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Data Analytics Skills: Is Accounting Curriculum Ready?

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Data assets that become very vast, unstructured, and move in a fast pace as a result of the digitalization of organizational business processes have a substantial impact and may have implications for greater advantages from data analytics. This creates a need for modifications to accounting education. This study examines how data analytics is integrated into the accounting curriculum. Through an online survey of 238 accounting educators. The findings indicate a gap between the need and actual conditions incorporating data analytics capabilities into the curriculum, with a scarcity of resources with data analytic skills serving as the main cause. The findings have implications for all stakeholders involved in accounting education in Indonesia, encouraging them to collaborate to anticipate the potential effects of the Industry 4.0 revolution, particularly about the graduates' data analytics skills and ability to make the best business decisions.

Keywords: data analytics, curriculum, accounting education

INTRODUCTION

The Fourth Industrial Revolution (IR 4.0) is characterized by smart technologies which connect computers, machines, and humans. These technologies have a significant effect on organizational processes, especially accounting business processes. One of the IR 4.0 technologies that impacts accounting business processes is big data/data analytics (McKinsey, 2018) (Schwab, 2016). Big data refers to a company's data asset with high volume, high veracity, high velocity, and high variety of information that provides enhanced benefits through data analytics capabilities (Davenport, 2014). Data analytics refers to the efforts to extract meaning from raw data using specialized computer systems to transform, organize, and model data to draw conclusions and identify patterns (Tschakert, Kokina, Kozlowski, & Vas, 2016). An online bookstore like Amazon is an illustration of a business practice in accounting that uses big data and data analytics capabilities. Amazon keeps track of every transactional information during the sales process and utilizes data analytics to boost sales results.

Much research has been done on curricula that contain analytical data, and it is proven that in the RI 4.0 era data analytics played an important role in business processes (Andiola, Masters, & Norman, 2020); (Dzuranin, Jones, & Olvera, 2018); (Gamage, 2016). Additionally, there is a high demand for data analytics,

including the need to integrate data analytics skills into the accounting curriculum (Daniel, 2015), identify the scope of data analytics skills and their placement in courses, as well as the need to enhance the skills of designing and teaching courses related to data analytics (Andiola, Masters, & Norman, 2020). Furthermore, there is a demand for students to demonstrate data analytics skills in management, auditing, and taxation areas (Kushniroff, 2012).

In addition to academic literature, global professional organizations in the field of public accountant, such as AICPA (American Institute of Certified Public Accountants) in 2021, also emphasize the importance of interdisciplinary approaches in accounting curriculum and the need to equip students with data analytics skills, such as statistical concepts, data management/analysis, and the use of tools. Data analytics skills are becoming the primary technical skills required for employees to succeed in the next five years (Wiley, 2021); (Vien, 2021). Current data also indicates that companies are hiring fewer accounting graduates due to their lack of skills in data analytics, cybersecurity, and Information Technology auditing (Vien, 2021).

The significant increase in data availability due to digital business processes requires more substantial changes in all aspects than before, particularly in accounting education (McKinney, Yoos II, & Snead, 2017). A new CPA licensing model will be introduced soon (Coffey, 2020), highlighting the importance of data analytics skills for future accounting professionals.

It is anticipated that the usage of information technology in Indonesia—which refers to the use of digital business processes in industries—will substantially impact the country's GDP (Ali, 2019). However, Indonesia's major problem still remains absence of graduates with competence in managing big data and the limited capacity of graduates to produce insightful knowledge (Wiley, 2021). In order to comprehend the gap between the corporate sector's needs and graduates' capabilities, it is necessary to assess the progress of the accounting higher education curriculum in integrating data analytics skills.

This study aims to answer whether accounting education in Indonesia has responded to technological advancements and industry demands, particularly in equipping students with data analytics skills. Accounting education encompasses accounting curriculum, accounting faculty, program management, knowledge, and skills expected from accounting graduates. This study addresses six questions related to data analytics, including challenges, effectiveness, scope of abilities, framework, level of understanding, and teaching methods. The study contributes to the literature on accounting education by addressing the need to examine to what extent accounting programs have integrated data analytics skills into their curriculum and courses. The practical contribution is that the study's findings serve as a basis for developing strategies for all stakeholders in accounting education in Indonesia to anticipate the potential impacts of Industry 4.0.

LITERATURE REVIEW

Industrial Revolution 4.0 (Digital) and Big Data/Data Analytics

Around 2015, the digital era began, marking the start of the Fourth Industrial Revolution. Businesses then started utilizing big data analysis, machine learning, Internet of Things (IoT), cloud computing, and autonomous decision-making systems (Ali, 2019). The big data phenomena have significantly impacted accounting organizations and business processes, as was the case with Amazon's online bookstore. Amazon keeps track of every transaction made during the book-selling process and uses data analytics to boost sales and acquire a competitive advantage. Big data and data analytics allow companies to make data-driven decisions and transform how they conduct their business. According to a study by the MIT Center for Digital Business, businesses that make data-based decisions outperform competitors in terms of financial and operational performance, being 5% more productive and 6% more profitable. Due to these significant benefits, big data and data analytics are the main focus of the largest information technology investments made by companies in the Asia-Pacific region (Kappelman, McLean, Johnson, Torres, & Nguyen, 2018).

Big Data/Data Analytics and Its Effect on Accounting Courses

Previous studies have shown that big data/data analytics affect several courses in the accounting program. For cost accounting/management accounting courses, big data/data analytics can facilitate better decision-making (Tschakert, Kokina, Kozlowski, & Vas, 2016). In the accounting information systems course, big data/data analytics enable faster accounting practices and data access within a short period of time (Voice of Vietnam, 2018). In the taxation course, the effect of big data/data analytics is associated with the risk of double taxation assessment (Monsellato, Pritchard, Hatherell, & Young). In other courses such as public accounting, business ethics, and corporate governance, big data/data analytics allow for the development of targeted programs based on historical and predictive analysis. For example, this enables the creation of more reliable budgets, enabling the sales of data (Hart, 2017), improves transparency, and helps evaluate outcome predictions (Microsoft, 2016).

Challenges and Effectiveness of Study Programs in Integrating Data Analytics Capabilities Into the Curriculum

Many expectations for accounting education improvements have occurred due to the developments in the financial and technology environment. The digital business process presents a challenge, namely the availability of a large amount of data, which simultaneously requires data analytics skills (McKinney, Yoos II, & Snead, 2017). The integration of data analytics into the accounting curriculum has its own challenges (Kushniroff, 2012). There is much confusion around analytical data, such as the challenges of integrating data analytics into the accounting curriculum and the effectiveness of study programs. Therefore, it is important to assess the success of study programs in incorporating analytical data into the accounting curriculum:

***RQ1.** What are the challenges of integrating data analytics capabilities into the accounting curriculum?*

***RQ2.** How effective is the study program in integrating data analytics capabilities into the accounting curriculum?*

Scope of Data Analytics Abilities Integrated Into the Curriculum and Integration Framework

After understanding the integration challenges, the study program can consider the scope of data analytics abilities that need to be integrated into the curriculum and how to conduct the integration. Accounting programs should determine the relevant data analytics skills and how to integrate them into their curriculum (Dzuranin, Jones, & Olvera, 2018). Data analytics skills include identifying what questions should be asked, formulating hypotheses, and exploring, discovering, and making decisions based on data (Tang & Sae-Lim, 2016). Data analytics is categorized into descriptive, diagnostic, and predictive (Tschakert, Kokina, Kozlowski, & Vas, 2016).

There are 12 (twelve) recommended scope of data analytics skills identified from several literature sources (Dzuranin, Jones, & Olvera, 2018) (Gamage, 2016) (Sledgianowski, Gomaa, & Tan, 2017) which include: (1) communicating results effectively; (2) asking critical questions; (3) interpreting results; (4) using visualization tools; (5) identifying anomalies and data-related risk factors; (6) extracting, cleaning, and loading relevant data; (7) applying appropriate data analytics techniques; (8) assessing data reliability and completeness; (9) utilizing statistical software; (10) showing data optimization; (11) evaluating data security; (12) utilizing basic programming language. These skills are highly in accord with the learning objectives of the CPA Evolution (American Institute of Certified Public Accountants, CPA Evolution Model Curriculum, 2021).

The next step for the study program is to decide where these skills are integrated into the accounting curriculum after identifying the scope of data analytics capabilities. More research is needed to understand how the accounting study program integrates data analytics capabilities and information technology (Albring & Elder, 2020). Several integration frameworks are provided in the literature. The integration design can offer recommendations on aligning the curriculum's competencies with what graduates would be expected to do in their future careers.

Article (Andiola, Masters, & Norman, 2020) suggested exploring how accounting study programs implement data analysis in specific courses. Integrating data analytics skills using a hybrid approach, either through integration within specific courses or as standalone courses (Dzuranin, Jones, & Olvera, 2018). Data analytics should be included in the curriculum, and data analytics skills should also be incorporated into elective courses such as intelligence & modeling, management and systems, database design, and business analytics (Gamage, 2016). An interdisciplinary approach is proposed to integrate data analytics skills (Chen, Chiang, & Storey, 2012). Data analytics capabilities, particularly related to statistical modeling, are primarily integrated into courses such as auditing, intermediate financial accounting, and accounting information systems (American Institute of Certified Public Accountants & National Association of State Boards of Accountanc, Accounting program curriculum gap analysis, 2021). Other data analytics capabilities, such as organizational digital intelligence, systems and controls, governance & risk, cybersecurity, audit IT, and IT control have limited coverage in accounting information systems & auditing courses.

The accounting curriculum should include business analysis, information systems, and Big Data technology competence (Lawson, Blocher, Brewer, & Cok, 2013). Combination technical knowledge, professional integrity skills, responsibility, and commitment (Behn, Ezzell, Murphy, , & Ray, 2012). Data analytic skills integrated into five accounting areas: accounting information systems, auditing, taxation, financial, and managerial/cost accounting (Sledgianowski, Gomaa, & Tan, 2017). The Big Four also contribute recommendations for integrated curriculum. AICPA & NASBA propose a curriculum model aligned with a CPA licensure model that has been updated, suggesting that courses include data analytic capabilities (American Institute of Certified Public Accountants, CPA Evolution Model Curriculum, 2021).

RQ3. What is the scope of data analytics abilities integrated into curriculum?

RQ4. Where are data analytics skills embedded in the course?

Understanding the Data Analytics and Methods of Teaching Data Analytics

This study further examines how respondents understand data analytics capabilities, as well as their level of knowledge about data analytics and their level of comfort using resources to teach data analytics, after identifying the range of data analytics capabilities that have been incorporated into the curriculum and where these capabilities are taught.

More research is needed to determine whether accounting programs can keep up with technology developments and adapt to the shifting demands of the accounting profession (Dzuranin, Jones, & Olvera, 2018) (Brink & Reichert, 2020).

There is a negative relationship with using technological tools in learning (Blix, Edmonds, & Sorensen, 2021). In other words, professors with extensive teaching experience may be far from proficient in practical skills. Numerous resources are available to assist study programs and administrators in integrating data analytics into the curriculum and course learning. The American Accounting Association (AAA) proposes that academics and professionals work together by organizing forums, conferences, seminars, and webinars on topics related to Technology IR 4.0, thereby providing abundant resources to support study programs (Janvrin & Watson, 2017). The AICPA also enhances learning resources to improve understanding of data analytics through webinars and case studies and by providing curriculum models that integrate IR 4.0 technological skills. The Big Four accounting firm, Ernst & Young (EY), offers various academic resources such as cases, materials, and data sets to help develop students' analytical skills. KPMG provides free webcasts on information technology and accounting (Sledgianowski, Gomaa, & Tan, 2017). The Journal of Accounting Education also dedicates special topics to Big Data and data analytics (Janvrin & Watson, 2017). Considering the accessibility of numerous resources, this study surveyed the understanding of data analytics in study programs and teaching methods used for data analytics.

RQ5. How can courses and administrators gain an understanding of data analytics to design and teach courses?

RQ6. How are the methods in teaching data analytics and the level of understanding?

METHODS

The data was obtained through an online survey among educational accountants at universities in West Java, Indonesia, from January-March 2023. A total of 251 respondents were obtained, and from the data screening results, 238 questionnaires were fully completed and processable. The descriptive analysis began by presenting the respondents' characteristic data, including gender, age, last education, position at the institution, academic position, institutional origin, years of teaching experience, and teaching area. Subsequently, the variables discussed were the respondents' perception of the challenges of integrating data analytics skills into the curriculum (10 question items), the effectiveness of integrating data analytics into the curriculum (3 question items), the types of data analytics skills embedded into the curriculum (12 question items), the placement of data analytics skills within courses, resources, and level of understanding, and the methods used by respondents in data analytics learning. All survey questions were designed based on the literature by (Andiola, Masters, & Norman, 2020) (Dzuramin, Jones, & Olvera, 2018) (Losi, Isaacson, & Boyle, 2022). Respondents' answers were measured on a scale from 1 to 7 or from strongly agree to strongly disagree.

FINDINGS

Respondent Demographic

TABLE 1
RESPONDENT DEMOGRAPHIC CHARACTERISTICS

Respondent Demographic	∑Respondent	%
Gender		
Male	136	57.3
Female	102	42.7
Sub Total	238	100
Age		
< 30	69	29.0
30-40	24	10.0
41-50	103	43.4
51-60	30	12.6
> 60	12	5.00
Sub Total	238	100
Last Education		
Bachelor's Degree	-	-
Master's Degree	136	57.3
Doctorate	102	42.7
Sub Total	238	100
Position at Institution		
Head of Study Program	21	8.6%
Secretary of Study Program	22	9.3%
Dean/Deputy Dean/Higher Education Leaders	19	8.0%
Lecturer	176	74.1%
Sub Total	238	100

Respondent Demographic	Σ Respondent	%
Academic Position		
Expert Assistant	73	30.6%
Lector	98	41%
Head of Lector	50	21.1%
Professor	17	7.3%
Non-titled	-	-
Sub Total	238	100
Institutional Origin		
A Accredited	2	0.8%
B Accredited	192	80.7%
C Accredited	44	18.5%
Sub Total	238	100
Years of Teaching Experience		
<10 Years	84	35.1%
>=10 Years	154	64.9%
Sub Total	238	100
Teaching Area		
Basic Accounting		50%
Cost Accounting / Management Accounting		37%
Accounting Information System		29%
Intermediate/Advanced Financial Accounting		25%
Auditing		25%
Data Analytic		19%
Taxation		19%
Others		189%

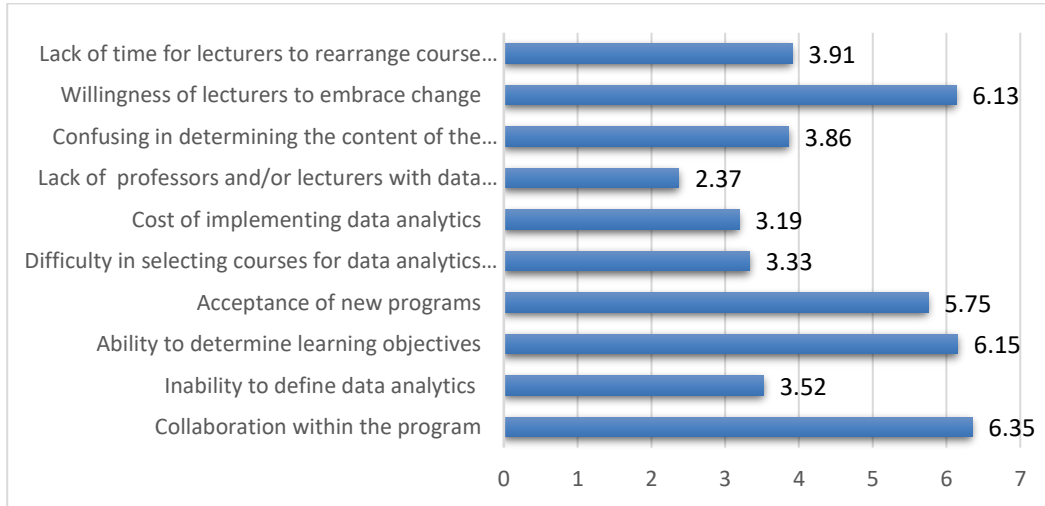
238 respondents were obtained, from the data collection, who are lecturers in the accounting study program at various universities in West Java, Indonesia. From that number, there is a relatively balanced gender proportion, namely 57.3% (female) and 42.7% (male). The composition of lecturers by age is as follows: less than 40 years old (39%), 40-60 years old (56%), and above 60 years old (5%). Regarding education level, most respondents have met the qualifications, with a Master's degree (57.3%) and a Doctorate (42.7%). Regarding positions in higher education institutions, most respondents are lecturers (74.1%), and the rest are heads and secretaries of study program (25.9%). As for academic positions, the majority of lecturers are still assistant professors and lectors (71.6%), while the remaining positions are head of lectors and professors (28.4%). Most respondents have more than 10 years of teaching experience (64.9%) and come from well-accredited universities (80.7%). Several courses that respondent has taken, namely Financial Accounting (50%), Cost Accounting/ Management Accounting/ (37%), Accounting Information System (29%), Auditing (25%), Data Analytics (19%), Taxation (19%), and Other Courses (19%).

The Challenges of Integrating Data Analytics Into the Accounting Curriculum

Figure 1 shows the respondents' responses towards ten challenges related to data analytics by indicating their level of agreement using a scale of 1 to 7 or strongly agree to strongly disagree. The seven biggest challenges faced by the accounting program in integrating data analytics into the accounting curriculum are the lack of professors and/or lecturers with data analytics expertise (mean = 2.37), data analytics implementation cost (mean = 3.19), the difficulty in choosing courses for implementation of data analytics (3.33), the inability to define data analytics (3.52), confusing in determining the content of curriculum (3.86), and the lack of time for lecturers to rearrange course materials, particularly related to data analytics (3.9). Collaboration within the program, the ability to determine learning objectives, the acceptance of new

programs, and the willingness of lecturers to embrace change are not concerns for the program in incorporating data analytics into the accounting curriculum.

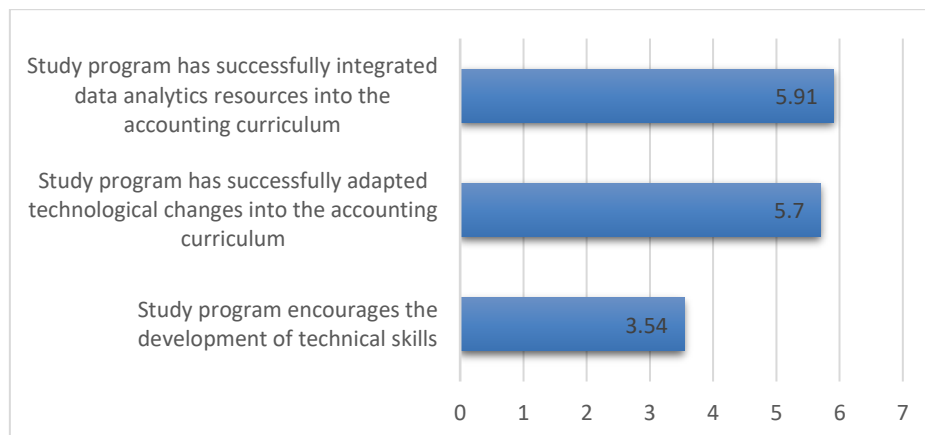
FIGURE 1
CHALLENGES RELATED TO DATA ANALYTICS INTO ACCOUNTING CURRICULUM



The Effectiveness of Study Program in Integrating Data Analytics into the Accounting Curriculum

Furthermore, the respondents were asked to indicate their level of agreement on a scale of 1 (strongly agree) to 7 (strongly disagree) regarding three questions to determine the effectiveness of integrating data analytics capabilities into the curriculum. Figure 2 illustrates the three questions, and the respondents' responses are as follows: the study program encourages the development of technical skills (mean = 3.54), the study program has successfully adopted technological (mean = 5.70), and the study program has successfully integrated data analytics resources (data sets, materials, case studies) (mean = 5.90). These results are quite encouraging because there has been support and encouragement from the study program for faculty members to further develop their technical skills. However, what needs to be given significant attention is the success of technology adoption and the success of integrating data analytics resources into the accounting curriculum, which still pose significant challenges and tasks for the future.

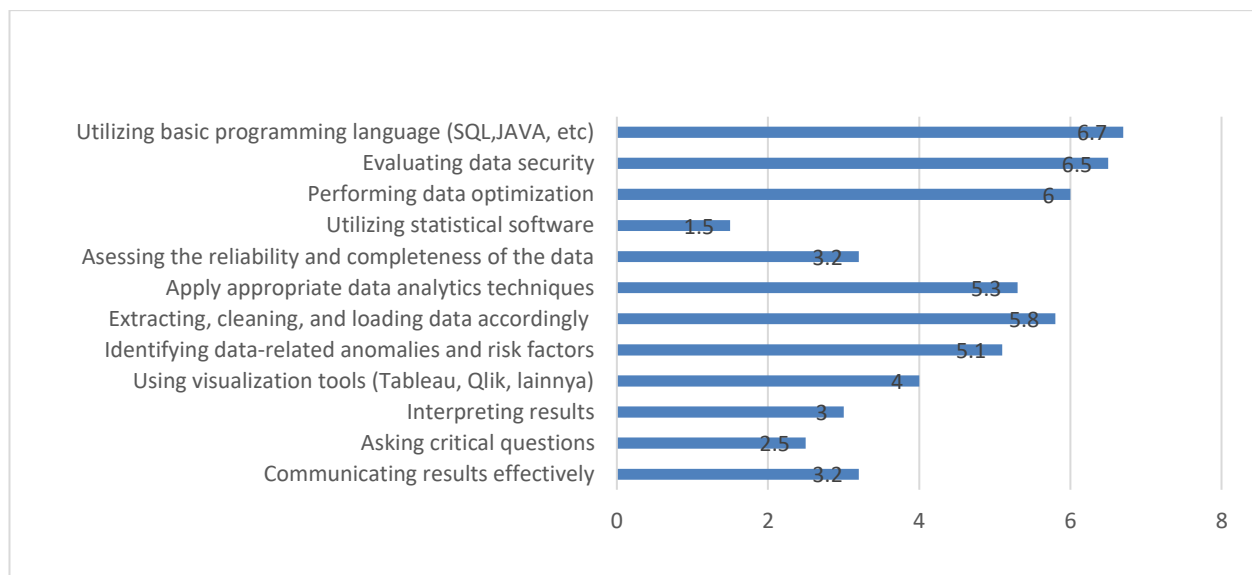
FIGURE 2
HOW EFFECTIVELY DATA ANALYTICS SKILLS HAS BEEN INTEGRATED INTO THE ACCOUNTING CURRICULUM



Integrating Data Analytics Skills to Accounting Curriculum

Figure 3 illustrates the respondents' feedback regarding integrating data analytics skills into the accounting curriculum using a scale ranging from 1 (strongly agree) to 7 (strongly disagree). Out of the 12 skill items referenced from PWC 2015; (Dzuramin, Jones, & Olvera, 2018) (Gamage, 2016) (Sledgianowski, Gomaa, & Tan, 2017) it was found that six data analytics skills have not been embedded in the accounting curriculum. These skills include basic programming language proficiency, data security evaluation skills, data optimization skills, application of appropriate data analytics techniques, data extraction, cleaning, and loading skills, identification of anomalies and data-related risk factors, as well as visualization tool proficiency. Based on the survey results, the accounting curriculum has been included into the accounting curriculum with 5 skills: reliability and completeness, utilizing visualization tools, interpreting results, asking critical questions, and communicating results effectively.

FIGURE 3
INTEGRATING DATA ANALYTICS SKILL TO THE ACCOUNTING CURRICULUM



Courses That Integrate Data Analytics Skills

Next, respondents were asked to provide feedback on the skills embedded into the accounting curriculum, specifically integrated into courses. This study found that data analytics is taught as a standalone subject in certain courses within the accounting program, namely courses that are not core competencies, such as statistics and research methodology courses. Both of these courses cover the use of statistical software such as SPSS, SEM PLS, STATA in data processing, assessing data reliability and completeness, and interpreting and effectively communicating results. Some aspects of data analytics are also integrated into auditing and accounting information systems courses. Respondents indicated that accounting information systems and auditing courses are courses that include several data analytics skills. The findings of this study support [5] which state that auditing and accounting information systems courses are the most common courses that include data analytics skills.

TABLE 2
DATA ANALYTICAL SKILLS IN THE ACCOUNTING INFORMATION SYSTEMS COURSE

Data Analytics Skills	Respondents' Percentage	
	Accounting Information System	Audit
Communicating Results Effectively	65.20%	60.10%
Asking critical questions	67.10%	68.80%
Interpreting results	63.20%	63.50%
Using visualization tools	31.50%	-
Identifying data-related anomalies and risk factors	12.20%	58.70%
Extracting, cleaning, and loading data accordingly	15.50%	-
Assessing the reliability and completeness of the data	36.50%	9.87%
Utilizing statistical software		
Performing data optimization	32.20%	-
Evaluating data security	10.20%	-
Utilizing basic programming language	9.30%	5.11%
Total		

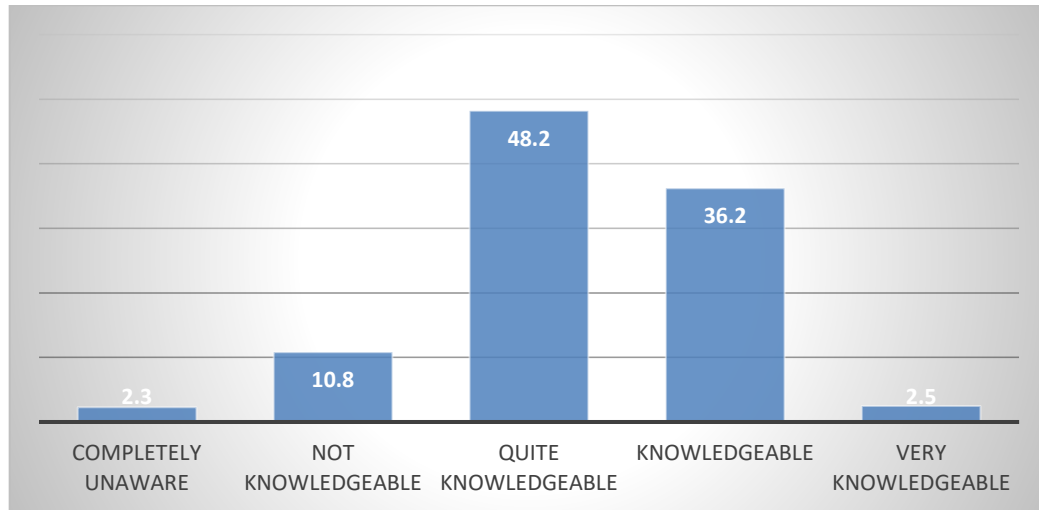
Table 2 shows the percentage of respondents who identified data analytics skills in the accounting information systems course. For skills in using statistical software (32.2%), Assessing data reliability and completeness (36.5%), using visualization tools (31.5%), interpreting results (63.2%), asking critical questions (67.1%), and communicating results effectively (65.2%). However, skills in identifying data risks, data extraction, data security, and programming language usage have not been adequately integrated into the Accounting Information Systems course. Table 2 demonstrates the percentage of respondents identifying the most commonly integrated data analytics skills in the auditing course, which include asking critical questions (68.8%), communicating results effectively (60.1%), interpreting results (63.5%), and identifying risk (58.7%).

This study also found that several core accounting courses have not addressed or only briefly discussed data analytical skills, such as basic and intermediate accounting, cost/management accounting, and taxation. Some data analytical skills covered in these courses include asking critical questions and data interpretation skills.

Data Analytics Resources, Level of Understanding, and Teaching Methods

The results indicate that respondents gain understanding of data analytics skills through conferences (63 percent), seminars/webinars (50 percent), prior experience (38 percent), training (26 percent), forums (14 percent), conducting research (n=29), taking software training and other IT training, engaging in professional education (n=20), consult with professionals industries (n=10), reading textbooks & self-learning (n=10), and other sources such as teaching cases and others. Respondents were asked to indicate their level of knowledge and knowledge of the study program regarding data analytics skills using a scale of 1 = very knowledgeable to 5 = completely unaware. The results show that most respondents still have insufficient or limited knowledge of data analytics (61.3 percent), with only approximately 38.7 percent having knowledge of data analytics, and it is likely that these respondents are doctoral-level instructors who are already familiar with using statistical software. Regarding the level of comfort in using resources to teach data analytics on a scale of 1 = very comfortable to 5 = very uncomfortable. The results show that comfort in teaching data analytics using case studies is rated at an average of 2.07, comfort in using statistical software is rated at an average of 2.73, and comfort in using visualization tools is rated at an average of 2.76.

FIGURE 4
PERCENTAGE OF UNDERSTANDING DATA ANALYTICS



CONCLUSION

This research looks at how curricula in tertiary institutions are developed by incorporating data analytics. The objective is to comprehend the discrepancy between the capabilities of graduates in the Fourth Industrial Revolution era and the needs of the corporate sector. Several conclusions were reached. **First**, the program lacks resources and data analytics competence, which impacts the faculty members' level of knowledge of the subject since most of them only have sufficient or even insufficient knowledge. **Second**, the integration of data analytics into the curriculum has not been effective, as indicated by the response that the adoption of technological skills, particularly data analytics integration, has not been successful enough, despite the support from the program. **Third**, the integrated data analytics capabilities in the curriculum include statistical software, data reliability and completeness, visualization tools, interpreting results, asking critical questions, and communicating results effectively. However, some skills have not been adequately integrated into the curriculum, such as basic programming skills, data security assessment, data optimization, appropriate data analytics techniques, extracting, cleaning, and loading relevant data, identifying risk factors and anomalies, and using visualization tools. **Fourth**, while fundamental accounting courses covering data analytics are mostly found in auditing and accounting information systems courses, certain data analytics topics were identified in statistics and research methodology courses. **Fifth**, IT training is needed among other methods, conferences, seminars, webinars, prior experiences, software training, and to understand data analytics. In addition, professors are at ease using case studies and visualization tools to teach data analytics.

Contribution this research by investigating how far the implementation of data analytics focuses on the development of an accounting curriculum as well as the ability lecturers to design and teach data analytics. This study provides practical inputs for accounting education practitioners based on the identified gaps. **First**, study programs should be more active in discussing and pursuing the necessary modifications to incorporate data analytics into the curriculum. **Second**, in order to ensure that students gain a deeper understanding and development of data analytics, it is necessary to expand the content of various core accounting courses early on to include the 12 skills identified in the survey. These courses include basic accounting, financial accounting, taxation, and others. **Third**, it is important to further explore whether there are differences in the duration of work experience and academic position with adopting new technological skills. **Fourth**, conducting data analytics integration that considers efficiency & effectiveness with maximizing existing resources and focusing on developing cohesive strategies throughout the curriculum. **Fifth**, there is a need to develop data analytics competency assessments for students to monitor

progress and reduce gaps in meeting future job demands. **Lastly**, maintaining collaboration and sustainable relationships between higher education in accounting, the accounting profession, & the corporate sector to ensure that the accounting curriculum remains robust & relevant.

LIMITATION

Some of the study's limitations are due to the small sample size from the West Java region in Indonesia, which unquestionably does not yield enough data for generalization. Future research can expand the sample size and use various techniques to involve program managers to provide a broader picture of how Indonesia's accounting higher education is doing. A curriculum that adapts to demands and changes will determine the future of accounting in higher education in Indonesia.

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