327	4.489	0.000	Supported

V. Discussion

The discussion section delves into the significant and non-significant relationships revealed in the analysis of the structural path coefficients related to the quality and effectiveness of video conferencing platforms in higher education settings.

Starting with system quality, the analysis underscores a robust positive influence on satisfaction and academic achievement, as evidenced by the supported hypotheses H1a and H1b. This finding aligns with previous studies[35][36], which emphasized the critical role of system quality in enhancing user satisfaction and educational outcomes in tech-supported learning environments. The substantial beta values suggest that a high-quality system that is efficient, reliable, and user-friendly enhances student satisfaction and directly contributes to their academic success. These results reinforce the necessity for educational institutions to invest in superior technology to foster a conducive learning atmosphere.

In contrast, the results concerning service quality (H3a and H3b) indicate no significant effect on either satisfaction or academic achievement. This contradicts prior findings[37][38], where service quality was deemed essential for enhancing user satisfaction and learning outcomes. A possible interpretation of this discrepancy could be that students prioritize the functional aspects of the technology over the support services provided. This suggests that while service quality is generally important, its direct impact may be overshadowed by the more immediate effects of system functionality and information quality in virtual learning contexts.

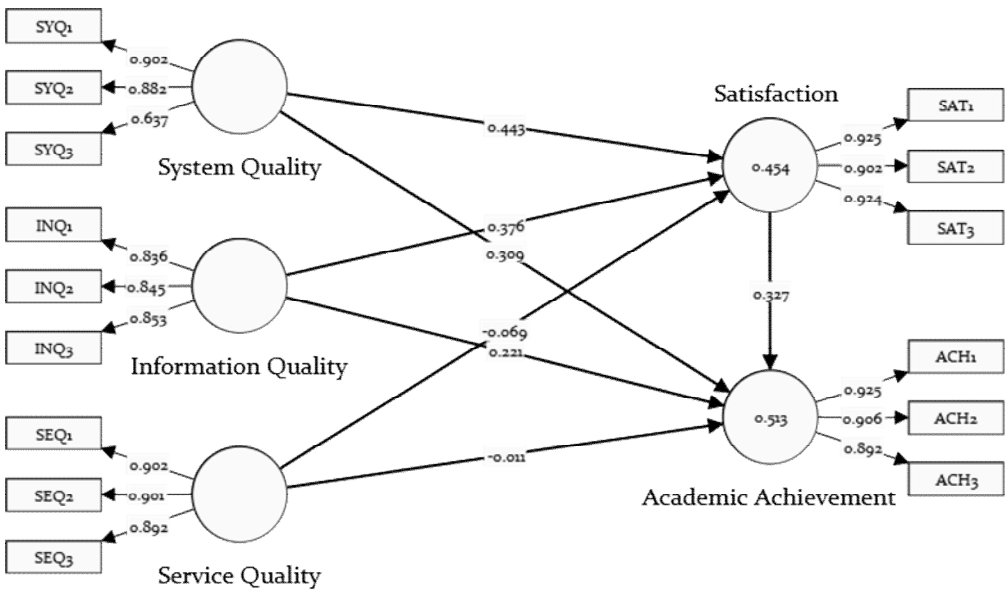

Fig. 1. SEM results

Information quality's impact on satisfaction and academic achievement (H2a and H2b) was also significant, supporting the contention that high-quality, relevant, and accurate content is critical in educational settings. This is consistent with the findings of previous works[9][39], which argued that the quality of information significantly affects learning satisfaction and outcomes. The relationship between high-quality information and academic achievement underscores the idea that educational content must be both accurate and timely to effectively support student learning, suggesting that educators and platform developers should focus on curating and delivering top-notch content.

Finally, the relationship between satisfaction and academic achievement (H4) was significantly positive, highlighting satisfaction as a crucial mediator in the educational process. This aligns with formers studies [40][41], which found that satisfaction with learning platforms significantly enhances academic outcomes. This finding suggests that satisfaction might operate as a key driver of student engagement and motivation, which are vital for academic success in virtual learning environments.

In summary, the analysis results offer deep insights into how different aspects of video conferencing platforms influence learning experiences in higher education. While system and information quality directly enhance satisfaction and academic achievement, service quality does not show a significant impact, suggesting that the core functionalities of the platform are more critical to student outcomes than the ancillary support services. These insights are crucial for educational technology developers and providers aiming to enhance the effectiveness of virtual learning environments.

Ⅵ. Conclusion

This research extends the understanding of the role that various qualities of video conferencing platforms play in higher education. Prior studies have emphasized the importance of system quality and information quality in educational contexts, noting their positive impacts on student satisfaction and academic achievement[35][39]. However, this study uniquely identifies that, contrary to expectations and previous findings[37][38], service quality does not significantly influence satisfaction or academic achievement in the realm of video conferencing used for higher education. This suggests that the technical aspects of a system, such as functionality and information accuracy, are more crucial than the support services provided. Scholars should consider this differentiation in future studies, potentially examining how and why the importance of service quality may differ based on educational settings or technological advancements. This insight encourages a reevaluation of the weight assigned to different system qualities in educational technology research. Further, this research significantly enhances the existing literature on video conferencing platforms in higher education by exploring the nuanced roles of system, information, and service quality in student outcomes. Unlike many existing studies that generally affirm the importance of all three dimensions[35][39], this study provides a differentiated view, especially highlighting that service quality does not impact student satisfaction or academic achievement as significantly as previously thought. By pinpointing this discrepancy, the study contributes a critical perspective that challenges prevailing assumptions in educational technology research. It underlines the need for educational institutions to prioritize technical performance and content quality over supplementary service features. This divergence from established research invites a broader discussion on the specific attributes that truly enhance learning efficiency and student engagement in digital environments, offering a valuable direction for future research to refine the design and focus of educational technologies.

The findings of this study provide actionable insights for practitioners involved in the implementation and management of educational technologies. For educational IT personnel and service providers, the emphasis on system and information quality over service quality highlights the importance of investing in robust and reliable technological infrastructures. This could involve enhancing the user interface to ensure it is intuitive and streamlining access to information resources to support real-time learning needs. For educators, understanding that the technological efficiency of video conferencing tools can directly impact student outcomes might encourage the adoption of platforms known for their superior system quality. Similarly, students should be guided to select and utilize platforms that are recognized not just for their functionality but also for the quality of information they can access, which this study has shown to be linked to higher academic achievement.

One notable limitation of this study is its focus on higher education without exploring varied educational levels such as K-12, which may exhibit different dynamics in technology use and needs. Future research could explore whether the findings here apply across different educational stages or if younger students' satisfaction and achievement are influenced differently by these platform qualities. Additionally, exploring the role of cultural differences in the acceptance and effectiveness of video conferencing tools could provide deeper insights, as cultural contexts might alter the importance or perception of system, information, and service quality in educational settings. This approach could help delineate more specific strategies tailored to diverse learning environments and technological landscapes.

Finally, the sample size of 236 in this study does not fully represent all specialized groups and platform types, particularly those with very small sub-sample sizes such as education majors and Google Classroom users. Future research should aim to either focus on specific user groups or expand the sample size and diversity to include a broader range of disciplines and platform types to enhance the generalizability of the findings.

Table 6. List of constructs and items

Construct	Item	Description	References
System quality	SYQ1	The video conferencing platform I use for my virtual, live classes is always responsive.	[9]
	SYQ2	The video conferencing platform I use for my virtual live classes communicates information clearly to both professors and students.	
	SYQ3	The video conferencing platform I use for my virtual live classes was free of buffering, stuttering, and noise.	
Information quality	INQ1	The information I receive from the video conferencing platform in my virtual live classes feels like something I would experience in real life.	[9]
	INQ2	The video conferencing platform I use for virtual live classes allows me to access information immediately when needed.	
	INQ3	The amount of information provided by the video conferencing platform in virtual live classes is sufficient.	
Service quality	SEQ1	The video conferencing platform used in virtual live classes is easy to use.	[9]
	SEQ2	The video conferencing platform used in virtual live classes was easy to learn how to use.	
	SEQ3	The video conferencing platform used in my virtual live classes is easy to access.	
Satisfaction	SAT1	I am overall satisfied with the content of the virtual live class I took.	[9]
	SAT2	I think it was a good decision to participate in a virtual live class.	
	SAT3	I do not regret participating in a virtual live class.	
Academic achievement	ACH1	The virtual live class I took provided me with a good overall understanding of the course content.	[42][43]
	ACH2	The knowledge I gained in the virtual live class was actually useful to me.	
	ACH3	The virtual live class I took expanded my knowledge and understanding.	

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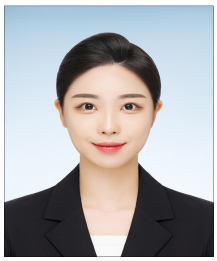

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