EXAMINATION OF THE ANALYTICS MODULE IN AN UNDERGRADUATE MIS COURSE: ALIGNING LEARNING OUTCOMES WITH JOB REQUIREMENTS

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SUMMARY: Analytics has transitioned to becoming a fundamental skill for businesses. So, being data literate is vital because utilizing data is key to decision-making in organizations. This paper describes our approach of using the Community of Inquiry framework to redesign the analytics module in the introductory MIS undergraduate course to align with job requirements. On assessing the framework's cognitive, social, and teaching presence elements, our results indicate that students are better prepared to utilize analytics with the redesigned module. Further, using Lexalytics, an NLP software, our findings show that entry-level job applicants must possess higher-order cognitive analytics skills.

Keywords: MIS, Analytics, Community of Inquiry Framework, NLP

Introduction

Web 2.0, advanced analytics tools, increased computer processing capabilities, enhanced storage, and data management techniques have changed the analytics landscape. Accordingly, analytics has taken on a dual nature, from the highly technical skills required by analytics professionals to the fundamental skills necessary for all business people. Despite the increased necessity and ubiquitous nature of analytics, few scholars have evaluated how to comprehensively integrate analytics into the core business school's curriculum without leveraging electives.

This paper explores the implementation of analytics as part of a core course for all undergraduate business majors. We propose extending the introductory management information systems (I-MIS) course since the objective is to enable students to leverage technology. Business intelligence is an excellent introductory topic as analytics is defined broadly. Business intelligence encompasses data gathering, storage, and knowledge management (Negash & Gray, 2008). It is a salient topic because business intelligence systems have changed how functional areas such as marketing, finance, accounting, and management tackle their jobs (Murthy & Ragland, 2009). In fact, the business world reacted by creating several subspecialties jobs in analytics to meet the changing demand (Brown, 2017). For example, entry-level roles like marketing analyst, data analyst, financial analyst, and sales analyst.

Many researchers have sought to determine the knowledge and skills data analysts need. For instance, Chang, Wang, and Hawamdeh (2019) analyzed jobs in the analytics and knowledge management domains from LinkedIn. While the study provided valuable insights, they did not address the design of analytics as part of the core business curriculum, leaving a gap in the extant literature. Conversely, the I-MIS course's curriculum, instruction, and assessment have been examined. For example, manuscripts evaluate the topics necessary for business students in the introductory information systems class (Chen & Holsapple, 2014; Gudigantala, 2013; Wang, 2007). Although this prior research has assessed the need for a standardized pedagogical approach to introductory information systems courses, to our knowledge, no paper has examined the expansion of the analytics curriculum in the introductory MIS course.

Our contribution to the literature comes from providing a student-centered, practical approach for implementing the I-MIS analytics module while enhancing the learning experience. Another contribution is augmenting the I-MIS analytics module to include higher-order Bloom's cognitive levels to match those required for business careers. The rest of the paper is outlined as follows: the literature review, then we describe the methodology in detail. The results and analysis are presented, followed by the impacts of the analytics curriculum on organizations and a conclusion.

Literature Review

The American Assembly of Collegiate Schools of Business (AACSB) established the basic requirements for management information systems (MIS) in 1969. Regular curriculum evaluation and development are required for Information Systems departments within AACSB-accredited business schools (AACSB, 2011b; Mills et al., 2008). Thus, the Association for Information Systems (AIS) established a model curriculum to provide direction for departments. The most frequently used iteration of the guidelines, the IS 2010 curriculum, was published ten years ago. Since its publication, significant changes have occurred, such as the emergence of technology that is now commonplace and actively implemented in organizations. The AIS has since developed the IS 2020 curriculum guidelines, including data and information management as a core competency. This update aligns with the need for the current study.

The IS curriculum guidelines provide direction for identifying IS occupations. According to the AIS Index, some of the most common IS occupations obtained by recent graduates are IT Consultant, Data Analyst, Computer Systems Analyst, and Software Applications Developer. Others are IT Auditor and Information Security Analyst. Growth in the job demand for analytic skills is evident because big data technology was ranked number one technical skill from 2011 to 2015 (Kauflin, 2017). Higher education institutions are rushing to create graduate and undergraduate programs in areas such as data science and data analytics to address the talent shortage of data analytics professionals.

Tang and Sae-Lim (2016) examined thirty randomly selected graduate-level Data Science programs in the United States using a content analysis method. They identified eight different disciplines that have contributed to the development of data science programs: arts and sciences, business, computer science, data science, engineering, information science, mathematical science, and statistics and professional studies. They found that the most frequently used terms in the program descriptions across disciplines contained "data," "analytics," "information," "tools," and "communication." Although analytics involves a broad range of disciplines and job functions within organizations, most analytics and data science programs focus primarily on the technical side of data analytics.

Researchers have also investigated how to identify the types of job roles, knowledge, and skills that make up the field of data science. For instance, Pejic-Bach et al. (2020) used a text mining approach that merges topic modeling, clustering, and expert assessment to explore job postings that appeared on Indeed, Monster, and Glassdoor. With foundations of analytics now becoming an essential skill, this paper focuses on developing the content for the analytics module in the Introduction to Information Systems course taken by Business students from all majors.

Methodology

This research utilizes a mixed-methods approach to collect and analyze data from three different sources:

1. University syllabi/textbooks
2. Job requirements
3. Course data

Mixed methods research involves synthesizing quantitative and qualitative data in a single research project; it is frequently utilized by social and behavioral or human sciences researchers (Doyle, Brady, & Byrne, 2009; Hall, 2013; Johnson, Onwuegbuzie, & Turner, 2007).

University syllabi/textbooks

The process begins with a web survey of universities teaching the Introduction to Management Information Systems course. To ensure the course syllabi were high standard, we selected universities listed on the 'US News Best Information Systems Programs.' We eliminated some observations by selecting only schools listed on the top 55 US News Best Information Systems Programs between March and April 2020. After cleaning the search data, thirty-two universities had syllabi for their introductory MIS courses. Thirteen of the university syllabi specifically listed business intelligence or analytics learning outcomes.

A total of fourteen books were identified across all thirty-two universities that had syllabi. The fourteen textbooks were reduced to the six most frequently used for MIS courses. Each text's analytics learning outcomes are identified using the following topics from the framework: data analysis, decision support systems, data mining, artificial intelligence, data management, and business intelligence. We mapped the learning objectives to Bloom's taxonomy to assess students' cognitive effort currently required in the MIS classes. The levels include remembering, understanding, applying, analyzing, evaluating, and creating (L. W. Anderson & Bloom, 2001).

Job requirements

To identify entry-level jobs, the team searched Indeed.com using the terms "Business Intelligence Analyst." Indeed.com was selected as the job board because it solicits job postings from employers and aggregates ads from other career sites. Further, we used Lexalytics, an excel plugin tool with embedded text analytics and NLP feature stack, a layered process each text document goes through. According to Lexalytics (2021), the items extracted are features such as entities, themes, categories, intentions, summaries, and sentiment.

Course data

We assess the practical application of an introductory MIS course redesigned to address the importance of analytics job requirements. To support course standardization and promote a student-centered mindset, the instructional material and assessments are further refined using the learning approach proposed by Wang (2007) and the Community of Inquiry framework, as shown in Figure 1. Each framework used in the refining process is described below.

Wang (2007) proposed four approaches to learning – instructional, intellectual, clinical, and technical. In the instructional approach, an instructor focuses on the remember cognition in Bloom's taxonomy model (Krathwohl & Anderson, 2009). The intellectual approach raises the level of cognition to understand. The clinical approach teaches students skills for executing and implementing what they learn. In the clinical approach, students' cognitive processes are applying and analyzing. For students to evaluate and create the highest order cognitive levels in Bloom's Taxonomy, they participate in the technical approach (Wang, 2007).

The Community of Inquiry framework is a process that fosters deep and meaningful learning based on three interconnected elements – social, cognitive, and teaching presence (Cleveland-Innes & Campbell, 2012). Social presence is defined as the capacity of learners to create a social and emotional persona reflective of themselves in mediated communication. Cognitive presence is the degree to which learners can construct and confirm meaning through sustained study and discourse. Teaching presence is described as the coordination of cognitive and social processes to realize meaningful and academically valuable learning outcomes (Garrison & Arbaugh, 2007).

This study illustrates an integrative approach for the development of instructional and assessment material for the redesigned I-MIS analytics module, displayed in Figure 1. A students' level of interaction with other learners during team activities and assessments indicates their social presence. Students' level of engagement with interactive content is used as a measure of their cognitive presence. For example, the BI module readings assigned by the instructor fall under the cognitive presence. As part of teaching presence, students explore, integrate, and apply what they have learned by interacting with a next-gen adaptive learning tool and completing exams.

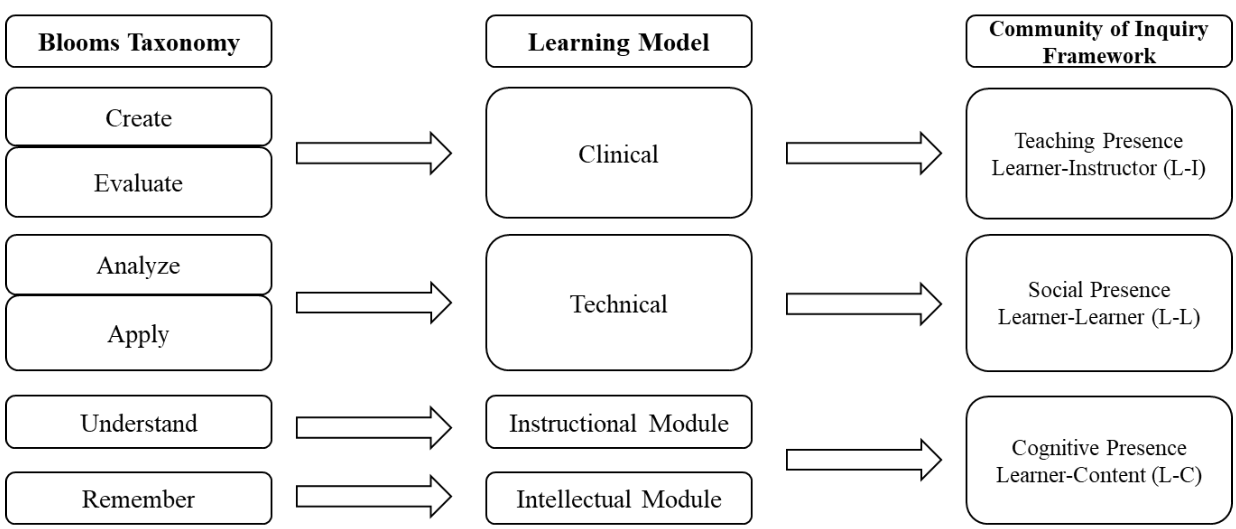

Figure 1: Research Framework

Results and Analysis

Bloom's Analysis of the Relevant Textbooks

A total of sixty-five analytics module-level learning outcomes were identified in the six most frequently used texts for an Introduction to Information Systems course. Following are some examples of the Analytics module-level learning outcomes:

- List the benefits and risks of automated decision making
- Explain key features of Tableau and Power BI - two data visualization platforms

We classified all objectives using Bloom's Taxonomy (Nilson, 2016). The results were classified and tabulated for visualization in Figure 2. Five of the six texts analyzed have analytics outcomes classified with Bloom's cognitive dimension remember. The remember taxonomy accounts for 16.92 % ~ 17% of all 65 module-level learning outcomes analyzed. These learning outcomes are three commonly occurring action verbs: identify, define, and list. An example of the learning outcomes that fall under this category is: 'Identify the advantages of using business intelligence to support managerial decision making' (Baltzan, 2019).

The most frequently occurring Bloom's dimension, as seen in Figure 2, is 'understand.' The understand taxonomy accounts for 78.46 % ~ 78% of all 65 module-level learning outcomes. The action verbs used for the 'understand' taxonomy include 'explain,' classify, describe, compare, and explain. An example of the learning outcomes that fall under this category is: 'Explain key features of Tableau and Power BI as two popular business intelligence and visualization platforms' (Bidgoli, 2020). The results show that only two of the six texts suggest higher-order cognitive dimensions for the analytics module. Both texts focus on the application and analyze levels of Bloom's taxonomy. Module-level outcomes that represent apply are 1.54 % ~ 2% and 3.08 % ~ 3% for the 'analyze' cognitive level. An example of a learning outcome in this category is: 'Examine the advantages and challenges of big data and predictive analytics for a business' (Bidgoli, 2020). Of the six texts analyzed, none of the verbs used in the module-level objectives matched those frequently used to indicate the evaluate or create cognitive dimensions.

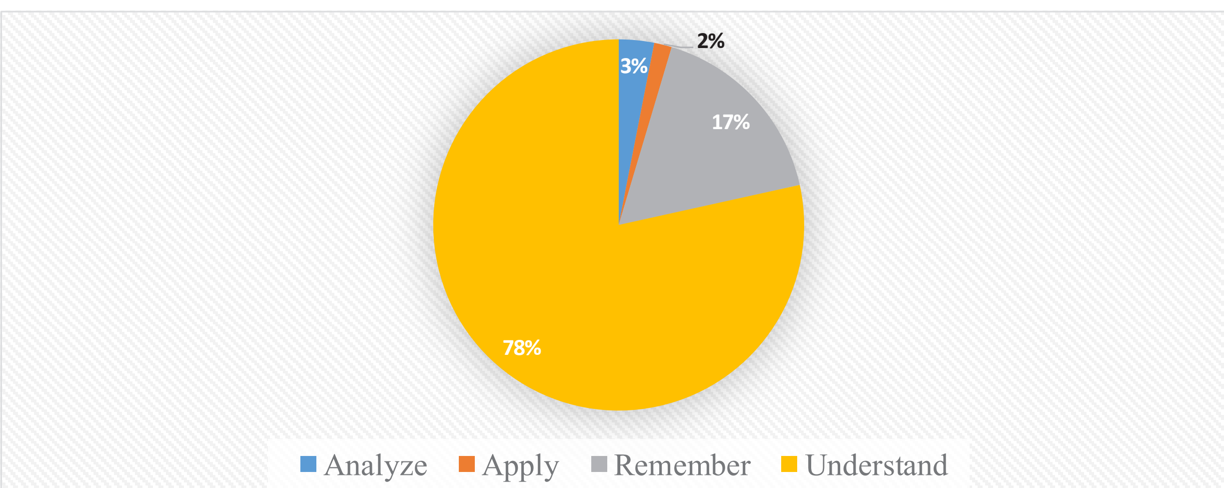

Figure 2: Business Intelligence Module Level Learning Outcomes (MLO) Classified Using Blooms Taxonomy from selected Textbooks

Job Description Analysis using Lexalytics

We reviewed the description of some analytics jobs using Indeed.com for the May 2020 period. The search results from Indeed.com generated hiring companies located across eighteen metropolitan and rural states. We randomly selected fifty-two entry-level analyst job postings from the indeed.com search results. Job posts can be classified as twenty-four roles that span established business functions, including marketing, operations, information systems, finance, and accounting. A sample job description is shown in Figure 3.

- Proven experience with BI tools like Power BI, COGNOS and/or Tableau
- Strong SQL background
- PHP experience
- Willingness to do some tech support (we are still a relatively small company, so our technical employees must be willing to wear multiple hats)

Figure 3: Sample Job Description (Source: Indeed.com)

Using Lexalytics (Barba, Marshall, & Lambrecht, 2016), we analyzed the unstructured text in the fifty-two job descriptions. Lexalytics identified forty-five themes in the cohort. According to Lexalytics (2021), themes are the ideas and subjects that "connect" a set of text documents. Using verbs to map Bloom's taxonomy to the job description's themes is illustrated in Figure 4. Themes classified in the **understand** cognitive taxonomy include *business processes* and *communication skills*. They are categorized as understand since team members are required to 'explain' themselves to communicate or be able to 'describe' business processes; both verbs describe and explain are classified in the understand taxonomy. *Reporting tools* and *database software* are examples of themes classified into the **apply** taxonomy. Verbs such as 'operate,' 'manipulate,' and 'employ' are associated with using software for data analysis.

The theme *deep understanding* is classified in the **analyze** Bloom's taxonomy due to the following description from the job search results, deep understanding of analytics. Another example is the *data engineers* theme classified in Bloom's taxonomy's **evaluate**. By definition, data engineers 'evaluate/prepare' data for analytical or operational uses. They 'integrate', consolidate and cleanse data and structure it for use in analytics applications. *Building tables* is a theme classified as **create**. Building tables requires team members to 'set up,' 'prepare,' 'develop,' or 'design' tables. Each of the aforementioned verbs are associated with the create cognition. A similar methodology was utilized to classify the remaining themes in Bloom's taxonomy.

Figure 4 shows that 24% of themes were classified as understand, 32% apply, 26 % required applicants to analyze, 13% of entry-level job descriptions required the capability to evaluate, and 5% required job candidates to create. The results of the job requirements evaluation indicated that employers need new hires to possess job skills represented by higher-order cognitive levels on Bloom's Taxonomy. Comparatively, most introductory I-MIS courses focus on only giving students an understanding of analytics concepts. The results support the need for an expanded module on analytics in the I-MIS course to meet job demands.

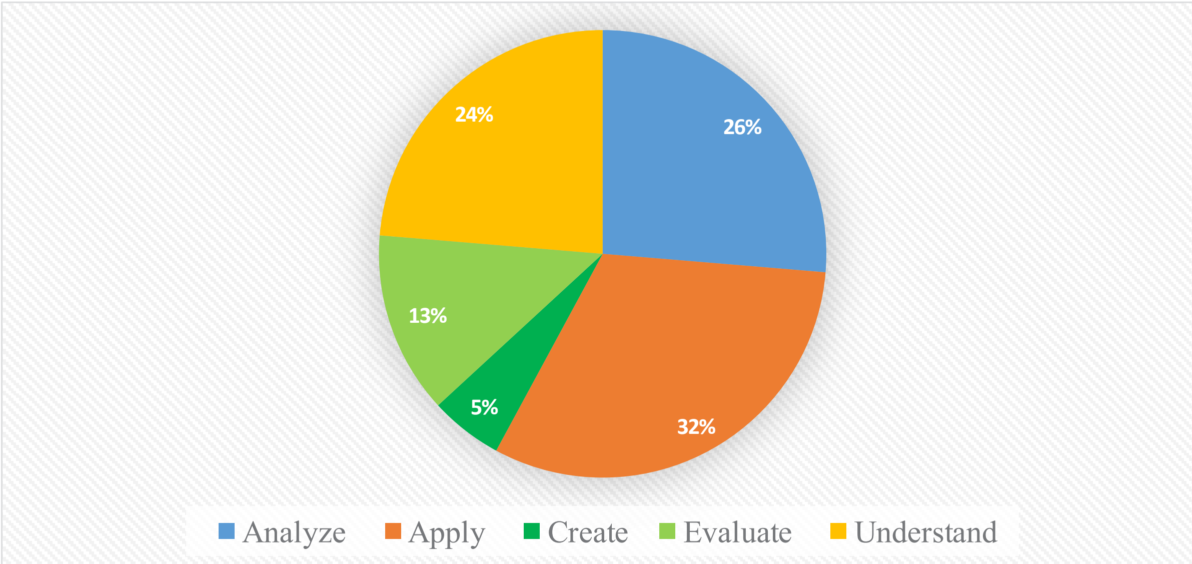

Figure 4: Job Description Themes generated by Lexalytics and Classified into Blooms Taxonomy

Analysis of Course Data

This section discusses the course design and delivery using the research framework shown in Figure 1.

Instructional and Intellectual

The McGraw-Hill Smart-Book was selected because of its adaptive next-gen learning tool that monitors students reading. Using the L-C approach from the Community Inquiry Framework, students are tested on their ability to recall concepts upon completing the reading. Three methods are utilized to deliver instructional material: reading, instructional video, and in-class lecture and lab.

To deepen students' ability to apply the information, they are assigned self-paced labs. Microsoft Excel, Tableau, and Microsoft Power BI are examples of tools students can learn within the timeframe from an open-source platform. The analysis of business intelligence job descriptions shown in Figure 5 indicates that multiple industries require students to know Excel, Tableau, IBM Cognos, Power BI, and Google Analytics.

Clinical and Technical

Business intelligence systems are ubiquitous across all business functions; therefore, students must have clinical and technical expertise. To assess clinical expertise, students learn how to implement their skills. Using the L-L methodology of the Community Inquiry framework, students receive an in-class demonstration of business intelligence in practice using a real-world data set and the data visualization tool Tableau. As a team, students apply the skills they learned to a new dataset. Using the L-I teaching presence methodology of the Community Inquiry framework, each student prepares at least one visualization to support decision-making in a real-world organization.

Figure 5: Lexalytics Word Cloud of Job Skills and Tools generated from the Business Intelligence Job Descriptions

Practical Implications for Instruction and Assessment

We evaluated the new analytics module in four class sections in Fall 2019 and Spring 2020. Table 1 indicates some of the assessment methods were implemented for Fall 2019 and Spring 2020 (N=103); and some assessment methods were implemented only in Spring 2020 (N =47). We examined the percentage of students who received scores above 80% for each assessment level on the business intelligence module.

From Table 1, our results indicate that eighty-three percent of students received an 80% or above score by accurately completing the customized adaptive reading assignment. The results further indicate that eighty-five percent of students received more than 80% for reviewing self-paced labs and submitting evidence of completing the labs. Eighty-four percent of students performed above average on cognitive presence for the instructional and intelligent components of the analytics module; i.e. 84% of students were able to discern a meaningful understanding of the course content through sustained immersion and interaction.

In the clinical module, sixty-nine percent of students scored above 80% by effectively visualizing data – identifying and correcting anomalies, correct measures/metrics, selecting a visual to match the context. Sixty-nine percent of students scored higher than 80% on a team activity geared toward improving social presence. For the technical module, seventy-five percent of students scored above 80% by creating effective visualizations for decision-making in the organization. With an average score of 77% on teaching presence across the clinical and technical module, our results indicated that instructional design and the interaction between students and faculty improved students' learning environment.

Learning Model (Wang 2007)	Bloom's Taxonomy	Assessment Method /Number of Students	**Community of Inquiry Framework** Cognitive Presence Learner-Content (L-C)	Social Presence Learner-Learner (L-L)	Teaching Presence Learner-Instructor (L-I)
Student Performance			% of Students Performing Above 80%		
Instructional	Remember	Reading (N = 47)*	83%		
Intelligent	Understand	Self-paced Labs (N = 103)†	85%		
Clinical	Apply	Exams (N = 47)*			79%
	Analyze	Instructor-led Labs (N = 103)†		69%	
Technical	Evaluate Create	Final Project (N = 103)†			75%
Average			84%	69%	77%
* Data collected in Spring 2020 † Data collected in Fall 2019 and Spring 2020					

Table 1: Students Performance on the Business Intelligence Module

Impact of Analytics Curriculum on Organizations

Data and analytics are prevalent in all aspects of businesses, communities, and our personal lives. In the past several years, popular terms like Big Data, Data Science, Data Analytics, Machine Learning, Business Analytics, and Business Intelligence have become part of the expanding horizons that impact organizations and their use of information technology (Jafar et al., 2017). With the advancement of technology, it is easier to gather, store, and process data. Hiring trends show employers prefer candidates with the ability to utilize analytic tools. Research also reinforces the need for students to possess industry-specific skills to successfully meet the changing demands of the job market (Stevens, Totaro, & Zhu, 2011). Hence, professors and colleges need to explore and specify the coursework for each area in Analytics. Prior studies support the need to reinvigorate the IS curriculum to meet the needs of the business world.

Organizations involved in the curricular design can help shape the trajectory of students. For example, companies like Tableau, IBM, SAS, and STATA - popular analytical tools - have taken steps to partner and shape curricular design. Another way for companies to leverage the redesigned introductory analytics module is to offer students internships or small projects. These partnerships allow students to showcase their technical and clinical skills. Institutions gain the ability to screen qualified candidates before initiating the hiring process, which can be expensive.

The analytics module developed in this study also helps improve business students' data literacy. Data literacy is now a business competency and a requirement for digital agility. Data literacy empowers organizations to implement a thriving data-driven culture (Duncan, 2020). Data literacy is fundamental to business analytics which helps organizations gain insights, inform, and support decision-making (Power et al., 2018), each of which supports maintaining a competitive advantage. For organizations to succeed, being data literate is only becoming more important. Nowadays, both analytics and data are key to decision-making in organizations. Every business needs to select the right mix of business analytics tools and techniques for the right decision problem. As information systems professionals and academics, we must adapt to meet the changing needs of the business environment.

Conclusion and Future Research

With the knowledge gained early at the beginning of an undergraduate degree, students are better prepared to absorb more advanced elective courses and critically assess how to utilize analytics in their given business field of choice. As our study results suggest, entry-level job applicants must possess analytics knowledge. Our results also show that entry-level job candidates must possess higher-order cognitive skills such as using visualization tools, preparing tables, evaluating data, and performing complex logic. In this paper, we have designed a framework to embed the requisite industry knowledge in the introductory MIS course.

Developing an expanded information systems analytics module based on job requirements helps equip students for business careers. Evaluating the learning outcomes would help employers and academics better prepare students to meet job requirements in the analytics field. Academic and industry alignment can result in student-centered outcomes that improve organizational data use to increase operational, tactical, and strategic efficiency. Future research should investigate student performance on analytics-related elective courses and related job prospects.

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