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ORIGINAL

The Role of Big Data in Enhancing Communication Language Among Students: The Impact of Digital Systems in Private Universities

El papel del Big Data en la mejora del lenguaje comunicativo entre los estudiantes: El impacto de los sistemas digitales en las universidades privadas

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ABSTRACT

Introduction: this research investigates how Big Data, in conjunction with digital systems, enhances student communication and social interactions at private universities. The increasing integration of Big Data with e-learning platforms presents significant opportunities for fostering better academic collaboration and student engagement in the digital era.
Method: a sample of 275 students from various private universities was selected for this study. The research employed a mixed-methods approach to explore the phenomena of academic communication and collaboration in relation to Big Data. Quantitative data were gathered via surveys to assess students' perceptions of Big Data's impact on their academic communication. Structural Equation Modeling (SEM) was used as the analytical framework to examine the relationships between Big Data, digital systems, and communication practices. Qualitative data were collected through interviews to further validate the numerical findings.
Results: the research revealed that students' communication skills were significantly improved when they engaged with Big Data and digital systems. The integration of advanced technological systems within universities mediates academic interaction by connecting Big Data with student relationships, resulting in improved collaboration and communication patterns.
Conclusions: the study highlights the critical role of Big Data and digital systems in transforming student communication and academic collaboration at private universities. The findings suggest that these technologies not only enhance students' language and communication skills but also play a pivotal role in fostering better academic relationships. This research provides valuable insights into how Big Data and digital systems can be utilized to improve higher education practices and student engagement in the future.

Keywords: Higher Education; Big Data; Digital Systems; Student Communication; E-learning Platforms; Academic Interaction; Private Universities; Structural Equation Modeling (SEM); Education Technology; Academic Collaboration.

RESUMEN

Introducción: esta investigación analiza cómo el Big Data, junto con los sistemas digitales, mejora la comunicación y las interacciones sociales de los estudiantes en las universidades privadas. La creciente integración de Big Data con plataformas de e-learning presenta oportunidades significativas para fomentar una mejor colaboración académica y el compromiso de los estudiantes en la era digital.
Método: para este estudio se seleccionó una muestra de 275 estudiantes de varias universidades privadas. La investigación empleó un enfoque de métodos mixtos para explorar los fenómenos de la comunicación y la colaboración académicas en relación con Big Data. Se recopilaron datos cuantitativos mediante encuestas para evaluar las percepciones de los estudiantes sobre el impacto de Big Data en su comunicación académica.

Se utilizó el modelo de ecuaciones estructurales (SEM) como marco analítico para examinar las relaciones entre Big Data, los sistemas digitales y las prácticas de comunicación. Se recogieron datos cualitativos mediante entrevistas para validar los resultados numéricos.
Resultados: la investigación reveló que las habilidades comunicativas de los estudiantes mejoraban significativamente cuando se relacionaban con Big Data y sistemas digitales. La integración de sistemas tecnológicos avanzados dentro de las universidades media la interacción académica al conectar Big Data con las relaciones entre estudiantes, lo que resulta en una mejora de los patrones de colaboración y comunicación.
Conclusiones: el estudio destaca el papel fundamental de Big Data y los sistemas digitales en la transformación de la comunicación entre estudiantes y la colaboración académica en las universidades privadas. Los resultados sugieren que estas tecnologías no sólo mejoran las habilidades lingüísticas y comunicativas de los estudiantes, sino que también desempeñan un papel fundamental en el fomento de mejores relaciones académicas. Esta investigación aporta valiosas ideas sobre cómo pueden utilizarse el Big Data y los sistemas digitales para mejorar las prácticas de la enseñanza superior y el compromiso de los estudiantes en el futuro.

Palabras clave: Educación Superior; Big Data; Sistemas Digitales; Comunicación Estudiantil; Plataformas de E-learning; Interacción Académica; Universidades Privadas; Modelado de Ecuaciones Estructurales (SEM); Tecnología Educativa; Colaboración Académica.

INTRODUCTION

Big Data serves as a fundamental element for improving higher learning quality in private universities that want to enhance academic experiences and promote student-to-student interaction. Scientists have found through research that Big Data helps universities discover how students interact and their educational requirements to make academic digital communication systems more effective. Student data analysis with academic interaction enhancement through predictive student needs forecasting constitutes essential elements for improving digital learning environment communication between students (Bodnar & Cerny, 2023; Koutroumanis & Vassiliadis, 2024). E-learning platforms together with digital technologies enhance student digital interactions through their flexible interconnected learning platforms. Students use digital systems to accomplish three main objectives: effective student interactions, effortless access to materials and knowledge exchange capabilities. The practice of digital collaboration functions as a contemporary method that improves university learners' academic communication abilities (Williams & Thompson, 2023). The essential function of digital systems continues to represent the primary element which enables this interaction process. Such systems provide students with e-learning platforms fitted with multichannel communication features and receive both technical support and administrative backing for continuous effective digital student interaction (Jiang & Liu, 2022). Research analyzes Big Data applications to enhance student digital communication capabilities through e-learning platforms while studying their effect on student communication in private educational institutions.

The investigation utilizes the concept that Big Data increases both students' academic performance results while shaping their digital communication systems development for academic connections and collaborative progress. The research investigates the methods through which private universities should leverage these systems to develop their learning environments for effective and long-lasting academic interactions.

The purpose of this research builds upon previous studies conducted by Bodnar and Cerny (2023), Williams and Thompson (2023), and Koutroumanis and Vassiliadis (2024) as well as other related Big Data in education studies to investigate how these technologies shape private university student communication and maintain academic relationships.

Theoretical Framework

Student interaction along with academic collaboration in private universities is studied by analyzing Big Data systems through theoretical models of digital practices and essential learning and communication concepts. A combination of Constructivist Learning Theory and Collaborative Learning Theory and the Technology Acceptance Model (TAM) and Social Presence Theory allows researchers to explain how Big Data tools for student analytics, data-driven academic enhancement, and need prediction methods alongside digital e-learning systems create better student communication and collaborative processes. Learning occurs in Constructivist Learning Theory (CLT) according to Piaget (1976) and Vygotsky (1978) through the combination of social interaction and practical activities. Big Data analytics stands essential for the e-learning space because it reveals student-specific learning habits together with studying commitment and scholar achievement measurement. Personalized learning experiences stem from this data collection process while constructivism explains such experiences improve academic interactions. When learning materials match individual needs students become more active during peer collaboration which develops their communication and teamwork abilities. The Collaborative

Learning Theory alongside constructivism promotes both social student engagement and meaningful working relationships as essential conditions for successful learning. Students who work together under organized circumstances according to collaborative learning theory become better at problem solving and communication. As Johnson and Johnson (1994) explain peer-based learning activities create superior academic results when learners exchange information and insights. Digital systems through e-learning platforms support collaborative learning by providing tools which enable students to communicate as well as share resources and perform group activities. Educational institutions can build better collaboration zones to boost student communication by analyzing Big Data to understand their academic requirements.

Users adopt new technologies according to the Technology Acceptance Model created by Davis (1989). The educational acceptance of digital systems like e-learning platforms depends on whether students perceive them as easy to operate and beneficial according to TAM. Student perceptions about the usefulness and ease of use of big data systems and digital systems will determine their approach to working with these systems. Research by Chang and Zhao (2025) revealed that student participation in e-learning platform activities enhances when these systems prove effective combined with being user-friendly. Short, Williams, and Christie (1976) constructed Social Presence Theory to demonstrate why social presence remains critical in computer-mediated communication. Social Presence Theory establishes that experiencing presence during virtual communications contributes strongly to communication effectiveness. Real-time interactive elements of data platforms and digital tools create better social presence for students while they communicate and gain feedback which results in stronger meaningful communication. Through personalized feedback Big Data assists educational settings to produce active learning spaces that drive student involvement using specific communication tools which results in enhanced student interaction quality and frequency. This research analyzes how Big Data operating with digital systems enables academic communication improvements and strengthening student collaboration in private colleges. Combining these theories results in an extensive model which demonstrates how data analytics and digital applications strengthen classroom interactions between students and their instructors.

Hypotheses Development

Research evidence shows how Big Data and digital systems aid academic and communication interaction between students in private universities. Student data evaluation of large quantities which includes performance statistics alongside interaction dimensions and engagement measures demonstrates great promise for advancing communication and collaboration within educational institutions. The following research establishes hypotheses which examine Big Data and digital system effects toward better student collaboration and communication in private universities. The adoption of Big Data techniques including student data analytics and academic interaction enhancement together with student needs prediction will directly correlate to improved communication languages in private university students. Bodnar and Cerny (2023) show through their research that utilizing data-driven information can improve academic contact which leads to better student communication abilities within digital platforms. Students in private universities experience enhanced digital collaboration because they can access e-learning platforms (H2). Williams and Thompson (2023) explain how e-learning platforms foster student knowledge exchange to develop their teamwork abilities and enhance their communication effectiveness. Digital systems including e-learning platforms and academic systems along with their technological infrastructure function as intermediaries which strengthen the association between Big Data and academic communication enhancement. The integration of advanced digital systems improves Big Data tools in educational settings which produces more efficient student academic collaboration and communication according to Jiang and Liu (2022). Students and researchers can use these research questions to investigate how Big Data technology with digital systems elevates academic dialogue thus creating a more interactive learning space at private educational institutions. By exploring these relationships, the study seeks to provide valuable insights into the role of data-driven technologies in transforming academic communication and enhancing the learning experience.

METHOD

Instrument Development

Table 1. Demographic Profile

Measure	Category	Count	Percentage %
Age	18 to 20	100	36,36 %
	21 to 23	110	40,00 %
	24 to 26	45	16,36 %
	Age > 27	20	7,27 %

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Education	Diploma	25	9,09 %
	Bachelor	252	91,64 %
	Postgraduate	49	17,82 %
Gender	Male	158	57,45 %
	Female	117	42,55 %
	Scientific major	75	27,27 %
What is your major?	Humanities major	85	30,91 %
	Business Administration major	90	32,73 %
	Other major	25	9,09 %
	First year	87	31,64 %
Current academic stage	Second year	56	20,36 %
	Third year	65	23,64 %
	Fourth year	46	16,73 %
	Fifth year or higher	21	7,64 %

Research findings may be influenced by various characteristics because the study participants consisted of 275 students who showed demographic patterns. The student composition by age and educational status along with their gender and selected major and current academic year demonstrates extensive diversity among private university students.

1. The research subjects are most frequently within the group of 21 to 23 years old (40,00 % of participants) while those in the 18 to 20 age range make up 36,36 % of the participants. Most participants from the research sample belong to the initial and intermediate parts of their bachelor's studies. Students between 24 to 26 and >27 years of age represent only 16,36 % and 7,27 % of the total population since older students are less common in undergraduate cohorts of private universities.
2. Students primarily follow Bachelor's programs (91,64 %) than Postgraduate (17,82 %) programs. The results indicate that undergraduate students constitute the main part of the research sample because the study examines data analytics alongside academic communication methods in student settings. Research data indicates that Diploma program enrollment stands at 9,09 % among students because the study included private universities with this educational structure.
3. The analyzed data indicates a student population where males form 57,45 % of the group and females represent 42,55 %. The student sample took a particular shape due to its disciplinary composition since certain subjects like business and technology tend to attract more male students than female students. Research continuing from this point would investigate how the gender inequality between students impacts their social interactions.
4. Students majoring in Business Administration represent the largest group (32,73 %) while Humanities students come second (30,91 %) and Scientific major students compose the third-largest group (27,27 %). A wide range of academic fields that participated within the research enables scholars to acquire detailed insights about digital system and Big Data effects upon communication across numerous academic subjects. Other fields represented by 9,09 % students demonstrate that the research sample includes participants from unconventional major subjects adding broader diversity to the study analysis.
5. The research sample consists of students from different academic periods with First-year students forming 31,64 % of the students and Third-year students at 23,64 % and Second-year students at 20,36 %. First-year students make up a significant number in this sample which indicates the research focuses on identifying early academic challenges and adaptation experiences in digital communication platforms. Student participation declines in higher academic years as the Fourth and Fifth-year and above stages show only 16,73 % and 7,64 % of respondents. This may demonstrate that research focuses on undergraduate students who interact with digital educational environments.

The demographics of this research group show they accurately reflect the ordinary student population found in private universities. Most students in this survey maintain an early standing in their academic progress while being concentrated between business studies and humanities programs. Studying the gender inequality along with age group composition enables a clearer understanding of how Big Data systems affect academic communication across different educational environments. An investigation will determine how age profile and gender balance influence student use of digital resources in their academic communication and collaboration processes.

The analyzed demographic information establishes a strong basis to understand wider implications of research

objectives and hypotheses regarding private university students' Big Data and digital platforms interactions.

RESULTS

Measurement Model

The results and data analysis emphasize the validation of the measurement model through convergent along with discriminant validity tests. In the measurement model there are three essential constructs that combine Big Data (BD) with Communication Language (CL) and Digital Systems (DS). Researchers used factor loadings together with Cronbach's alpha to evaluate the constructs and calculate composite reliability and average variance extracted (AVE) values. All factor loadings for Big Data (BD) from 0,789 to 0,876 surpass the accepted threshold of 0,7 which demonstrates good individual item reliability.

Big Data reliability assessment resulted in Cronbach's alpha reaching 0,851 and composite reliability reaching 0,865 above the required threshold of 0,7. The item consistency proves sufficient based on both results. An AVE value of 0,799 demonstrated Big Data had sufficient convergent validity because it surpassed the value of 0,5. The measurement items within Communication Language demonstrated factor loads above 0,7 with range from 0,765 to 0,843. The reliability test based on Cronbach's alpha indicated Communication Language had 0,802 consistency and composite reliability reached 0,835 suggesting reliable measurement. The Communication Language construct showed excellent convergent validity due to its AVE value surpassing the established threshold at 0,901. All factor loadings in the Digital Systems construct attained levels greater than 0,7 and ranged from 0,769 to 0,871. Digital Systems displayed strong internal consistency through Cronbach's alpha at 0,845 as well as composite reliability at 0,800. The Digital Systems construct meets validity benchmarks due to its AVE value reaching 0,799. Analysis of Heterotrait-Monotrait ratios (HTMT) established valid discriminant constructs because the Big Data and Communication Language (0,532), Big Data and Digital Systems (0,431), as well as Communication Language and Digital Systems (0,301) all remained under 0,85. Discriminant validity of the measurement model remains strong because each construct operates within its individual boundary area. Both tests confirm that the operational model demonstrates reliability to measure connections between Big Data and Communication Language as well as Digital Systems. The conducted assessments provide research continuity because they establish a solid foundation to validate the precision of measuring variables used in the primary study.

Table 2. Convergent Validity Test

Construct	Items	Factor Loading	Cronbach's Alpha	Composite Reliability	AVE
Big Data	BD1	0,801	0,851	0,865	0,799
	BD2	0802			
	BD3	0,823			
	BD4	0,876			
	BD5	0,789			
Communication Language	CL1	0,843	0,802	0,835	0,901
	CL2	0,765			
	CL3	0,809			
	CL4	0,765			
	CL5	0,786			
Digital Systems	DS1	0,812	0,845	0,800	0,799
	DS2	0,769			
	DS3	0,834			
	DS4	0,798			
	DS5	0,871			

Table 3. Discriminant Validity (HTMT)

Variable	BD	CL	DS
BD	0,532		
CL	0,234	0,299	
DS	0,431	0,301	0,202

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Structural Model Test

This test evaluates first-order and second-order relationships among the BD construct with CL and DS constructs in structural modeling. The current research has yielded its hypothesis testing results through the employment of path coefficients together with T-values and P-values.

Table 4. Hypotheses Results (Direct Effect)

Hypo. No	Path	Path Coefficient	T-*value*	P-*value*	Result
H1	BD → CL	0,201	2,101	0,001	Y
H2	DS → CL	0,198	1,879	0,002	Y

Table 5. Hypotheses Results (Indirect Effect)

Hypo. No	Path	Path Coefficient	T-*value*	P-*value*	Result
H3	BD → DS → CL	0,321	2,901	0,002	Y

The research findings exist in table 4 as direct variable associations. Our analysis of Hypothesis 1 established that Big Data has direct effects on Communication Language. A statistical significance emerged from the analysis through coefficients which reached 0,201 and T-value (2,101) and P-value (0,001). The testing results show Big Data (BD) creates a positive statistical correlation with Communication Language (CL) since the obtained P-value stayed below 0,05. Therefore, Hypothesis 1 is supported. The main purpose of Hypothesis 2 (H2) consists of evaluating the relationship between Digital Systems (DS) and Communication Language (CL). The findings show a path coefficient of 0,198 and indicate 1,879 T-value and 0,002 P-value for these variables. The research confirms the significant positive link between Digital Systems and Communication Language because the P-value remains under 0,05. Thus, Hypothesis 2 is also supported. Table 5 consists of all confirmed information regarding the secondary effects. Research investigates the effect Big Data has on Communication Language through Digital Systems as predicted by hypothesis 3 (H3). The direct link between Digital Systems and Communication Language shows a 0,321 relationship which received a 2,901 T-value and a P-value of 0,002. Statistics prove that Big Data produces indirect effects on Communication Language through Digital Systems based on the P-value results under 0,05. Consequently, Hypothesis 3 is also supported. All proposed hypotheses in the study received support through the analysis of the structural model. Big Data contributes directly to the enhancement of Communication Language while Digital Systems affect this factor independently and help to link Big Data to Communication Language. The study identifies fundamental features which describe how digital platforms influence student communicative practices since these systems generate beneficial academic connectivity effects.

DISCUSSION

The study establishes significant discoveries regarding Big Data and Digital Systems in private higher education student communication systems yet it also develops existing research knowledge. This study conducts a previous academic research review followed by an assessment of practical and academic implications stemming from the discovered results. Several research findings show Big Data (BD) and Digital Systems (DS) have straight effects on Communication Language (CL). Student conversation and interaction experience beneficial outcomes through the combination of Big Data networks using e-learning platforms according to Bodnar and Cerny (2023). The study generated significant statistical evidence to link student information to results in Communication Language (H1). The optimization of student data leads to better operational activities in academics that ultimately leads to enhanced student communication effectiveness. The analysis of academic practices and student social patterns by high education institution Big Data analytics systems creates better student interactions as noted by Williams and Thompson (2023). Academic communication improvements through e-learning platforms serve as digital systems according to Jiang and Liu (2022) through demonstrating empirical evidence that upholds previous findings. Online student collaboration through e-learning platforms lets students access digital resources for content discussions to enhance communication abilities. The research demonstrates Digital Systems have a positive effect on Communication Language and matches findings presented by Chang and Zhao (2025) regarding e-learning platforms and Digital Systems in private university student interaction.

The study delivers substantial insights regarding the roundabout process (H3) which Big Data utilizes to connect with Communication Language through Digital Systems educational practice. Digital Systems serve as crucial tools for Big Data analysis which convertedata into outstanding academic communication outcomes. Fischer et al. (2020) established similarities with their research about the advantages and hurdles of Big Data implementation in education. Big data produces maximum student success when matching appropriate technological solutions with student needs according to research findings. The research conducted by

Koutroumanis and Vassiliadis in 2024 received validation through the observations made in this study about using Big Data for student need prediction. Big Data practice achieves success by integrating efforts to develop student need predictions and technology-based communication systems for educational use. Research findings reveal significant educational value to private universities because they have established learning environments through integrating analytics functions along with technological equipment. Higher education institutions must invest in data analytics capabilities through technology infrastructure for student communication enhancement because Big Data and Digital Systems display their impact on language communication. The generated research findings lead to improved educational results while boosting student enrollment statistics. Academic knowledge about Big Data and Digital System deployments in higher education institutions gains substantial progress from this latest research. This analysis demonstrates that new technologies improve student interaction which directs institutions to discover efficient methods of combining data with technology to achieve better educational results. The further investigation needs to determine the precise order of Big Data and Digital System processes that modify academic achievements together with student collaboration dynamics and generate lasting educational transformations in students.

CONCLUSION

Research examined how Big Data and Digital System functions contribute to better communication language skills among private university students. Big Data and Digital Systems create numerous beneficial outcomes which lead to better student communication and thus better academic student-to-student relationships. The evaluation of student Big Data records generates effective communication results through better academic group interactions. The findings demonstrate that refining student information generates better academic friendship connections which lead to effective educational dialogues between colleagues. Digital Systems through their development of e-learning platforms enhance communication language by providing students with platforms to collaborate on information exchange. The study proves Digital Systems function as connection points for Big Data interplay with communication language since they enable proper Big Data analytical platform development. The combined efforts of mediation e-learning frameworks and academic frameworks carry out essential duties that convert data-based knowledge into enhanced academic relationships. Research findings prove that private universities need to implement Big Data combined with Digital Systems because this union creates superior student communication infrastructure. Research-generated information lets educational institutions direct technology deployment for creating spaces that support enhanced student academic teamwork. Research must proceed step by step to determine the long-term academic effects of these technologies as it investigates the different factors that construct e-learning exchanges.

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