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Proceedings of the International Conference on Teaching, Learning and Education
Vol. 2, Issue. 1, 2025, pp. 104-122
DOI: https://doi.org/10.33422/ictle.v2i1.1730

ISSN: 3030-122X online

Organizational Culture, Support, and Competencies for Business Analytics: A Mixed-Methods Study Linking Industry Demand and Curriculum Development

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Abstract

The evolution of business analytics (BA) technologies has necessitated a recalibration of educational practices to meet the industry's dynamic requirements. This research examines the application of the Technology-Organization-Environment (TOE) framework to assess the essential skills, tools, and organizational support required for implementing Business Analytics (BA) in academic and professional settings. Employing a mixed-methods research design, a Systematic Literature Review (SLR) was conducted, encompassing 63 peer-reviewed articles, in conjunction with a web scraping analysis of 315 contemporary job postings via the JSearch API. The literature review reveals widespread application of the TOE framework in research on BA adoption. An analysis of job postings identifies critical competencies, including expertise in tools such as Python, SQL, and Tableau, as well as vital soft skills in communication and leadership, along with specific certifications such as the Certified Analytics Professional. Moreover, this study examines how educational technologies, including Massive Open Online Courses (MOOCs), Learning Management Systems (LMS), and virtual laboratories, serve as conduits for cultivating these competencies. The results underscore the importance of aligning curriculum development with the workforce's requirements by integrating project-based learning, simulation environments, and adaptive instructional methods. These approaches facilitate the enhancement of both technical and organizational competencies. The present study provides actionable recommendations for curriculum designers and educators to strengthen the connection between analytics education and readiness for real-world applications.

Keywords: business analytics, TOE framework, curriculum development, job market analysis, emerging technologies in learning

1. Introduction

Business Analytics' popularity across disciplines has created a lack of uniform standards for what to expect and what to know about this emerging practice and body of knowledge

(Ikegwu et al., 2022; Mrida et al., 2025). Educational institutions have creatively developed a curriculum on information systems and computer science, utilizing programming languages in the context of data literacy initiatives and integrating them with business (Aithal, & Aithal, 2024). Technological tools and the introduction of new mechanisms and frameworks to Operations Research and Management Science (OR/MS) gave birth to BA (Cribben & Zeinali, 2023). With many analytics tools entering the market, educational institutions and instructors are faced with the dilemma of which tool learners need to master. Afzaal and Nouri (2024) conducted a study on the software used in the classroom for analytics learners. With the fast-paced development of technology, the curriculum needs to be up-to-date (Yesilevskyi & Kyt, 2024).

This study identifies the skills and tools necessary for BA implementation. Tools are only one variable; thus, the Technology-Organization-Environment (TOE) framework is integrated to analyze the antecedents of BA implementation, including soft and technical skills, organizational support, and culture. Jia et al. (2023) recognized the importance of graduates being ready for employment, given the emerging knowledge and technological skills. Scraped job posting data provides context that helps bridge the gap between academic research and industry practice.

BA is integrated across different industries and can vary depending on the data involved in the organization's operations. Industry-specific BA is a gap in the literature (Pacis & dela Cruz, 2025). The diversity of technological tools, methods, and organizational expectations created inconsistencies in learning BA across academic and training settings. Thus, one solution to this issue in education is the use of Massive Open Online Courses (MOOCs). MOOC platforms provide a large learning community (İnan & Ebner, 2020), such as Coursera and DataCamp. MOOCs integrate accessibility and innovation in the digital era, which promotes continuous learning (Anson, 2024) in the dynamic landscape of BA.

However, the growing popularity of MOOCs often operates independently of formal curriculum development in higher education (Turan & Yilmaz, 2024), raising questions about the alignment of workforce needs with the content of learning platforms. Furthermore, a significant gap persists in the systematic investigation of the relationship between the competencies acquired through MOOCs and other educational formats and the industry's expectations. To address this deficiency, the present study employs the TOE framework to evaluate the alignment between the technological resources, organizational capacities, and environmental expectations highlighted in academic discourse and the demands of the labor market. By employing a mixed-methods approach that combines a Systematic Literature Review (SLR) with a web scraping analysis of contemporary job postings, this research offers valuable insights into how education, in both traditional and open-access formats, can better prepare learners for practical roles in analytics.

2. Theoretical Framework

2.1 Business Analytics as Strategic Infrastructure

Business Analytics (BA) has matured from technical expertise to a strategic organizational asset fully integrated into digital transformation projects (Davenport & Harris, 2007; Provost & Fawcett, 2013). Organizations have increasingly become analytics infrastructures, spanning data architecture, machine learning, and visualization platforms, to support decision-making, process optimization, and competitive advantage.

The growing use of big data and artificial intelligence has further fueled the need for graduates with not only technical skills but also organizational and strategic skills (Gandomi & Haider, 2015; Manyika et al., 2011). As a result, there is an ever-increasing pressure on higher education institutions to design curricula in line with the rapidly changing needs of the labor market.

Nonetheless, education in BA still lacks standards for tools, competencies, and integration. While some programs focus on programming and modeling, others focus on visualization and business interpretation skills. This diversity further underscores the need for a theoretical framework that integrates technological skills, organizational capabilities, and environmental factors. The Technology-Organization-Environment (TOE) framework offers one.

2.2 The Technology–Organization–Environment (TOE) Framework

The Technology–Organization–Environment (TOE) framework, proposed by Tornatzky and Fleischer (1990), is a theory that describes technology adoption as a function of three interrelated contextual factors:

Technology: Innovation characteristics and existing technological infrastructure

Organization: Organizational capabilities, leadership, and readiness

Environment: External pressures, regulatory requirements, and competitive forces

TOE has been widely used as a framework for analyzing the adoption of business analytics, big data, artificial intelligence, blockchain, and digital transformation projects across industries. Many studies have integrated TOE with other theories, such as the Technology Acceptance Model (Davis, 1989), the Diffusion of Innovations, and the Resource-Based View, to analyze the behavioral and strategic aspects of technology adoption.

In BA research, the Technology factor may include perceived usefulness, system compatibility, and infrastructure readiness. The Organization factor may include management support, analytics maturity, and workforce capabilities. The Environment factor considers regulatory forces, market competition, and customer demands.

Notably, existing research primarily uses TOE in the context of organizational technology adoption. There is a much smaller body of research that uses TOE to examine how educational institutions align their curricula to equip students for analytics-intensive environments. This presents an opportunity to reframe TOE as a framework for curriculum alignment.

2.3 Digital Transformation in Higher Education

Higher education institutions are undergoing rapid digital transformation driven by cloud computing, learning management systems, and online educational technologies (Laurillard, 2012; Selwyn, 2016). These technologies have reshaped instructional delivery, enabling hybrid and technology-mediated learning environments that increasingly resemble the digital infrastructures used in professional analytics practice.

Massive Open Online Courses (MOOCs) have expanded global access to analytics education by providing learning pathways in data science, machine learning, and business analytics through platforms such as Coursera and edX. MOOCs promote lifelong learning and mass participation in technical education (Hollands & Tirthali, 2014; Reich, 2015). However, challenges remain regarding completion rates, institutional integration, and alignment with formal curricula (Jordan, 2014). From the perspective of the Technology–Organization–Environment (TOE) framework, MOOCs contribute to technological capability development, require organizational readiness for effective curriculum integration, and function as environmental signals through certifications recognized by employers.

Learning Management Systems (LMS), including Canvas, Moodle, and Blackboard, have also become foundational infrastructure in higher education. These platforms increasingly integrate learning analytics capabilities that allow instructors to monitor engagement patterns, identify potential learning challenges, and adapt instruction accordingly (Ferguson, 2012; Siemens & Baker, 2012). In analytics education, this creates recursive learning environments in which students both learn analytics concepts and experience analytics-driven learning systems.

Experiential learning approaches further strengthen analytics education. Project-based learning, case competitions, and real-world data analysis projects allow students to develop analytical thinking and problem-solving abilities while applying theoretical knowledge. Virtual laboratories and cloud-based analytical environments support hands-on activities such as dashboard development, modeling, and predictive analytics. These learning strategies also help cultivate communication, teamwork, and stakeholder engagement skills, which are frequently identified in analytics job postings.

2.4 Pedagogical Theories Underpinning Analytics Education

Business Analytics (BA) education requires pedagogical approaches that support both technical skill development and professional competency formation. Several learning theories provide a conceptual foundation for analytics education, including Constructivism (Vygotsky, 1978), Self-Regulated Learning (Zimmerman, 2002), Communities of Practice (Wenger, 1998), and the Technology Acceptance Model (Davis, 1989).

Constructivist learning theory suggests that knowledge is actively constructed through interaction with problems, environments, and peers (Vygotsky, 1978). In analytics education, constructivist principles are reflected in project-based learning activities where students analyze datasets, interpret results, and develop solutions to real-world business problems.

Self-regulated learning emphasizes learners' ability to set goals, monitor progress, and reflect on their learning processes (Zimmerman, 2002). This perspective is particularly relevant in analytics education, where students frequently engage in iterative learning processes such as coding, debugging, and data exploration while using analytical tools.

Communities of Practice highlight the social dimension of learning, suggesting that expertise develops through participation in shared practices and collaborative problem solving (Wenger, 1998). In analytics education, collaborative projects, student analytics clubs, and online discussion forums allow learners to develop professional competencies through interaction with peers and instructors.

The Technology Acceptance Model (TAM) explains technology adoption based on perceived usefulness and perceived ease of use (Davis, 1989). In analytics education, TAM helps explain how students and instructors engage with tools such as programming environments, visualization software, and business intelligence platforms. Positive perceptions of these tools increase the likelihood that learners will integrate them effectively into analytical problem solving.

Together, these theoretical perspectives support the integration of technological, cognitive, and collaborative learning processes within analytics education. Their alignment with the Technology–Organization–Environment framework further reinforces the connection between educational practices and organizational technology adoption.

2.5 Connecting TOE, Labor Market Signals, and Curriculum Design

While there is much research on TOE theory and adoption in organizations, and on digital transformation in education, there is little research that connects all three: TOE theory and adoption, labor market competency signals, and curriculum design in analytics education

This research fills this gap by applying TOE theory not to organizational adoption but to curriculum design in analytics education.

In particular:

1. The Technology component comprises the technical tools and methods mentioned in job postings (e.g., SQL, Python, data visualization tools).
2. The Organization component is represented by behavioral and teamwork competencies (e.g., communication, leadership, teamwork).
3. The Environment component is represented by professional certifications and industry-recognized credentials.

By combining a Systematic Literature Review with web-scraped job market data, this research triangulates theory, labor market signals, and curriculum design.

3. Methodology

This study employs a mixed-methods approach combining a Systematic Literature Review (SLR) with web-scraped job market data to examine the application of the Technology-Organization-Environment (TOE) framework in Business Analytics adoption. The SLR synthesizes recent scholarly literature on BA implementation, while web scraping captures current labor market expectations reflected in analytics job postings. Integrating these two data sources enables theoretical triangulation between academic research and workforce demands.

3.1 Research Objectives

This research aims to explore how the Technology-Organization-Environment (TOE) framework has been used in the literature to analyze the adoption and implementation of Business Analytics (BA) technologies, and to translate these theoretical findings into relevant competencies for the curriculum. Moreover, this research aims to explore how the elements of the TOE framework, such as technological instruments, organizational skills (e.g., soft skills), and environmental requirements (e.g., certifications and industry standards), are represented in modern analytics job advertisements. By combining theoretical findings with real-world evidence from the job market, this research aims to contribute to evidence-based curriculum development and competency design in BA education.

3.2 Part 1: Systematic Literature Review (SLR)

This study followed PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) reporting principles to enhance transparency and methodological rigor in article identification, screening, and selection. The databases examined for this study include Scopus, ScienceDirect, IEEE Xplore, and Google Scholar (to ensure comprehensive coverage).

3.2.1 Identification

A comprehensive database search was conducted in:

- Scopus
- ScienceDirect
- IEEE Xplore

The search strings are reported in Table 1.

Table 1: Database keyword search

Database	Search Keywords / String	Filters Applied	Results Retrieved
Scopus	(TITLE-ABS-KEY (business AND analytics) OR TITLE-ABS-KEY (data AND analytics)) AND (TITLE-ABS-KEY (toe) OR TITLE-ABS-KEY (technology AND organization AND environment)) AND (TITLE-ABS-KEY(implementation) OR TITLE-ABS-KEY(adoption))	Document Type: Article Language: English Publication Stage: Final Source Type: Journal Subject Area: Business Year: 2020–2025	75 articles
ScienceDirect	business analytics OR data analytics AND TOE OR Technology Organization Environment AND Implementation OR Adoption	journal articles, business-related topics Year: 2020–2025	816 articles
IEEE Xplore	("All Metadata": business analytics) OR ("All Metadata": data analytics) AND ("All Metadata": implementation) OR ("All Metadata": adoption) AND ("All Metadata": TOE) OR ("All Metadata": Technology Organization Environment)	Content Type: Journals Subject Area: Business Year: 2020–2025	47 articles

3.2.2 Inclusion and Exclusion Criteria

Inclusion Criteria:

- Peer-reviewed research published between 2020 and 2025
- Explicit reference to or discussion of the Technology-Organization-Environment (TOE) framework within the context of Business Analytics (BA) or closely related technological fields (big data, AI, Machine learning, blockchain, BI, digitalization)
- Articles published in the English language

Exclusion Criteria:

- Studies that employ the TOE framework in unrelated fields (e.g., e-commerce without integration to analytical components)
- Publications that do not demonstrate a theoretical application of the TOE framework

3.2.3 Inter-Rater Validation

Two researchers independently conducted title/abstract screening and full-text eligibility assessment. Disagreements were resolved through structured discussion and consensus. Most discrepancies involved borderline cases in which TOE was indirectly referenced. Consensus ensured a consistent interpretation of the inclusion criteria before finalizing the sample.

3.2.4 Quality Appraisal

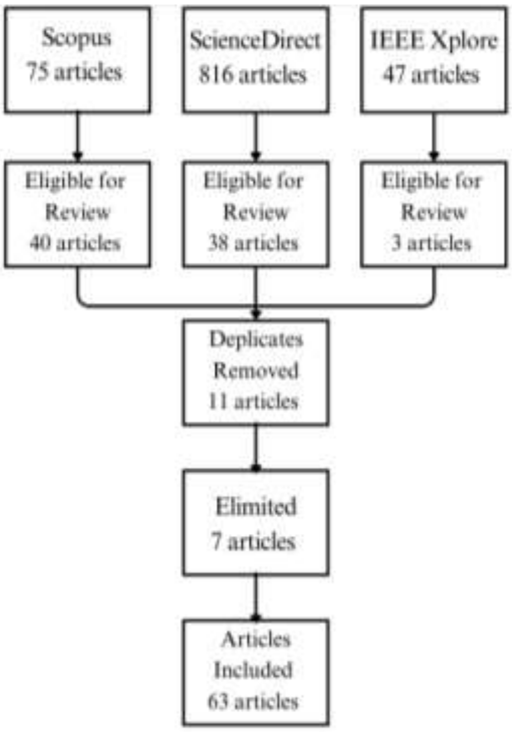
Included studies were evaluated based on:

1. Explicit operationalization of TOE constructs

2. Methodological transparency
3. Relevance to Business Analytics adoption

Only studies demonstrating substantive theoretical engagement with the TOE framework were retained. Figure 1 shows the PRISMA process for this study.

Figure 1: SLR process using PRISMA



A narrative synthesis and a framework mapping were employed to identify patterns in the interpretation, application, and adaptation of the TOE framework across the literature on Business Analytics and related practices. The corresponding author may provide supplementary materials pertinent to the SLR upon request.

3.3 Part 2: Web Scraping of Online Job Postings

To complement the systematic literature review, this study employed a structured web scraping approach to capture current labor market expectations for analytics-related roles. The purpose of this phase was to examine how the Technology–Organization–Environment (TOE) framework components—technological tools, organizational capabilities, and environmental expectations—are reflected in real-world job postings.

3.3.1 Sampling Frame and Data Collection Period

Job postings were collected between March 12, 2025, and April 20, 2025. The sampling was cross-sectional and included active job listings during this collection window.

Inclusion criteria were:

- Country: United States
- Employment Type: Full-time
- Posting recency: Within 30 days of scraping
- Role relevance: Analytics-focused positions

3.3.2 Data Source and Query Construction

Job data were retrieved using the JSearch API via RapidAPI, which aggregates postings from multiple online platforms, including Indeed, LinkedIn, and ZipRecruiter. Data extraction was conducted using Python 3.x to automate API calls and structure retrieved data.

The following Boolean query string was used:

"Business Analyst" OR "Data Analyst" OR "Analytics Consultant"

OR "Business Intelligence Developer" OR "BI Analyst"

OR "Data Scientist" OR "Reporting Analyst"

The following fields were extracted for analysis:

- job_id
- job_title
- employer_name
- location
- job_description
- date_posted

The initial scraping process yielded 1,040 job postings.

3.3.3 Data Cleaning and Deduplication

To ensure data integrity and eliminate redundancy:

1. Duplicate records were removed using the unique job_id identifier.
2. Entries with incomplete or missing job descriptions were excluded.
3. Non-analytics roles (e.g., internships or unrelated administrative roles) were manually screened and removed.

Following this cleaning process, the final dataset consisted of:

315 unique and eligible job postings, representing a 30.3% retention rate from the original dataset.

3.3.4 Coding Scheme and Variable Classification

A structured keyword-based content analysis was conducted to classify job requirements according to the TOE framework dimensions. Coding was non-mutually exclusive, meaning a single posting could contain multiple tools, skills, or certifications. The coding framework included four categories:

1. **Technical tools:** Python, R, SQL, Power BI, Tableau, Excel, SAS, Looker, Snowflake, ETL, Hadoop, Spark, Alteryx, AWS, Azure, Google Cloud.
2. **Technical skills**: Data wrangling, data visualization, statistical analysis, predictive modeling, machine learning, big data processing, API integration, dashboard creation.
3. **Soft skills**: Communication, collaboration, problem-solving, leadership, time management, critical thinking, teamwork, stakeholder management, presentation skills.
4. **Certifications**: PMP, CBIP, CAP, Six Sigma (Green/Black Belt), Google Data Analytics Certificate, AWS Certified Data Analytics, Microsoft Certified: Data Analyst Associate, Tableau Desktop Specialist.

The keyword dictionary was developed based on:

- Findings from the systematic literature review
- Industry competency reports
- Pilot coding of 50 postings

3.3.5 Intercoder Validation

To enhance methodological rigor, a subset of 50 job postings (15.9% of the final dataset) was independently reviewed by two researchers. Each coder applied the predefined keyword dictionary to identify technical tools, technical skills, soft skills, and certifications in job descriptions. Minor refinements were made to the keyword dictionary to ensure consistent interpretation of terms across postings. Once alignment was achieved, the refined coding scheme was applied to the full dataset of 315 job postings.

4. Results

4.1 Descriptive Statistics of TOE Dimensions

To gain a quantitative insight into the importance of the TOE framework, descriptive statistics were conducted for the SLR (n = 63) and the web-scraped job postings (n = 315). The subcategory counts were aggregated at the dimension level to enable inter-dataset comparison.

4.1.1 Descriptive Statistics of TOE Dimensions in the SLR

Across the 63 peer-reviewed articles, the Technology dimension appeared most frequently, with 34 mentions (M = 0.54 per article), followed by the Organization dimension with 29 mentions (M = 0.46). Table 2 shows the mean for each dimension.

Table 2: Descriptive statistics of TOE dimensions in SLR (n = 63)

TOE Dimension	Total Mentions	Mean per Article
Technology	34	0.54
Organization	29	0.46
Environment	20	0.32

It should be noted that in individual studies, multiple TOE dimensions are often considered simultaneously; therefore, the counts represent dimension-level mentions rather than mutually exclusive categories. The result indicates that although technological infrastructure and characteristics remain central to BA adoption studies, organizational and environmental aspects are meaningfully incorporated into the current body of knowledge. This observation is consistent with the multidimensional nature of BA implementation studies in current literature.

4.1.2 Descriptive Statistics of TOE Dimensions in Job Postings

A parallel aggregation was also carried out for the 315 job postings to analyze how the TOE dimensions are realized in the contemporary labor market requirements. The Technology dimension showed a much higher frequency than the other dimensions. Technical skills and tools contributed a total of 685 mentions across the postings, averaging 2.17 mentions per posting. The Organization dimension, as measured by soft skills such as communication, teamwork, leadership, and problem-solving, contributed 233 mentions (a mean of 0.74 per posting). By contrast, the Environment dimension, which is mostly represented by professional certifications such as CAP and Six Sigma, accounted for only 48 mentions, yielding a mean of 0.15 per posting as shown in Table 3.

Table 3: Descriptive statistics of TOE dimensions in job postings (n = 315)

TOE Dimension	Total Mentions	Mean per Posting
Technology	685	2.17
Organization	233	0.74
Environment	48	0.15

The data shows a stark imbalance in the labor market focus. Technical skills are the most prominent requirement, followed by organizational soft skills, and environmental certifications are relatively low. These results suggest that while credentials are useful supplementary requirements, technical skills and interpersonal skills are the primary requirements in analytics roles.

4.2 Cross-Dataset Observations

A comparison of the SLR and job posting datasets reveals an important structural difference. In the research literature, the TOE dimensions are well balanced, with Technology (mean = 0.54), Organization (mean = 0.46), and Environment (mean = 0.32) relatively close. This indicates that research on BA adoption tends to view the phenomenon as a complex system in which technology, organization, and environment are intricately linked.

On the other hand, the job market shows a strong emphasis on Technology (M = 2.17), followed by Organization (M = 0.74), and a very weak emphasis on Environment (M = 0.15). This suggests that recruitment practices significantly favor operational technical expertise over broader notions of the environment.

Employing the TOE Framework, this section presents the analytical findings from two interrelated research components: a SLR and an empirical web scraping of contemporary job listings. The literature review amalgamates insights from 63 peer-reviewed articles, systematically categorizing each publication by methodological orientation (quantitative, qualitative, or mixed) and its alignment with the dimensions of the TOE framework. Simultaneously, the web scraping initiative collected 1,040 job postings from various platforms using the JSearch API, which were subsequently refined to 315 distinct entries after removing duplicates by job identification number. These postings were scrutinized to discern the predominant technological tools, organizational capabilities, and environmental requirements for Business Analytics positions represented in the job market. These two data sources collectively furnish a triangulated perspective on the manifestation of the TOE framework in scholarly literature and industry practice.

4.3 Research Question 1: How has the TOE framework been utilized in scholarly literature to elucidate the factors influencing the adoption of Business Analytics?

A significant finding is that numerous articles incorporated variables spanning multiple dimensions and subcategories, highlighting the intricate, interrelated characteristics of BA adoption. Refer to Table 4 for the results of the variables used to measure the TOE framework across the 63 articles.

Table 4: Variables used to operationalize the TOE framework

TOE Dimension	**Subcategory**	**Variables (Examples)**	**Count**
Technology	Technology Characteristics	Perceived usefulness, system innovation, user-friendliness, technology compatibility	19
Technology	Technology Infrastructure	IT capabilities, data architecture, integration readiness, cloud computing adoption	15
Organization	Management Support	Executive sponsorship, leadership alignment, and strategic vision	14
Organization	Organizational Readiness	Change management, training programs, cultural alignment, and analytics maturity	10
Organization	Analytics Capabilities	Analytical skills, data governance, and business intelligence proficiency	5
Environment	Market Pressure	Competitive intensity, innovation demands, and peer benchmarking	11
Environment	Regulatory Environment	Government regulations, data protection laws, and industry compliance	6
Environment	Customer Expectations	Personalization requirements, service responsiveness, and customer-centric analytics	3

The operationalization of variables across the 63 reviewed articles demonstrates consistent application of the TOE framework. Within the Technology dimension, two subcategories emerged. The first, Technology Characteristics—including perceived usefulness, system innovation, user-friendliness, and compatibility—was examined in 19 articles. The second, Technology Infrastructure—covering IT capabilities, data architecture, integration readiness, and cloud computing adoption—appeared in 15 articles, highlighting strong emphasis on technological foundations.

In the Organizational dimension, Management Support was identified in 14 articles, including executive sponsorship, leadership alignment, and strategic vision, emphasizing leadership's role in enabling BA adoption. Organizational Readiness—including change management, training, and cultural alignment—appeared in 10 studies. Analytics Capabilities, such as analytical skill development, data governance, and BI proficiency, were operationalized in 5 articles, reflecting growing attention to internal skill development.

Within the Environmental dimension, Market Pressure was the most prominent factor, appearing in 11 articles and including competitive intensity, innovation demands, and peer benchmarking. The Regulatory Environment appeared in 6 studies, while Customer

Expectations—including personalization and service responsiveness—were examined in 3 articles.

4.4 Research Question 2: What technological instruments, organizational capabilities, and environmental expectations that align with contemporary labor market requirements can guide the structuring of business analytics curricula?

This section delineates the results from a dataset comprising 315 job postings about business analytics roles. The analysis aimed to identify the predominant technical tools, skills, and certifications required by the sampled postings. The findings were systematically categorized according to the three dimensions of the TOE framework.

4.4.1 Technology Dimension

a. Technical Tools

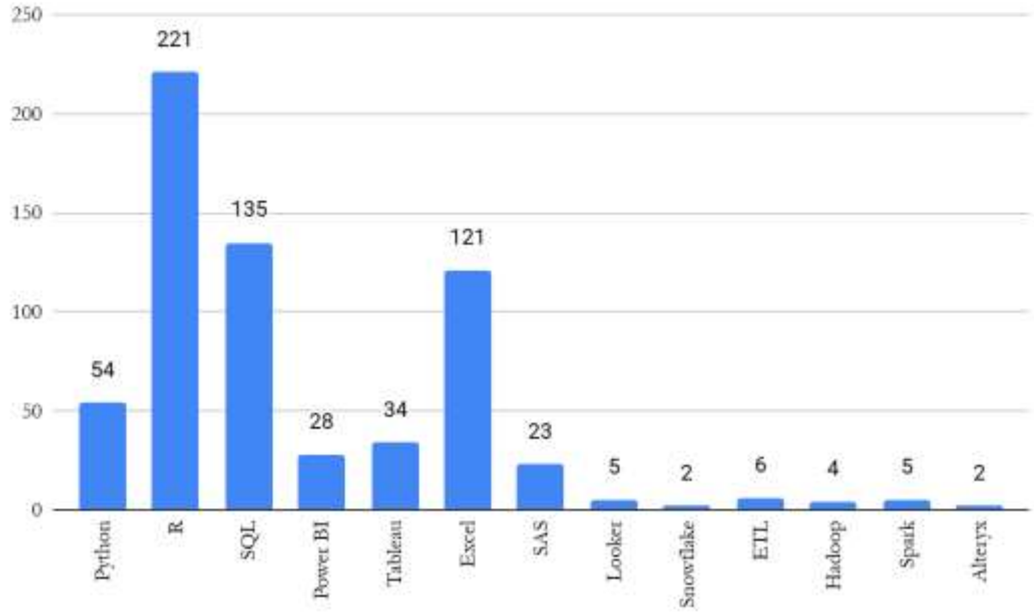
The tools most commonly referenced in job advertisements include R, SQL, Excel, Python, and Tableau. These tools underscore the significant focus on data manipulation, reporting, and visualization skills in analytical positions. Power BI and Alteryx were frequently mentioned, underscoring a preference for platforms that support visual analytics and data preparation.

Table 5: Technical tools from job postings

Technical Tool	Frequency (n)	Percentage (%)
R	221	70.2
SQL	135	42.9
Excel	121	38.4
Python	54	17.1
Tableau	34	10.8
Power BI	28	8.9
SAS	23	7.3
ETL	6	1.9
Looker	5	1.6
Spark	5	1.6
Hadoop	4	1.3
Snowflake	2	0.6
Alteryx	2	0.6

Table 5 presents the frequency and percentage distribution of technical tools identified across the 315 job postings. Percentages were calculated relative to the total sample (N = 315). Because postings may list multiple tools, totals exceed 100%. Figure 2 presents the distribution of technical tools that employers are seeking applicants to have experience with.

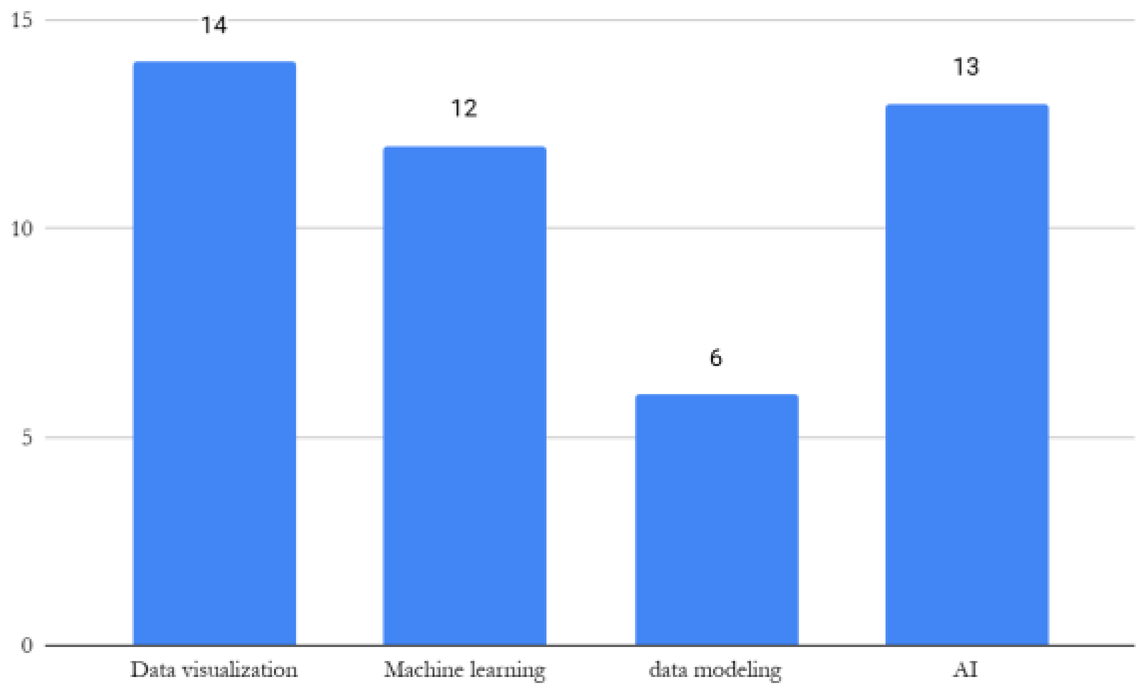
Figure 2: Technical tools from job postings



b. Technical Skills

Essential technical competencies identified from job descriptions include data modeling, machine learning, and artificial intelligence, as well as data visualization and dashboard development. These results indicate a growing need for advanced analytical skills and highlight the importance of aligning industry requirements with the academic training provided for data-centric positions. Figure 3 shows the results of web-scraped data from job advertisements on the applicants' technical skills.

Figure 3: Technical skills from job postings



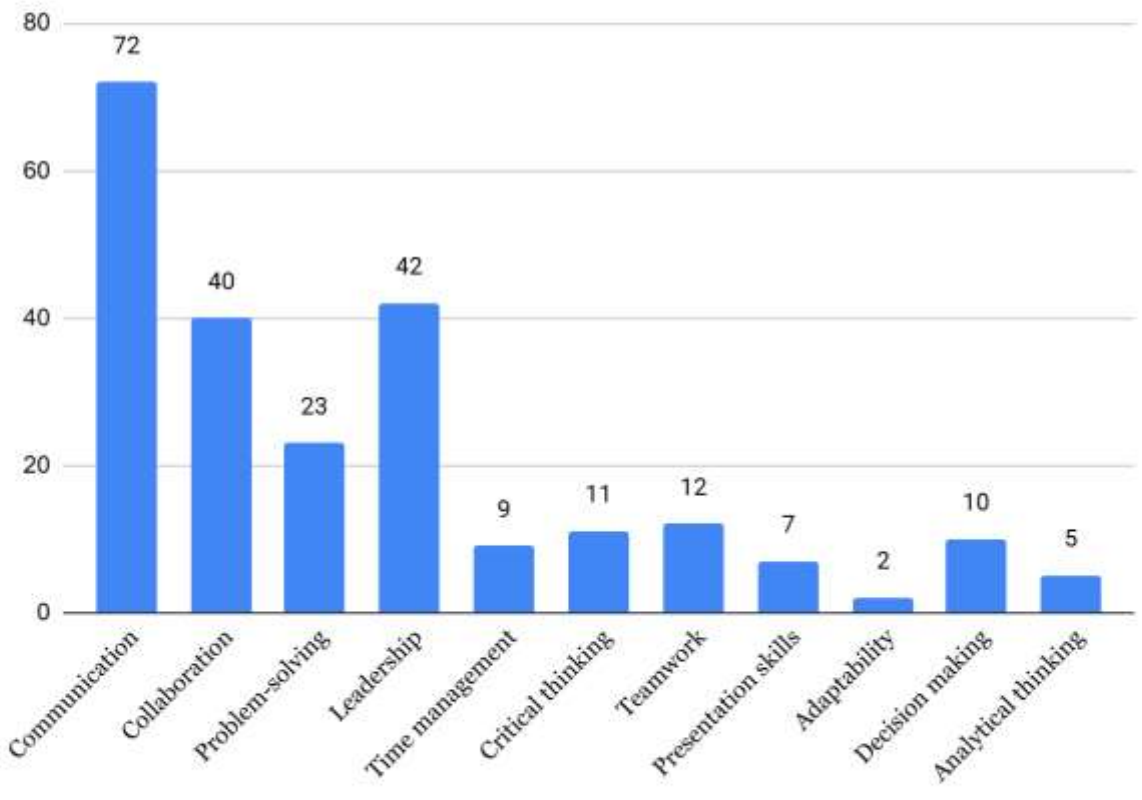
4.4.2 Organization Dimension

Soft skills identified in the job postings included communication, collaboration, leadership, problem-solving, and teamwork. Communication appeared most frequently, emphasizing the importance of translating analytical insights into recommendations for non-technical stakeholders. Collaboration and teamwork also appeared prominently, reflecting the interdisciplinary nature of analytics roles that require coordination with marketing, finance, operations, and information technology.

Problem-solving and critical thinking highlight the expectation that analytics professionals move beyond technical tool usage to support decision-making. Leadership, stakeholder engagement, and time management also appeared in several postings, indicating the value of professional and organizational competencies in analytics roles.

Figure 4 presents the distribution of soft skills identified across the 315 job postings, illustrating the prominence of communication and collaborative competencies within the organizational dimension

Figure 4: Soft skills from job postings



4.4.3 Environment Dimension

The environmental aspect examined in this study focused on professional certifications referenced in job postings. Although several certification types were identified, only a few appeared consistently. The Certified Analytics Professional (CAP) was the most frequently cited credential, followed by Six Sigma certifications. Other certifications, such as the Project Management Professional (PMP), Certified Business Intelligence Professional (CBIP), and Tableau Desktop Specialist, were rarely mentioned or absent. This suggests that while certifications may add value, they are not universally required for analytics-related roles.

Within the 315 job postings analyzed, certification requirements were relatively limited. A total of 124 postings (41.3%) did not specify any certification. CAP appeared in 39 postings (13.0%), while Six Sigma certifications, including Lean Six Sigma, appeared in 6 postings (2.0%). Other certifications, such as CPA, Power BI Certified, and AWS Certified Solutions Architect, appeared only once each (0.3%), indicating that certification requirements remain selective rather than standard across analytics positions.

Table 6 shows that more general analytics-related vendor certifications, such as PMP, Microsoft Certified: Data Analyst Associate, Tableau Desktop Specialist, and Google Data Analytics Certificate, were not present in the dataset.

Table 6: BA job postings certification distributions

Certification	**Count**	**Percentage (%)**
CAP	39	13.0%
Six Sigma (incl. Lean)	6	2.0%
Other (CPA, AWS, Power BI)	3	1.0%
Not specified	124	41.3%

5. Discussion

The analysis of web-scraped job postings supports these academic insights by highlighting practical competencies required in the workforce that align with the three dimensions of the TOE framework. The frequent inclusion of technical and analytical tools reflects the strong technological expectations for aspiring analytics professionals. At the same time, the emphasis on soft skills such as communication, stakeholder management, and leadership reflects the organizational capabilities emphasized in the literature. The environmental dimension appears less prominently but remains visible through references to professional certifications.

Together, insights from both data sources confirm the broad relevance of the TOE framework in explaining the complexities of BA adoption, linking theoretical perspectives with workforce requirements. The interaction among technological, organizational, and environmental dimensions consistently appears across both datasets, reinforcing the interconnected nature of these factors in the adoption and development of business analytics.

5.1 Instructional Methods and Pedagogical Strategies in Business Analytics Education

In addition to its methodological advances, this research is closely linked to themes in curriculum development, digital competencies, and learning assessment in higher education.

5.1.1 Bridging Labor Market Signals and Curriculum Development

The triangulation of TOE-related literature with labor market data provides an evidence-informed basis for curriculum alignment. The results show that:

1. The Technology factor captures the need for specific tool proficiency
2. The Organization factor stresses the importance of soft skills like communication, teamwork, and problem-solving.
3. The Environment factor focuses on professional certifications and awareness of compliance.

This systematic approach allows teachers to develop competency-based curricula that are aligned with verifiable market signals rather than hearsay industry feedback.

5.1.2 Implications for Learning Outcomes

Table 7 presents how the TOE framework can be applied to assessable learning outcomes.

Table 7: Learning outcomes for BA

TOE Dimension	Educational Translation	Assessment Implication
Technology	Tool proficiency and data modeling capability	Hands-on projects, dashboards, coding labs
Organization	Communication and stakeholder engagement	Data storytelling presentations, group analytics consulting projects
Environment	Professional standards and certifications awareness	Certification-aligned modules, ethics case analysis

In this way, the framework transcends descriptive labor-market analysis and enters the realm of constructive alignment among curriculum goals, teaching methods, and assessment criteria.

5.1.3 Assessment Innovation

This research also has implications for the methodological practice of educational assessment in demonstrating how:

1. Web scraping can be used as a dynamic curriculum audit tool
2. Job market analytics can be used to inform program review cycles
3. Data-driven curriculum design can be used to replace traditional syllabus development

Institutions can move away from traditional reliance on accreditation guidelines or advisory boards and instead use systematic web data analysis as part of their continuous program improvement. This directly addresses the current discourse on evidence-based curriculum innovation in educational technology.

5.1.4 Preparing Students for Adaptive Analytic Roles

The results of this research indicate that BA education must not be solely focused on technical skills. Organizational skills, such as communication, leadership, and stakeholder management, are also in equal demand in the market. As such, teaching methods such as Project-based learning, Interdisciplinary case simulation, Industry-sponsored capstone projects, and embedded certification programs are necessary for preparing students for roles in adaptive analytics.

5.2 Limitations

Although this study combines a systematic literature review with empirical job market data, several limitations should be acknowledged. First, the web-scraped dataset focused only on job postings within the United States, which may limit the generalizability of the findings to international labor markets with different regulatory, technological, and educational contexts. Second, the job postings were collected using the JSearch API, which aggregates listings from platforms such as Indeed, LinkedIn, and ZipRecruiter. Because not all organizations advertise positions through these platforms, some analytics roles may not be represented. In addition, ethical considerations were addressed by collecting only publicly available postings through an authorized API (RapidAPI's JSearch service), and the data were used solely for research purposes without gathering any applicants' personal information.

Third, the data were captured within a limited time window, providing only a cross-sectional snapshot rather than a longitudinal view of labor market trends. Finally, the keyword-based content analysis relied on predefined dictionaries to identify tools, skills, and certifications. Although this approach ensures consistency, it may overlook emerging technologies or context-specific skill descriptions. Future research could incorporate natural language processing techniques to capture deeper semantic patterns within job descriptions.

6. Conclusion

This research was based on a mixed-methods research methodology to explore the application of the Technology-Organization-Environment (TOE) framework in the adoption of Business Analytics (BA). The research has analyzed 63 peer-reviewed articles and 315 empirically collected job postings. The job market analysis has reinforced the theoretical constructs proposed in the literature review. The research has proposed the following findings: the integration of analytics technology into the classroom is not sufficient to prepare students to enter the business analytics field. It is important to incorporate the awareness of the changing job market into the classroom curriculum because business analytics is a growing field, just like the availability of data in the organizational environment. As a result, it is important to update the curriculum to keep it aligned with the changing job market.

The research has identified the importance of the following skills in the literature review and in job postings: SQL, Tableau, communication skills, stakeholder management, which can be achieved through the application of technology to support the learning environment. For example, the application of technology has enabled students to practice data modeling, predictive analytics, dashboard development through the use of virtual laboratories. In addition, the application of adaptive learning technology in Massive Open Online Courses (MOOCs) and Learning Management Systems such as edX, Coursera, Canvas, Moodle has enabled the tailoring of the curriculum to the students' progress. This has supported the technological dimension of the TOE framework.

The integration of systematic literature review findings with labor market analytics provides educators with a data-driven approach to curriculum design, enabling Business Analytics programs to continuously align learning outcomes with evolving industry competencies.

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