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The Impact of Business Intelligence on E-Learning at Technical University

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ABSTRACT: This study explores the effect of Business Intelligence (BI) on the effectiveness of E-learning systems within technical universities. With the increasing metamorphosis of the world of education into a digital one, the role of BI tools in the enhancement of decision-making processes, monitoring of the students, and the improvement of academic processes have become pivotal. The study adopts a quantitative, descriptive-correlational research design involving 385 faculty members and structured questionnaires to measure the influence of BI dimensions Analytical Capability, Data Quality and Accessibility, and Infrastructure and Technical Support on E-learning metrics like Learning Outcomes, Student Engagement, and Organizational Support. Findings show strong correlations between the BI dimensions and the success of E-learning, with the greatest emphasis on Analytical Capability and Data Quality. These results highlight the importance of educational institutions strategically utilizing their data and improving their analytic frameworks rather than concentrating solely on the technical aspects of the institution's infrastructure. The study also demonstrated that the integration of BI into educational frameworks, particularly within technical universities, improves E-learning systems by fostering personalized learning, providing proactive interventions, and much more, thus making a compelling case.

Keywords: business intelligence- e-learning- technical university- educational technology- data-driven - decision making- traditional education.

I. INTRODUCTION

In the context of digitally transforming the quality and effectiveness of educational delivery, technical universities are actively utilizing data-driven systems. One of the more recent breakthroughs that supports informed decision making and operational proficiency in educational institutions is Business Intelligence (BI). Business Intelligence is defined as a set of tools, techniques and processes that allows organizations to capture, process and transform raw data into meaningful information that aids in making tactical and strategic decisions, [1]

In the educational sector, the pedagogical model has shifted to the use of E-learning systems and, with the help of BI, information and data are processed and analyzed to have more informed instructional decisions. BI allows Makonye and Ndlovu (2023) [2] to track user behavior, provide instructional performance dashboards, and offer analytics. BI in higher educational institutions is no longer an option; with an overabundance of options available to students and the constantly evolving academic ecosystem, institutions need and students demand more and to stay competitive, Business Intelligence allows institutions to optimize academic performance. The incorporation of Business Intelligence in E-learning systems creates a distinct set of advantages and obstacles. Business Intelligence facilitates optimally tailored instructional pathways, forecast modeling of learner achievement, and informed curriculum crafting [3-4].

Conversely, its successful implementation is determined by data accuracy, technical systems, level of organizational preparedness, and other pre-requisites. Research shows that in the presence of weak data governance and low data literacy, simply having BI systems in place may not result in the intended educational change [5-6-7].

This research seeks to understand the relationship and impact of Business Intelligence in E-learning in technical universities, addressing the absence of empirical evidence in the context. Through exploring dimensions such as Analytical Capability, Data Quality & Accessibility, Organizational Support, the research aims to assess the impact of BI on the effectiveness, engagement, and overall impact of E-learning systems. The significance of the research lies in its ability to provide feedback to university policymakers, educators, and technology leaders on the use of BI on responsive, adaptive, and inclusive digital learning frameworks.

The previous literature review highlights the emerging pattern of data-oriented educational systems. [8-9] takes note that BI in education entails going beyond just reporting and advocated for advancement to forecast analytics along with real-time interventions. [10] advocate for the adoption of "learning analytics" that utilizes BI for designing learner-centric frameworks. Given the context of technical universities, which frequently possess more digitally advanced infrastructures, this change is not only possible, but necessary.

To conclude, this research is based on the premise that Business Intelligence, if applied appropriately, can and severely should accelerate change and development in pedagogical practices and within educational institutions in the context of e-learning. The study analyzes not just the relationship that exists between the BI dimensions and the outcomes of e-learning but also examines how the BI components predict the quality and the performance of the digital education platforms. This method adheres to the global calls for the adoption of evidence-based education which aims to place technical universities at the leading edge of the digital education transformation.

II. REVIEW OF THE LITERATURE

In recent years, business intelligence (BI) systems have transformed e-learning frameworks, especially in a technical university setting, where data-driven methodologies may refine administrative functions and improve learning outcomes. Underlying studies conducted before 2020 confirmed that BI enhances instructional design, resource management, and learner engagement through dashboards and analytics. More recently, studies have focused on the use of predictive analytics to project student performance and attrition, allowing timely behavioral interventions that significantly enhance retention and achievement [11].

In the years following 2020, there have been additional international studies that have developed the theme of BI in e-learning within tertiary education. One such study from Indonesia showed that adaptive e-learning co-design functions as a mediator where high-quality information within adaptive frameworks results in continuous institutional innovation and performance in marketing. In 2025 an additional systematic review that synthesized 230 studies from around the world on the use of BI and machine learning to predict and mitigate student dropout published with a central theme of providing effective intervention while focusing on data quality, ethics surrounding predictive model use, institutional scalability and resiliency of BI systems throughout multiple learning environments as key persistent gaps [12].

At the same time, a more comprehensive review, "Educational Data Mining and Learning Analytics" from 2024, situates BI within a full range of data-informed educational technologies from institutional analytics, to teaching analytics, illustrating the increasing integration of BI tools into the comprehensive learner data collection, analysis, and feedback cycle [5]. Additionally, Wu (2023)[13] introduced generative AI within learning analytics, discussing the role of large language models in generating synthetic learner data and interaction logs as well as in BI-enhanced analytics adaptive interventions. Additionally, Sajja, et al. (2024)[14] presented a framework for AI-enabled intelligent assistants in higher education, wherein BI methods integrate with NLP-driven tutoring systems to provide customized assistance, thereby reducing cognitive load, creating dynamic quizzes and flashcards, and interfacing with LMS portals to enhance and adapt e-learning systems, thereby creating more responsive and adaptive e-learning systems. A 2025 case study by Milinthapunya[15] and colleagues demonstrates the use of AI-integrated management systems for predicting the performance of IT assets in relation to students and evolving pedagogical trends in infrastructure financing.

The most recent works from 2020 to 2025 highlight advancements in BI application areas of e-learning including predictive dropout prevention, generative AI integration, adaptive stakeholder co-design, and strategic infrastructure planning. For technical universities, these insights indicate that embedding BI into LMS frameworks and administrative processes enhances learner and user personalization, retention, and institutional responsiveness agility.

1. BUSINESS INTELLIGENCE IN HIGHER EDUCATION

Business Intelligence Technologies are beginning to transform the strategic and operational functions of higher education institutions. BI permits various stakeholders to carry out policy, teaching, and administrative decisions based on insight gleaned from vast amounts of institutional data. In technical universities, data is plentiful, and BI systems provide precise data-driven, prompt evaluations, enabling action [16]. The theoretical foundations of BI rests on the information systems theory which proposes structured data leads to enhanced decision-making after thorough processing, and precision-based analysis. Recent research underscores the significance of BI in the higher education sector, demonstrating its utility beyond administrative functions to teaching by providing real-time snapshots of learner involvement, learning patterns, and academic risk [17]. The latest generation of BI tools is user-friendly, and through the cloud, they are available and scalable to universities, irrespective of size, location, or administrative bounds.

2. THE EVOLUTION AND THEORETICAL BASIS OF E-LEARNING

The incorporation of analytics and immediate feedback elevates the effectiveness of e-learning systems, which have now advanced into dynamic and user-friendly platforms that offer flexibility and autonomy to learners, allowing for tailored pathways. Reflective and collaborative learning enhances knowledge retention and construction, which are promoted by e-learning systems that are rooted in constructivist learning theory. Enhanced feedback capabilities in e-learning systems yield even greater effectiveness, especially when sharpened by analytics. Dritsas and Trigka (2025) [18] reveal that learning analytics tools empower real-time feedback, enabling engagement, content, and learning materials to be tailored to students. In this case, the technology acceptance model (TAM) is still applicable since the perceived usefulness and usability of BI-enhanced and traditional e-learning systems impacts their effectiveness. The COVID-19 pandemic, as noted by Ali (2020) [19], triggered a pivot to a greater hybrid and fully online learning model that depended more on digital learning ecosystems. This shift has called for advanced tools aimed at supporting and optimizing the identified learning gaps.

3. LINKING BUSINESS INTELLIGENCE TO E-LEARNING: A STRATEGIC INTERSECTION

The integration of business intelligence (BI) and e-learning is validated through sociotechnical systems theory, which posits that the integration of technology and human elements yields the best results [20]. In technical universities, BI capabilities and tools integrated into learning management systems (LMS) facilitate the tracking of students, instructors, and the overall instructional program's performance. This collaboration assists in proactive intervention, tailored individualized assistance, and better target efficiency in resource allocation. Recent studies such as those by Khan et al, (2024) [21] underscore the importance of data dashboards and predictive analytics in uncovering patterns of learner engagement that in more traditional paradigms go unnoticed. Beyond enhancing management efficiency, these tools improve instructional design and learning performance by the instructor's supporting students in a responsive real-time approach, which is increasingly critical as educational transformation agendas streamline digital learner-centric paradigms [19].

4. ORGANIZATIONAL LEARNING AND CONTINUOUS IMPROVEMENT

Business Intelligence supports feedback collection and interpretation at the different levels of the university by fostering institutional learning. BI systems as noted by Bartlett & Camba (2024) [22] enable organizations to build knowledge over time adapting strategies based on evidence rather than on gut feeling. Following organizational learning theory, this iterative process of data collection and analysis, reflection, and action leads to improvement BI systems strengthen this by integrating operational data (system usage, course completion rates) with strategic educational targets (student satisfaction, retention, employability) [23]. Adopting this approach enhances institutional agility and accountability, particularly regarding performance-based funding and accreditation Milinthapunya, et al (2025) [15].

5. THE IMPACT OF BUSINESS INTELLIGENCE ON E-LEARNING

The impact that Business Intelligence (BI) offers in teaching, aiding in student performance, and refining digital learning systems in higher education is revolutionary. In e-learning contexts, BI facilitates decision-making through data collection, analysis, and visualization of educational data from various digital sources, such as learning management systems (LMS), student information systems, and online evaluations. This functionality enables academic institutions to monitor learner engagement, anticipate learning outcomes, and tailor instruction to each learner [24]. As noted by Laksitowening, et al. (2022) [17], BI in e-learning provides opportunities for universities to shift from reactive problem-solving to proactive educational architecture. In many technical universities, where there is heavy reliance on data and practical applications in the curricula, strategically employing BI tools to address the timely and specific educational content requirements of the students facilitates real-time adjustments to instructional delivery. This congruence significantly improves the impact, adaptability, and appropriateness of e-learning.

6. COMPONENTS OF BUSINESS INTELLIGENCE IN THE UNIVERSITY ENVIRONMENT

In the context of universities, business intelligence (BI) includes the integration of various data systems, data warehouses, data analytical tools, dashboards, and reporting systems. Every data component assists the university to gather, interpret, and analyze institutional data. For example, data integration systems fetch academic data, attendance data, and interaction data. These integration systems work in cooperation with data warehouses that keep the data in organized formats such as relational databases, making data mining and data visualization tools available for in-depth analysis. These systems are monitored with a data governance framework which supervises the various aspects such as the quality, privacy, and the usability of the data [15]. BI as outlined in [25] hinges on the interoperability of the components and the institutional specific strategy. Training especially those in the interface of data systems and academic strategy shifts the balance to the other side for making BI more beneficial for universities.

7. ASPECTS OF BUSINESS INTELLIGENCE'S USE IN E-LEARNING

Business Intelligence (BI) applies to e-learning improvements in various ways. One of them is learning analytics, which enables comprehensive monitoring of e-learning activities and the levels of student engagement alongside progress by instructors [26]. Another is predictive analytics, which is concerned with forecasting future academic performance based on present trends. It helps in identifying at-risk students early. In addition, BI tools evaluate instructional content and materials and teaching effectiveness by analyzing quiz, assignment, and forum participation results. As Dritsas & Trigka (2025) [18] report, such data is invaluable for coarse-less feedback-driven instructional design and teaching. At the BI's administrative level, other applications include enrollment, resources management, and academic quality assurance including the alignment of academic programs with student needs and institutional objectives. The e-learning environment, enriched by BI capabilities, is the responsive and self-improving learning system of the teaching and instructional design frameworks. Continuous feedback provides the basis for continuous evolution.

8. THE POSITIVE EFFECTS OF BUSINESS INTELLIGENCE ON E-LEARNING

The integration of BI into e-learning brings about numerous benefits. First, personalization, which is BI driven, facilitates the customization of lessons to the student's needs, habits, and development [19]. indicates that this leads to better motivation, engagement, and retention. BI also fosters transparency and accountability since performance metrics and progress indicators are available to both students and instructors. At the institutional level, BI helps evidence-based policy-making, enabling leaders to better allocate institutional resources, refine curricula, and assess the impact of programs. As noted by Bartlett & Camba (2024) [27], universities that systematically incorporate BI are better able to adapt to changing educational needs and improve institutional performance. These effects are particularly pronounced in technical universities which require rapid alignment with industry and innovation trends due to the fast evolving nature of the disciplines.

9. CHALLENGES AND OBSTACLES

The integration of BI into e-learning frameworks faces particularly daunting challenges. The most critical barriers include the lack of competent personnel, technical complexity, privacy issues, and lack of institutional acceptance. "As pointed out by Alier, et al. (2024) [26], several universities do not possess the requisite technical infrastructure or human resources needed to effectively deploy BI tools [28]. Concerns regarding student data monitoring and data surveillance may also hinder adoption on the faculty side. Another widely recognized problem is the presence of disparate data systems that prevent data integration, thereby compromising the reliability of analytics outputs. Strategically, the successful BI implementation is contingent on the adopted organizational culture, and specifically the presence of a culture that embraces data-driven decision-making. Nonexistant or underdeveloped data cultures pose further challenges to BI adoption [28]. Alongside issues of ethics, such as the data monitoring of students, universities face challenges where the use of analytics is justified while concerns on consent and digital rights remain. Overcoming these issues while under-supported requires investment, professional development, and data governance strategies [29]. Here is the hypothesis of this work.

- The first hypothesis: there is no significant relation between the Business Intelligence and E-learning at Technical University
- The second hypothesis : There are no impact of the Business Intelligence dimensions on E-learning at Technical University

IV. RESEARCH METHODOLOGY

1. RESEARCH DESIGN

The current study adopted a quantitative approach to examine the relationship between the Business Intelligence (BI) dimensions and the E-learning outcomes in technical universities. A descriptive-correlational approach was used to measure the relationships and predictive influences between the different constructs. The study applied a cross-section survey approach to gather data from faculty members using standardized tools to enhance reliability and consistency in the measurement.

2. POPULATION AND SAMPLE

The study population was faculty members from different technical universities. With stratified random sampling, a sample of 385 respondents were selected. This sample captured diverse representation across gender, age, teaching experience, and education level. The sampled population included 204 males (53%) and 181 females (47%).

3. INSTRUMENTATION

Two constructs were created based on preexisting literature: Business Intelligence and E-learning.

A questionnaire focusing on each of those constructs was created. The BI construct was subdivided into three dimensions:

- Analytical Capability
- Data Quality and Accessibility
- Infrastructure and Technical Support

The E-learning construct included:

- Learning Outcomes and Effectiveness
- Student Engagement and Satisfaction

Each dimension was assessed with five items on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The internal reliability of all constructs was assessed with Cronbach's alpha, which ranged from 0.744 to 0.836, indicating from acceptable to excellent reliability.

4. DATA COLLECTION PROCEDURE

Data were collected from faculty members across various technical universities and assessed with an online survey. Ethical considerations included obtaining informed consent, confidentiality, and privacy of respondents. The data collection process ensured that all participation was voluntary and anonymous.

5. DATA ANALYSIS

The collected data were processed through SPSS. The analysis included:

- Descriptive measures (mean and standard deviation) to summarize perceptions during the survey.
- Pearson correlation analysis for the first hypothesis testing on the relationship check of BI and E-learning.
- Multiple linear regression analysis for the second hypothesis on determining the predictive power of BI dimensions on the E-learning outcomes.

Depending on the analysis, significance levels were set at $p < 0.05$, and $p < 0.01$. For the validity of the regression models, multicollinearity was assessed through Tolerance and Variance Inflated Factor (VIF) values.

V. RESULT AND DISCUSSION

1. SAMPLE CHARACTERISTICS

Table (1) delineates the demographic features of the study sample, comprising 385 respondents from technical universities. The demographic variables comprise Gender, Age, Teaching Experience, and Education Level. These qualities facilitate a thorough comprehension of the participants' background and diversity in the study examining the influence of Business Intelligence on e-learning.

Table 1. Sample demographic characteristics.

Variables	Categories	Frequency	Percent %
Gender	Male	204	53.0
	Female	181	47.0
	Total	385	100.0
Age	Less than 30 years	80	20.8
	30–45 years	232	60.3
	More than 45 years	73	19.0
	Total	385	100.0
Teaching Experience	Less than 5 years	78	20.3
	5–10 years	227	59.0
	More than 10 years	80	20.8
	Total	385	100.0
Education Level	Bachelor	234	60.8
	Master	110	28.6

PhD	41	10.6
Total	385	100.0

The sample comprises 204 males (53.0%) and 181 females (47.0%), reflecting a broadly equal gender distribution with a small male predominance. This equilibrium facilitates an equitable representation of viewpoints from both genders in the realm of e-learning and Business Intelligence deployment.

A majority of the participants, 232 responses (60.3%), belong to the 30–45 years age range, commonly linked to mid-career professionals with considerable expertise in education and technology. Furthermore, 80 respondents (20.8%) are under 30 years of age, possibly indicating early-career educators or graduate assistants, whereas 73 respondents (19.0%) are over 45, implying the presence of more seasoned academics or administrators. The predominant segment of the sample, comprising 227 respondents (59.0%), possesses 5–10 years of teaching experience, indicating a robust cohort of mid-level academic professionals proficient in both conventional and digital pedagogical approaches. Additionally, 80 participants (20.8%) possess over 10 years of expertise, potentially contributing senior-level perspectives on the integration of BI and e-learning. Of the remaining 78 responses (20.3%), fewer than 5 years of experience reflects their status as recent entrants into the academic domain.

The educational qualifications of the participants indicate that the majority, 234 respondents (60.8%), possess a Bachelor's degree, likely comprising teaching assistants, lecturers, or early-career teachers. In all, 110 participants (28.6%) possess a Master's degree, while 41 participants (10.6%) hold a PhD, suggesting a presence of experienced instructors or decision-makers in technical universities. This distribution guarantees a varied academic viewpoint in assessing the utilization and effects of Business Intelligence tools in e-learning.

2. RELIABILITY

The table below displays the internal consistency reliability of each concept utilized in the survey, as assessed by Cronbach's alpha. This metric assesses the dependability of the scale items employed for each dimension of the study, with values over 0.70 often regarded as satisfactory in social science research. Each construct has five statements intended to encapsulate various facets of Business Intelligence and E-Learning inside technical institutes.

Table 2. Cronbach's alpha coefficient for study dimensions.

Dimensions	Cronbach's alpha	number of statements
Analytical Capability	0.81	5
Data Quality and Accessibility	0.809	5
Infrastructure and Technical Support	0.776	5
Learning Outcomes and Effectiveness	0.745	5
Organizational Support and Use	0.836	5
Student Engagement and Satisfaction	0.744	5

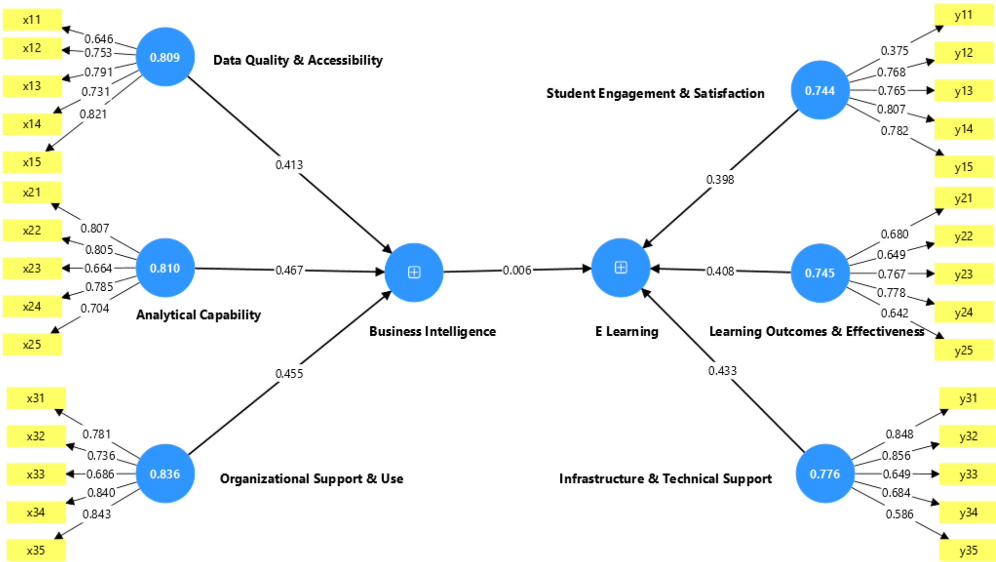

FIGURE 1. Cronbach's alpha coefficient for study dimensions.

From table (2) and chart (1), all dimensions in the study exhibited acceptable to excellent internal consistency reliability, with Cronbach's alpha values between 0.744 and 0.836. The Organizational Support and Use dimension exhibited the highest reliability ($\alpha = 0.836$), signifying robust coherence among its items. Analytical Capability ($\alpha = 0.81$) and Data Quality and Accessibility ($\alpha = 0.809$) are well aligned, indicating a dependable assessment of user perceptions on the functionality and data management of BI tools. The Infrastructure and Technical Support dimension demonstrates a robust reliability score ($\alpha = 0.776$), affirming the consistency of the scale items evaluating technical readiness and support. Both Learning Outcomes and Effectiveness ($\alpha = 0.745$) and Student Engagement and Satisfaction ($\alpha = 0.744$) satisfy the acceptable threshold, indicating that the items within these educational dimensions are reliable and valid for evaluating e-learning efficacy in the setting of a technical institution. The reliability results confirm that all constructs employed in the survey are statistically sound and appropriate for subsequent analysis.

3. THE DESCRIPTIVE STATISTICS FOR STUDY VARIABLES

The table presents the average scores and standard deviations for the principal dimensions of the survey, reflecting participants' perceptions of Business Intelligence and E-Learning at technical universities. Each dimension was evaluated using a 5-point Likert scale, with elevated mean values signifying greater agreement with the statements pertaining to each construct.

Table 3. The descriptive statistics for study variables.

Variables	Mean	Std. Deviation
Analytical Capability	4.311	0.521
Data Quality and Accessibility	4.291	0.582
Infrastructure and Technical Support	4.274	0.582
Business Intelligence	4.292	0.415
Learning Outcomes and Effectiveness	4.374	0.440
Organizational Support and Use	4.281	0.464
Student Engagement and Satisfaction	4.338	0.482
E-learning	4.331	0.372

The results demonstrate uniformly elevated perceptions across all dimensions, with mean values between 4.274 and 4.374, signifying a robust positive assessment of both Business Intelligence and E-learning systems. Among the independent variables, Analytical Capability received the highest score (M = 4.311, SD = 0.521), indicating that participants perceived BI technologies as particularly effective for data analysis and interpretation in educational contexts. Data Quality and Accessibility (M = 4.291) and Organizational Support & Use (M = 4.281) closely follow, indicating assurance in data dependability and institutional backing for BI integration. In the realm of E-learning, Learning Outcomes and Effectiveness achieved the highest score (M = 4.374, SD = 0.440), underscoring the perceived influence of e-learning on enhancing academic performance. Student Engagement and Satisfaction got a robust mean score (M = 4.338), highlighting the platform's efficacy in promoting student participation. The average scores for Business Intelligence (M = 4.292) and E-learning (M = 4.331) further substantiate that stakeholders perceive these technologies as very advantageous and effectively integrated within the technical university context. The very low standard deviations signify a robust consensus among respondents, hence enhancing the credibility of these findings.

4. RESEARCH HYPOTHESES

- The first hypothesis: there is no significant relation between the Business Intelligence and E-learning at Technical University

The Pearson correlation coefficients for the principal study variables, encompassing the dimensions of Business Intelligence (Analytical Capability, Data Quality and Accessibility, Infrastructure and Technical Support, Organizational Support and Use) and E-learning at Technical University (Learning Outcomes and Effectiveness, Student Engagement and Satisfaction), along with their aggregate constructs. The study demonstrates the magnitude and orientation of linear correlations among variables, with significance levels marked at the 0.01 and 0.05 thresholds. These correlations elucidate the degree of association between the variables and offer insights into the potential impact of Business Intelligence on various facets of E-learning at Technical University within the framework of a technical university.

The correlation matrix reveals substantial and positive associations among the study variables, offering empirical evidence for the interrelation between Business Intelligence (BI) dimensions and E-learning at Technical University results in technical universities. All correlations are positive and statistically significant at the 0.01 or 0.05 level, showing substantial relationships among constructs.

The most robust intercorrelation among BI dimensions is noted between Infrastructure and Technical Support and Business Intelligence ($r = .820$, $p < .01$), closely succeeded by Data Quality and Accessibility and Business Intelligence ($r = .813$, $p < .01$), underscoring the pivotal role of technical infrastructure and superior data quality in enhancing the efficacy of BI systems. The dimension of Organizational Support and Use exhibits a strong correlation with E-learning ($r = .871$, $p < .01$), indicating that robust institutional support substantially improves the efficacy of e-learning programs. Likewise, Learning Outcomes and Effectiveness demonstrates a strong association with E-learning ($r = .824$, $p < .01$), highlighting the direct educational advantages linked to e-learning platforms.

Furthermore, Business Intelligence as a composite variable exhibits a moderate to strong correlation with all E-learning components, including Student Engagement and Satisfaction ($r = .305$, $p < .01$) and overall E-learning ($r = .320$, $p < .01$), suggesting that effective BI implementation positively impacts user experience and system performance. Although certain BI subdimensions, such as Analytical Capability, exhibit comparatively smaller correlations with learning outcomes (e.g., $r = .101$, $p < .05$), their positive significance nonetheless underscores their contributory function.

The matrix underscores a synergistic relationship between BI systems and e-learning quality, affirming that the integration of data-driven decision-making and infrastructural support can enhance the efficacy, engagement, and outcomes of digital education in technical university environments.

From the previous explanation, the null hypothesis that there is no significant relation between the Business Intelligence and E-learning is rejected. Means there is significant relation between the Business Intelligence and E-learning

Table 4. Correlation matrix for Business Intelligence and E-learning variables and its dimensions.

Variables	Analytical Capability	Data Quality and Accessibility	Infrastructure and Technical Support	Business Intelligence	Learning Outcomes and Effectiveness	Organizational Support and Use	Student Engagement and Satisfaction	E-learning
Analytical Capability	1	.145**	.163**	.563**	.101*	.129*	.376**	.256**
Data Quality and Accessibility	.145**	1	.607**	.813**	.220**	.253**	.156**	.259**
Infrastructure and Technical Support	.163**	.607**	1	.820**	.102*	.210**	.159**	.196**
Business Intelligence	.563**	.813**	.820**	1	.193**	.271**	.305**	.320**
Learning Outcomes and Effectiveness	.101*	.220**	.102*	.193**	1	.707**	.315**	.824**
Organizational Support and Use	.129*	.253**	.210**	.271**	.707**	1	.409**	.871**
Student Engagement and Satisfaction	.376**	.156**	.159**	.305**	.315**	.409**	1	.726**
E-learning	.256**	.259**	.196**	.320**	.824**	.871**	.726**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

- The second hypothesis: There are no impact of the Business Intelligence dimensions on E-learning at Technical University

Table (5) displays the findings of a multiple linear regression analysis aimed at assessing the influence of the three principal dimensions of Business Intelligence specifically Analytical Capability, Data Quality and Accessibility, and Infrastructure and Technical Support on the overall E-learning at Technical University outcome in technical universities. The table presents unstandardized and standardized coefficients, t-values, significance levels (Sig.), and collinearity diagnostics (Tolerance and VIF) to evaluate the individual and collective predictive capacity of each BI dimension. The model produced an R-squared value of 0.117, signifying that around 11.7% of the variance in E-learning at Technical University is elucidated by the BI dimensions. The comprehensive model is statistically significant ($F = 16.763$, $p < .001$), corroborating the hypothesis that Business Intelligence significantly contributes to the improvement of E-learning at Technical University performance.

Table 5. Impact of the Business Intelligence dimensions on E-learning at Technical University.

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	2.991	.194		15.430	.000		
Analytical Capability	.157	.035	.220	4.502	.000	.970	1.031
Data Quality and Accessibility	.132	.039	.206	3.392	.001	.629	1.589
Infrastructure and Technical Support	.023	.039	.035	.582	.561	.626	1.598
R						.341	
R -squared						0.117	
F- test						16.763	
P-value						0.000	

The regression analysis results in Table (5) provide useful insights into the predictive influence of multiple Business Intelligence (BI) aspects on the success of E-learning at Technical University at technical universities. The model has statistical significance ($F = 16.763$, $p < .001$), with an R-squared value of 0.117, signifying that around 11.7% of the variance in E-learning outcomes is accounted for by the three BI characteristics used in the model.

Among the predictors, Analytical Capability emerged as the greatest and most significant contributor ($\beta = 0.220$, $t = 4.502$, $p < .001$), demonstrating its vital significance in evaluating educational data and directing pedagogical techniques. Data Quality and Accessibility demonstrated a notable positive impact ($\beta = 0.206$, $t = 3.392$, $p = .001$), indicating that prompt and precise access to data improves e-learning efficacy by facilitating superior decision-making and resource distribution. Conversely, Infrastructure and Technical Support exhibited no statistically significant effect ($\beta = 0.035$, $t = 0.582$, $p = 0.561$), suggesting that although technical support is crucial, it may not independently affect the perceived success of e-learning in the absence of robust analytical capabilities and high-quality data access. Collinearity diagnostics indicate the lack of multicollinearity among the predictors, ensuring the trustworthiness of the regression estimations. In summary, the findings underline the necessity of increasing analytical and data quality activities inside BI systems to generate more successful e-learning outcomes, while technical infrastructure, albeit required, may require integration with strategic analytics to produce significant effects. From the previous explanation, the null hypothesis that There is no impact of the Business Intelligence dimensions on E-learning is rejected. Means There are impact of the Business Intelligence dimensions on E-learning

VI. CONCLUSION

This study has illustrated the substantial impact of Business Intelligence on the improvement of E-learning at technical universities. The findings demonstrate that essential aspects of Business Intelligence specifically Analytical Capability and Data Quality and Accessibility positively affect the efficacy and efficiency of digital learning environments. These findings confirm that when institutions invest in comprehensive data analysis tools and guarantee the availability of timely, precise information, they foster a more responsive and effective e-learning experience for both students and educators. Of the individual variables, Analytical Capability emerged as the most significant predictor of E-learning success. This indicates that the capacity to derive meaningful insights from data is essential for informing curriculum design, recognizing student needs, and improving engagement. Likewise, the role of Data Quality and Accessibility underscores the importance of pristine, structured, and accessible data in facilitating decision-making across diverse educational tiers. Conversely, while Infrastructure and Technical Support is essential, it did not demonstrate a statistically significant impact when analyzed independently underscoring the necessity for comprehensive strategies that extend beyond technical preparedness to encompass data-informed pedagogy and institutional backing. In conclusion, the incorporation of Business Intelligence into educational systems should be regarded not merely as a technical enhancement but as a strategic endeavor intended to revolutionize learning outcomes. Universities aiming to improve their E-learning systems must prioritize investments in analytical tools, personnel training, and data governance frameworks. Implementing this will guarantee that technology is not only accessible but also efficiently employed to stimulate creativity, enhance performance, and address the changing requirements of contemporary higher education.

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Author Contributions

The author conducted all aspects of the research, including conceptualization, methodology, investigation, data curation, formal analysis, and writing-original draft preparation, review and editing.

Conflicts of Interest

The authors declare no conflicts of interest.

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