ISSN: 1935-8156 Volume 18, Number 1, 2023, pp. 1–19 DOI: 10.3194/1935-8156-18.1.1

Preparing Accounting Students for Careers Utilizing Data Analytics: Curriculum Innovation Steps and Challenges

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Abstract

Data analytics has become increasingly important in the accounting profession. To prepare accounting students for careers that require data analytic skills, accounting departments in institutions of higher education need to integrate data analytics into existing curricula. While the curriculum development process has been described extensively in prior literature, adding data analytics to accounting curriculum proves challenging for several reasons, including the complexity of the subject of data analytics, insufficient faculty resources, and the limited credit hours accounting students have available for new courses. In this paper, we describe our business school's seven-step process of incorporating data analytics into the accounting curriculum. Since analytics learning objectives cannot be taught within the accounting curriculum by accounting faculty alone, this curriculum innovation required collaboration with other faculty. This analytics curriculum update required buy-in from various stakeholders, all done despite notoriously limited time and resources. We were able to see accounting students succeed in their internships and careers using analytics learned from this new curriculum. In addition to describing the steps, we discuss the challenges faced and lessons learned from integrating accounting and analytics education.

Keywords
Accounting curriculum, curriculum challenges, innovation, data analytics, accounting education

Acknowledgements
We appreciate the helpful feedback of the anonymous reviewers, the associate editor, and the senior editors in improving the manuscript. We want to thank Dr. Cynthia Frownfelter-Lohrke for her thoughtful guidance on the manuscript. We also want to thank Dr. Alan Blankley for chairing the data analytics curriculum committee described in this manuscript, and Dr. Cynthia Frownfelter-Lohrke, Dr. Charles Carson, and Dr. Jennings Marshall for their instrumental work on the data analytics curriculum committee.

Data analytics has become an increasingly important topic in the business world over the last decade (Chen et al., 2012; Davenport et al., 2020; Hamilton & Sodeman, 2020). The accounting profession acknowledges this, with increasing needs to understand and apply a comprehensive set of data analytics skills, including data management, manipulation, cleaning, analysis, and presentation. Analysis showed that recent accounting job postings listed both technical skills and soft skills in analytics and accounting information systems (AIS) education (Larson et al., 2021).

Accordingly, professional organizations such as the AICPA (American Institute of Certified Public Accountants) have been developing resources on data analytics for accounting professionals (Tschakert et al., 2016). As data analytics and visualization tools (beyond Excel) are becoming important assets within accounting firms (Lee et al., 2018), accounting faculty have started incorporating tools such as Alteryx and Tableau into their courses (Dow et al., 2021). Gomaa et al. (2021) proposed a data analytics elective course for graduate accounting students.

In another strong institutional signal of support, AACSB standards expect data analytics to be included in curricular content for business schools (AACSB International, 2018). The CPA (Certified Public Accountant) exam has expanded its coverage of data analytics, such as analytical mindset, procedures, data management, and data visualization (Tysiac, 2019).

Seven years ago, motivated by the importance of data analytics education for our business and accounting students, we embarked on a journey to incorporate data analytics into our business school curriculum. Building on three established models for curriculum development, we underwent a process to develop business analytics curriculum that would support accounting students as well as our other business majors. Tyler (1949) was an influential resource that proposed four integral steps for curriculum development: define the objectives, select learning experiences, organize the learning experiences, and evaluate the objectives. Taba (1962) further emphasized the importance of student needs and teacher influence. Wheeler (1967) modified the process to be a cyclical model; that is, evaluation is not the end but leads to the next phase of defining the objectives.

Our work follows a framework that integrates the structures developed by Tyler (1949), Taba (1962), and Wheeler (1967) as we sought to enhance our programming and build new skills for students that were valued on the job market. Specifically, we used the following steps for incorporating data analytics into accounting education:

1. Build the team. In our experience, it is very beneficial to collaborate with faculty outside the accounting department.
2. Review the literature. We can learn from what others in our field have already accomplished.
3. Survey faculty and industry advisors. Using a list of topics gathered from the literature, we surveyed our business and accounting faculty, as well as industry advisory board members, asking each survey respondent to rate the importance of each topic to help us determine the priority of topics.
4. Define the learning outcomes. After gathering supporting information from the literature and from the faculty and industry advisor surveys, the team reviews the material to specify the learning outcomes of the new curriculum.
5. Revise current courses. Since the accounting curriculum is often packed with many courses already, we find it better to start with collaboratively revising the current courses rather than adding brand new courses.
6. Add an undergraduate and a graduate minor (concentration) in data analytics. Based on accounting industry advisors' input, having data analytics as part of a student's degree would send a signal to prospective employers. However, it is challenging for undergraduate accounting majors to add a second major because of the course load and the winter internship, which makes it difficult for them to take regular courses in that semester. Instead of requiring accounting majors to add a second major, a data analytics minor seemed to fit into an accounting curriculum more readily. Likewise, at the graduate level, a data analytics concentration can add value to our conventional Master of Accountancy program by meeting the demand from the industry for accounting graduates skilled in data analytics.
7. Keep the feedback line open. It is unrealistic to expect the curriculum to be perfect immediately. Oftentimes, we need to revise the curriculum based on feedback from faculty, students, alumni, and industry advisors and changes in the field.

This manuscript details our experience updating business school curriculum to incorporate data analytics. Our contribution in this manuscript is not the novelty of these steps but the specific application of incorporating data analytics into accounting curriculum. We can also see the challenges and results of the steps after several years—having many accounting students go through this curriculum helped us see what worked well and what needed improvement. In addition to describing the steps, we also summarize the challenges we faced and lessons we learned during this process. We hope that, by sharing these lessons, we can help accounting educators in future curriculum innovations.

Background

Although we may believe our business school to be special, it is—in numerous ways—similar to many others. For example, our university has about 5,800 students in total, and our business school has approximately 1,000 students; approximately twenty percent of the university's students major or minor in business. Our business school includes programs in accounting, economics, finance, management, marketing, and entrepreneurship. We offer both graduate and undergraduate business programs, and our business school is accredited by AACSB International (hereafter, AACSB).

In addition to AACSB's guidance to include a curriculum involving data analytics, our university administration approached our business school to provide recommendations that would deepen data analytics content in our undergraduate business curriculum. The reasoning was that students in other majors may be interested in pursuing a minor in business analytics.

We started our curriculum innovation, as described in this paper, in the fall semester of the 2016–2017 academic year. Our work culminated in the spring semester of 2023 when we developed the Data Analytics Concentration for the Master of Accountancy.

Curriculum Innovation Planning and Implementation

Step 1: Build the Team

Taba (1962) highlighted the most important element in curriculum development, namely, that faculty's input should inform all the steps, such as formulating objectives and selecting activities (Bhuttah et al., 2019). Therefore, the first step in our curriculum innovation was to gather a faculty team to lead this process.

Our accounting advisory board members communicated to our business school dean and accounting department chair that graduates would need improved data analytics skills to stay competitive. In response, our business school dean and accounting department chair decided to form a faculty committee with a formal charge to research data analytics curriculum development and propose curriculum revisions to incorporate data analytics into the curriculum.

Organizations, including institutes of higher education, can create silos when there are multiple departments of distinct disciplines, and silos can create challenges for departments to collaborate (Nisul & Pekkola, 2018). Meanwhile, as the committee sought to incorporate data analytics, we acknowledged it would not be possible to incorporate analytics education by one department alone due to limited faculty, time, and resources. We also recognized the value and impact knowledge and experience with analytics would have on students across our different majors. Therefore, it was necessary to have the accounting department collaborate with other departments to accomplish our goal.

We coordinated among faculty of different disciplines to get buy-in from all business school departments and to ensure these foundational business analytics courses would serve all disciplines. Like many schools, our undergraduate majors relied upon a common set of core business courses. As we planned to use core business classes as part of our analytics curriculum redesign, it was important to have faculty from all disciplines on board with the changes. Having the faculty teaching business core courses involved in curriculum redesign had multiple benefits: we learned from faculty who were subject experts, we learned from faculty who had experience working with student populations who would be taking the redesigned courses, we generated buy-in and limited resistance from faculty, and all the courses would be better integrated when the teaching faculty were contributing to the redesign process.

To facilitate collaboration between accounting and the other departments, the business school dean brought together a committee that included six business school faculty members:

- Committee Chair: chair of the accounting department
- Member 1: an accounting faculty member who teaches accounting information systems
- Member 2: a management faculty member who has published on the role of data analytics in corporate strategy
- Member 3: an economics, finance, and quantitative analysis faculty member who teaches business statistics
- Member 4: another economics, finance, and quantitative analysis faculty member who teaches business statistics and management information systems
- Member 5: the associate dean, who was not a voting member of the committee but represented the perspective of business school administration

The two business statistics faculty were selected as they had experience teaching quantitative analysis courses and would be teaching the new data analytics courses. The two accounting faculty and the management faculty were selected to represent the perspectives of accounting and other disciplines in business outside of quantitative analysis.

The associate dean was included to help explain what administrative support or obstacles the curriculum innovation process might have.

The six-person collaboration brought helpful diversity and perspective to the discussion, increasing innovation, creativity, and overall performance of our initiative (e.g., Bell et al., 2011). The course sequence would be taken by students of all departments, so it was helpful to have buy-in from all disciplines. Furthermore, having each department represented on the committee meant all departments would be informed of what the students would learn at each level. Finally, our collaboration allowed for a reduction in the redundancy of course materials. To facilitate this collaboration, the six-person team met once a week for more than twelve months to develop the business analytics curriculum. The frequent meetings helped develop team cohesion, which grows stronger over time and contributes to positive team performance (Mathieu et al., 2015). The faculty and administrators have been conscious about having faculty members from different departments collaborate, not just for curriculum items but for all school-related issues. The collegial atmosphere helps reduce relationship conflicts, which can negatively impact performance (De Dreu & Weingart, 2003) and improve both team performance and individual performance (Chiocchio et al., 2012). We acknowledge and offer credit to the administration and faculty that promote and maintain this collegial atmosphere.

Step 2: Review the Literature

Recent curriculum development models have expanded upon the work of Tyler (1949), Taba (1962), and Wheeler (1967) to meet emerging needs in different disciplines. For example, Kern et al. (2009) proposed a six-step approach of curriculum development for medical education, and one must start with "problem identification and need assessment," which requires "collecting new information" (Kern et al., 2009).

Our first task was to learn from the state of the field and research what has been done in order to incorporate that knowledge in our curriculum revision. At the time of the committee's review of the literature (Fall 2016), we saw several important new trends related to accounting: Big Data (Vasarhelyi et al., 2015), data visualization (Yigitbasioglu & Velcu, 2012), and predictive analytics (Earley, 2015). (These were the trends we saw when we embarked on this journey in 2016; it is not meant to be a literature review as of today. Appendix Table A1 offers a list of resources that might be useful for incorporating data analytics into an accounting curriculum.)

Step 3: Survey Faculty and Industry Advisors

Another approach to "problem identification and need assessment" is through surveys (Kern et al., 2009). The survey approach has also been reported in accounting education literature; for example, Lee et al. (2018) surveyed accounting practitioners to identify relevant software tools for data analytics and visualization.

For our accounting education curriculum innovation, an important step we undertook before formalizing and defining our primary objectives was to conduct information-gathering surveys from key stakeholders. Connecting with and querying stakeholders to better understand their needs helps to balance those needs, which is beneficial for organizational performance (Freeman, 1984). With greater insights from the many groups influencing or impacted by an organization, leaders gain helpful perspectives on issues, enabling an increased ability to anticipate how different alternatives might impact outcomes (Duncan & Wack, 1994). Giving these stakeholders a voice allows for a more comprehensive strategic assessment to determine how organizational strengths can be applied to market opportunities (Andrews, 1971).

Stakeholder groups for institutions of higher education include students, parents, faculty, staff, administrators, advisory boards, and employers. Over the last seven years, we have conducted multiple surveys. Appendix Table A2 summarizes the timeline, target survey respondents, and purposes of these surveys. The first survey was given to faculty members within our school. We conducted this survey in Fall 2016. The survey indicated a strong interest in data analytics, and the faculty members at the time did not have concrete ideas on how to include data analytics in the curriculum. This was understandable, since data analytics was an emerging field and the faculty did not have answers on how to incorporate it. Nevertheless, the survey accomplished the goal of identifying the four courses that we should revise to incorporate data analytics (we discuss this further in Step 5).

Another goal of the faculty survey was to identify and prioritize the topics required to maintain success in subsequent courses and to identify and prioritize new topics required for success in the changing business landscape (in concert with the recognized trends noted above). For example, if an AIS course needs a student to have prior knowledge of databases, a business analytics course can cover that topic as a prerequisite. Likewise, if multiple upper-level courses require students to have spreadsheet skills, it seems logical for students to learn Microsoft Excel® in a lower-level course.

We next surveyed our industry advisory board members (Appendix Table A2). Our advisory boards are alumni and other professionals with over 10 years of professional experience. This group of external constituents is invested in the business school's success and has a history of hiring our graduates. The combined experience of these board

members, spanning all disciplines within our curriculum and representing many potential employers locally and regionally, offered an additional perspective on what our graduates need for success in the industry. In this survey, we asked our advisory board members to rank the importance of a list of data analytics topics. Table 1 summarizes the ratings of data analytics topics according to the surveys.

Table 1
Topics for Data Analytics Curriculum Based on the Surveys

Priority	Topics
Required	Basic Excel skills
	Intermediate Excel skills
	Presentation and communication skills with data
	Report writing skills with data
	Basic statistical analysis
	Basic database skills
	Basic data visualization skills
Useful but not required	Basic programming skills
	Intermediate database skills
	Intermediate data visualization skills
	Predictive analytics
	Data mining
	Analytics workflow integration tools
Low priority	Intermediate programming skills
	Advanced programming skills
	Advanced statistical analysis
	Advanced machine learning

A third survey (discussed in more detail in Step 6) was conducted in Fall 2022 to ask industry professionals about the objectives for graduate-level analytics courses (Appendix Table A2). The surveys of faculty and industry advisors helped us define the learning outcomes for data analytics curriculum, which we will describe next. An additional benefit was that it helped us enhance buy-in from the faculty and advisory boards for the curriculum innovations. We heard stakeholder opinions and experiences, and these contributions became an important and valued element in delivering the new curriculum innovations.

Step 4: Define the Learning Outcomes

In the curriculum development model proposed by Tyler (1949), the first step is to define the educational objectives. Kern et al. (2009) suggests one assess the needs first, which is analogous to our previous two steps. Taba (1962) suggested that teachers play a crucial role in curriculum development. Accordingly, in this step, our faculty committee gathered and reviewed the results accumulated from our efforts in Steps 2 and 3 to properly define our intended learning outcomes.

While scanning the literature and querying advisors provided many potential topics for curriculum enhancement, the resulting list was lengthy. It would not be feasible to integrate every possible topic or innovation into the curriculum. Curriculum innovation should first have a clear scope and direction, and all curriculum revisions should be aligned with university and business school missions and goals (Clayton & Clopton, 2018). Beyond mission alignment, it is also critically important to connect curriculum with core competencies within the organization to help faculty maintain direction and focus.

Except for a few students who eventually enter doctorate programs and academic careers, our accounting education helps students enter industry careers. This includes public accounting, including both auditing and tax, and private sector accounting. Therefore, we used the industry advisors' survey results to help us select the data analytics topics that are most important for all accounting students. The survey results also helped us identify topics that may be interesting to some industry practitioners but not all—these topics can be included in elective courses that interested students can take. Table 1 shows a summary of the priority of data analytics topics according to the surveys.

A tradeoff is that students wishing to enter careers in academic research may not learn the research skills needed for scholarly research through our curriculum. Similarly, our curriculum would not be sufficient for students who wish to become full-time data scientists (Hardin et al., 2015; Burnham, 2020). Our faculty's main competencies are in accounting and business applications of analytics rather than basic mathematics or computer sciences. Hence, we determined it most important to define and focus our learning outcomes on helping students become data-enabled accountants rather than full-time data scientists.

Step 5: Revise the Current Courses to Incorporate Data Analytics

In the curriculum development models proposed by Tyler (1949), Taba (1962), and Wheeler (1969), the two important steps are selecting and organizing learning activities. Our Steps 5 and 6 embody these steps. We saw a definite need to introduce more contemporary topics to our curriculum, but business students have limited credit hours available due to an already full slate of courses required for a major.

One potential approach was to develop a new interdisciplinary course in business analytics (Wang, 2015; Wymbs, 2016). Unfortunately, this would require adding more hours to our business core, which was already at a maximum number of credit hours. However, as we learned from our faculty survey, some of our existing courses already covered several of the topics identified as important. For example, business statistics was extensively covered in the two quantitative methods courses, using specialized software tools rather than Excel. We saw an opportunity to retain some of the content of these previous courses, remove some content that was rated lowly in the surveys, and add some new content while maintaining the same number of overall credit hours.

Based on the faculty survey and collaborative discussions amongst faculty teaching the courses in question, our committee decided to replace four existing courses: Computer Software Competency, Management Information Systems, Quantitative Methods 1, and Quantitative Methods 2. These were replaced with the four new courses, DATA 200, DATA 201, DATA 301, and DATA 401, which prepare students for the AIS course (Table 2).

Table 2

Data Analytics Curriculum Required for Undergraduate Accounting Majors

Year	Courses
Sophomore year	DATA 200 Introduction to Spreadsheets (1 credit hour): In this course, students learn the basics of Microsoft Excel®. DATA 201 Introduction to Data Analytics (3 credit hours): In this course, students learn Microsoft Excel®, basic probability, and basic statistics.
Junior year	DATA 301 Intermediate Data Analytics (3 credit hours): In this course, students learn database concepts and applications, data visualization, and statistical analysis.
Senior year	DATA 401 Advanced Data Analytics (3 credit hours): In this course, students learn predictive analytics such as regression analysis and decision trees using the R programming language. ACCT 470 Accounting Information Systems (3 credit hours): In this course, students study how accounting information is recorded, summarized, and reported in both manual and computerized systems. There is an emphasis on internal control features necessary to produce accurate and reliable accounting data, and it includes descriptions of methods used to develop accounting systems and of auditor involvement in the process. DATA 301 is a prerequisite of this course.

A summary of the curriculum update can be found in Appendix Table A3. Appendix Table A4 provides a summary of the learning objectives from the syllabi of DATA 200, DATA 201, DATA 301, and DATA 401. Appendix Table A5 summarizes our data analytics courses.

Step 6: Create an Undergraduate and a Graduate Concentration (Minor) in Data Analytics for Accounting Students

As summarized in Table 1, our survey results showed that some data analytics topics should be required for all students, while others are useful but not necessary for all students. We deemed the courses noted above as required for all accounting majors because they cover the topics necessary for all students. These required courses do not cover more specialized topics, so we built out more advanced programming for students interested in developing analytics skills beyond our required core classes.

To develop more advanced data analytics curricular tracks, we considered several approaches. One was to design a data analytics major and a data analytics master's degree program. However, as discussed in Step 4, we were compelled to follow our business school's mission and work with the resources and competencies available. Our business school's primary mission is to educate data-enabled business professionals, including accountants, rather than to educate full-time data scientists. Our faculty's competencies reflected this mission, and we did not have the resources to hire enough new faculty to start a new department in data analytics. Therefore, it would also be challenging to start a major or full master's degree program in data analytics.

Instead, given our business school's mission and faculty resources, we decided to start concentrations in data analytics at the undergraduate and graduate levels. At our business school, a minor within the business school is

considered a "concentration," which goes on a student's official transcript. At the undergraduate level, a concentration requires four additional courses besides one's major, and at the graduate level, a concentration requires three additional courses besides one's degree requirement. This level of requirement makes it feasible for our faculty to start concentrations efficiently and gives students greater flexibility to add these curricular tracks to their degree programs. Appendix Table A5 summarizes the courses for undergraduate (in Panel A) and graduate (in Panel B) data analytics concentrations.

For accounting students, we worked collaboratively with our advising office to have accounting students take the courses in a recommended sequence, as shown in Table 3.

Table 3
Curriculum for Undergraduate Accounting Majors Earning a Concentration (Minor) in Data Analytics

Year/Term	Courses
Sophomore	DATA 200 Introduction to Spreadsheets (1 credit hour): In this course, students learn the basics of Microsoft Excel®.
	DATA 201 Introduction to Data Analytics (3 credit hours): In this course, students learn Microsoft Excel®, basic probability, and basic statistics.
Junior (Fall)	DATA 301 Intermediate Data Analytics (3 credit hours): In this course, students learn database concepts and applications, data visualization, and statistical analysis.
Junior (Spring)	DATA 401 Advanced Data Analytics (3 credit hours): In this course, students learn predictive analytics such as regression analysis and decision trees using the R programming language.
	DATA 402 Data Management for Business Analytics (3 credit hours): This course builds on DATA 301 (Intermediate Data Analytics) to prepare students for the practical business needs of data collection and data management. It focuses on the process of collecting data and preparing data for further analysis.
Junior (Summer)	DATA 499 Data Analytics Internship (3 credit hours): This is an individualized, experiential learning program structured through a variety of business organizations. This course is project-oriented, merging theory learning in the classroom with the workplace environment. It includes seminars, presentations, and career counseling in conjunction with on-site learning at the business organization. This course exposes students to the world of data analytics and the career planning process.
	DATA 421 Data Visualization for Business Analytics (3 credit hours): This course introduces students to the field of business analytics. Students learn fundamental concepts and skills of data analytics. This practical course aims to help students advance in their career field of interest.
Senior	ACCT 470 Accounting Information Systems (3 credit hours): In this course, students study how accounting information is recorded, summarized, and reported in both manual and computerized systems. There is an emphasis on internal control features necessary to produce accurate and reliable accounting data. It includes descriptions of methods used to develop accounting systems and auditor involvement in the process. DATA 301 is a prerequisite of this course.
	DATA 403 Introduction to Data Mining (3 credit hours): Data mining is the process of selecting, exploring, and modeling large amounts of data to uncover previously unknown patterns of data. By applying data mining techniques, data analysts can fully exploit large databases, identifying potentially useful patterns and behavior, and gain a greater understanding of the data. The goal of data mining in business applications is to produce new knowledge that decision-makers can act upon. This model produces patterns in the information that can support decision-making and predict new business opportunities.
	ACCT 496 Accounting Internship: Academic credit may be awarded for students who complete accounting internships with local firms or businesses.

Similarly, at the graduate level, we did not start a master's program in data analytics. Instead, we designed a graduate data analytics concentration for master of accountancy (MAcc) students, as shown in Table 4. Every student is required to take two of the four elective courses to earn the data analytics concentration.

Table 4
Curriculum for Students in the One-year Master of Accountancy Program to Earn a Concentration (Minor) in Data Analytics

Term	Courses
Summer 1	Elective: DATA 511 Big Data Strategy (3 credit hours): This course offers an overview of concepts related to the strategic use of "big data" and analytics in corporate settings. Course topics will include discussion on how organizations are leveraging data to solve traditional problems, identify new opportunities, and create value through other unique means. This is not a programming or technical course, but rather a look at big data from a 30,000-foot view of strategic decision-making.
Summer 2	Elective: DATA 521 Data Visualization for Business Analytics (3 credit hours): This course introduces students to the field of business analytics. Students learn fundamental concepts and skills of data analytics. This practical course aims to help students advance in their career field of interest.
Fall	Elective: DATA 571 Data Analytics for MBA (3 credit hours): This course covers analytical thinking and steps in data analytics including data cleaning, data management, and data analysis. This course also reviews important tools commonly used in the business world such as Excel. Open to MAcc students.
Spring	Required Core Course: DATA 531 Data Analytics in Accounting and Finance (3 credit hours): This course employs a project-based pedagogy in the study of data analytics within accounting and finance. Students will become proficient in the practice of analytics using the IMPACT cycle process. This course will include use of various contemporary tools, software, and technologies to (1) prepare data for analysis, (2) analyze data, (3) communicate insights from analysis, and (4) track outcomes from the analysis.
May	Elective DATA 599 Analytics Concepts and Consulting (3 credit hours): This course uses the case teaching method to introduce students to real-world problem-solving by applying data analytics. One part of the course uses cases that were previously developed to teach foundational data analytics skills. The other part of the course has students work as team consultants to a real-world business needing to make a decision.

Our decision to focus on minors instead of starting a data analytics major came with tradeoffs. We conceded that we may not have the same breadth or depth as other business schools that have a department dedicated to data analytics, and we may not offer as many elective courses. Despite these tradeoffs, we have not seen difficulty with job placement for students, as we maintained focus on very specific career-related skill development. However, it is possible that some prospective students would choose other universities' degree programs over ours because they could earn dual accounting-analytics master's degrees at other universities.

Step 7: Keep the Feedback Line Open

With plans in place to deliver new data analytics coursework, we focused on keeping communication lines open amongst committee members, business school faculty, students, employers, and advisory board members, as developing beneficial feedback loops can have important impacts on business curriculum innovation (Bayerlein, 2015). While Tyler's (1949) model of curriculum development was a linear process, Wheeler (1967) proposed a cyclical process consisting of five phases, where the last phase, evaluation, is followed by the first step, defining the objectives. Similarly, our process was developed as a cycle. Step 7 is not intended as the final step in a linear process but as preparation for a cycle of continuous improvement.

In our data analytics curriculum innovation, the committee members collaborated closely through the process. In addition to designing the data analytics curriculum, our collaboration extended into other projects, such as conducting several research projects and publishing multiple articles together. Therefore, we were able to keep communication lines open because we continued to collaborate extensively even after the curriculum design had been submitted and approved by the business school and by the university. Our way of keeping feedback lines open amongst faculty relied significantly on informal communication among the committee members and those actively teaching analytics classes.

Meanwhile, the AACSB accreditation process also helped to keep a feedback loop open formally. We presented our data analytics curriculum update to the AACSB visit team. The AACSB team appreciated the incorporation of data analytics into the curriculum and encouraged us to document the process. Specifically, we were encouraged to document the student outcomes and evaluations and the process we used to review and revise the curriculum. In response, we continued seeking feedback through student course evaluation and student career outcomes. This allows both faculty and administration to get direct feedback on specific courses and to recap the entire program. It also encouraged us to continue monitoring student progress as they begin their careers, often through informal conversations with recent graduates and employers, including our advisory board members.

Curriculum Innovation Results

With the steps noted above taking place over several years, we have the fortune to be able to reflect by examining early results from our curriculum innovation. Table 5 displays the number of accounting students enrolled in our accounting program in the last five years who have taken data analytics courses, and the number of undergraduate accounting students that have completed the data analytics concentration. The number of accounting and data analytics students fluctuates, possibly because of the global pandemic; however, accounting students continue to enroll in the data analytics concentration. We do not yet have data for the number of graduate-level data analytics concentration students because it is a new program.

Table 5
Undergraduate Accounting Majors Taking the New Data Analytics Courses: Concentration Declared or Undeclared

Year	Concentration declared	Concentration undeclared
2018	0	68
2019	3	55
2020	9	67
2021	3	55
2022	7	56

The complete outcome of curriculum innovation is nearly impossible to capture, but we have been active in assessing two feedback elements: students' subjective experiences and students' objective career outcomes. First, we have been reviewing student evaluations of analytics courses. Our course evaluation system does not separate the ratings by student majors, so we do not know accounting students' specific ratings of all the analytics courses. We selected a course where accounting students were the majority of attendees and reviewed the student feedback. This course was DATA 521 Data Visualization for Business Analytics. Overall, the students commented that the course was relevant to their careers. One student commented, "[T]he lessons in this course are quite thorough. I really feel prepared for the professional world as far as visual analytics are concerned." Another student thought that a strength of the course was "the application opportunities within everyday jobs and the direct correlation to real-world problems."

Second, we have continued to monitor how our accounting students perform outside of the university. The students have reported the usefulness of data analytics courses: some students received an accounting internship or a job offer because of their data analytics skills; some students received accolades at accounting firms due to their data analytics competencies; one student won an international undergraduate research competition with her research on data analytics for auditing. Again, it is a very small and selected sample, but our initial results are reassuring. Several of our undergraduate accounting students have won nationwide competitions related to data analytics. Multiple students reported having gained career opportunities because they have taken data analytics courses. Our overarching goals have been to develop the knowledge, skills, and abilities of our students to improve their attractiveness on the job market and provide solid training for careers in accounting. We remain confident that we are on the correct trajectory to do so.

Challenges and Lessons Learned

While curriculum development models have been described extensively in the literature (Tyler, 1949; Taba, 1962; Wheeler, 1967) and discussed in the context of accounting analytics education (Dzuranin et al., 2018; Qasim et al., 2020), we reflect on the challenges faced in the last seven years as we sought to develop new data analytics offerings, including important lessons learned along the way.

Challenge 1: Shifting Faculty Composition and Skills

Two members of our data analytics curriculum committee have retired. In the last three years, we conducted three additional faculty searches for new data analytics faculty due to retirements and growth. None of the candidates came with extensive backgrounds in accounting or AIS. Most of the candidates came from statistics, economics, or operations research. It is natural for a faculty with a statistics background to emphasize topics that are interesting to statisticians rather than accountants, so we have had to work diligently to ensure accounting concepts and applications remain part of our core data analytics offerings.

Lesson 1: Encourage Collaboration, but Set Up Formal Processes That Enable the Curriculum to Work Even with Low Collaboration

Collaboration is encouraged in the literature on higher education. For example, Kezar (2005) proposed a three-stage model for higher education collaboration: building commitment, commitment, and sustaining. Stevenson et al. (2005) described the development of faculty learning communities to foster collaboration among faculty, while

Nisula and Pekkola (2018) proposed the importance of intellectual coherence and organized learning communities to coordinate business education. However, it takes time to establish collaborative relationships, and new faculty are expected to start teaching data analytics courses immediately. Instead of simply relying on collaborative relationships, we learned to formalize master syllabi. Master syllabi are approved by our business school's undergraduate education programming committee, represented by faculty of all departments, including accounting. Master syllabi are to be used by all instructors teaching the same course. While an individual instructor is free to change the teaching methods, assignments, and other components of the course, the same learning outcomes should be achieved across all sections and instructors, as specified by the master syllabi. This helps to ensure that the learning outcomes of accounting students are met, as initially envisioned by the data analytics curriculum committee and agreed upon by the business school faculty.

Challenge 2: It Is Impossible to Cover All the Software Tools in the Curriculum

Just as business operations need continuous innovation (Baba, 1989), business school curriculum also needs to incorporate new topics continuously. However, data analytics is a fast-growing field, and there always seems to be more new tools. It is not possible for faculty to cover all the tools that are in the marketplace.

Lesson 2: Cover Concepts Applicable Across Different Software Tools, and Be Aware of Hypes

Instead of trying to teach all the different tools, faculty can cover the common principles that are applicable to a multitude of tools. For example, data join is a concept used in different software tools, including databases such as Microsoft Access® and data visualization tools such as Tableau® (Li & Lee, 2021).

Also, with many new industry trends, faculty needs to be careful about jumping on every trend. While trends can inform what is on the horizon, not all trends remain relevant over time; many are merely fads. For example, for business analytics, one source of innovation comes from new technologies. One way to assess a new technology is to use Gartner's Hype Cycle Methodology (Gartner Inc., n.d.), a framework that demonstrates technology life cycles. Not all technologies will be useful or commercially viable, or they may change with maturity through the various phases of their life cycle (Gartner Inc., n.d.). Therefore, although faculty should build awareness of new technologies, it is important to monitor tool adoption by industry; not all trends should be incorporated into the business curriculum.

Challenge 3: Industry Surveys Have Limitations

While industry surveys are helpful, one limitation is that they do not tell faculty how to incorporate the insights in the curriculum. The survey results may show "what" is interesting in industry today but may not tell "why" or "how" to incorporate it in the curriculum to facilitate learning.

Lesson 3: Faculty Input Is Crucial in Bringing Industry Survey Results into the Curriculum

In Taba's (1962) grass-root model of curriculum development, teachers play a critical role, including selecting and organizing learning activities. Similarly, we learned that surveys cannot be used as a top-down tool but can serve as input for the faculty committee, as faculty have subject expertise and classroom experience in selecting and organizing learning activities. Faculty also understand students' learning needs, another critical aspect in Taba's model (1962). This reinforces the importance of our initial step: gathering a faculty committee with expertise in data analytics as well as accounting and experience in classroom teaching.

Challenge 4: Students Can Resist Curriculum Innovation

While student feedback and outcomes have been largely positive, there can be occasional student resistance. For a small program, even a modest number of vocal students can seem to represent much resistance. For example, a few accounting students complained about wasting their time learning "tools they would never use" or "topics not on the CPA exam." This was especially true in the early years, when students had accounting internships mainly consisting of practical application with Excel and they concluded that "I just need to learn more Excel. Our school is wasting our time teaching tools we would never use."

Lesson 4: Respond to Student Input by Changing How the Topics Are Taught, Not the Topics—Only Revise the Topics After a Multi-Year Review

Regarding the example of accounting students complaining that "only Excel is useful, [and] school is wasting our time teaching Tableau and Alteryx," many accounting firms started to increasingly incorporate data analytics tools such as Tableau and Alteryx into mainstream operations, including with our interns. Our persistence in teaching these topics paid off, as students received accolades during their internships for their data analytics competencies.

In other words, business analytics curriculum innovation is not a single implementation; rather, it is a multi-year process of continuous improvement. A warning here is to not overreact to initial feedback and make changes too

frequently. As a business school introduces curriculum innovation, its administration and faculty may be eager to see the responses from students and employers. However, there needs to be sufficient time and sample size to measure the effectiveness of curriculum innovation. Another reason is that there will be growing pains and challenges that need to be overcome as new changes (e.g., topics, lessons, software, and techniques) are introduced into the classroom setting.

We learned that we should respond to student complaints by considering how the content is taught (i.e., single-loop learning; Argyris, 1977; Argyris, 2002), such as revising instruction materials, developing alternative assignments, culling proper business cases, or expanding social networks to identify knowledgeable guest speakers. Because the AACSB team visits every five years, we learned to set up a curriculum review process over five years, and we should review and revise the course topics on a multi-year cycle (i.e., double-loop learning; Argyris, 1977; Argyris, 2002).

Conclusion

In this paper, we reflect on our multi-year process of introducing business analytics into our accounting curriculum. We describe the seven-step process we use for curriculum innovation. The steps outlined in this paper should be generally applicable, though should be customized for each accounting program's specific needs. We discuss the feedback and student outcomes from the curriculum innovation process. We also review the challenges encountered and the lessons learned in increasing the effectiveness of our curricula in building career-ready, data-enabled accountants.

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Appendix

Table A1

A List of Resources That Might Be Useful for Incorporating Data Analytics in an Accounting Curriculum

Category	Resource	How to access
AICPA / Big 4 resources	AICPA resources on data analytics/business intelligence	https://us.aicpa.org/interestareas/informationtechnology/resources/business-intelligence-data-analytics
	University of Illinois-Deloitte data analytics curriculum	https://www2.deloitte.com/us/en/pages/about-deloitte/articles/deloitte-foundation-provides-analytics-curriculum-for-the-classroom.html
	EY academic resource center	https://www.ey.com/en_us/about-us/ey-foundation-and-university-relations/academic-resource-center
	KPMG University Connection data & analytics	https://www.kpmguniversityconnection.com/data-analytics
	PwC classroom materials & resources	https://www.pwc.com/us/en/careers/university-relations/classroom-materials.html
Peer-reviewed case studies that used analytics software for accounting sources	Alteryx	Parlier, J., & Lee, L. (2023). Inventory analytics: A teaching case using Excel and Alteryx. *Journal of Accounting Education*, *63*, 100848
	Alteryx and Tableau	Li, J., & Lee, L. (2021). Teaching data joins: A conceptual approach using SQL, Alteryx, and Tableau. *AIS Educator Journal*, *16*(1), 60–104.
	Microsoft Power BI	Nickell, E. B., Schwebke, J., & Goldwater, P. (2023). An introductory audit data analytics case study: Using Microsoft Power BI and Benford's Law to detect accounting irregularities. *Journal of Accounting Education*, *64*, 100855
	Tableau	Hoelscher, J., & Mortimer, A. (2018). Using Tableau to visualize data and drive decision-making. *Journal of Accounting Education*, *44*, 49–59.
	Tableau and Power BI	Cainas, J. M., Tietz, W. M., & Miller-Nobles, T. (2021). KAT Insurance: Data analytics cases for introductory accounting using Excel, Power BI, and/or Tableau. *Journal of Emerging Technologies in Accounting*, *18*(1), 77–85.
Textbooks	*Data and Analytics in Accounting: An Integrated Approach*	Dzuranin, A., Geerts, G., & Lenk, M. (2023). *Data and Analytics in Accounting: An Integrated Approach*. Wiley.
	Introduction to Data Analytics for Accounting	Richardson, V., Terrell, K., & Teeter, R. (2024). *Introduction to Data Analytics for Accounting. 2nd Edition*. McGraw Hill.
Peer-reviewed papers on accounting analytics curriculum development		Andiola, L. M., Masters, E., & Norman, C. (2020). Integrating technology and data analytic skills into the accounting curriculum: Accounting department leaders' experiences and insights. *Journal of Accounting Education*, *50*, 100655. Dzuranin, A. C., Jones, J. R., & Olvera, R. M. (2018). Infusing data analytics into the accounting curriculum: A framework and insights from faculty. *Journal of Accounting Education*, *43*, 24-39. Qasim, A., Issa, H., El Refae, G. A., & Sannella, A. J. (2020). A model to integrate data analytics in the undergraduate accounting curriculum. *Journal of Emerging Technologies in Accounting*, *17*(2), 31–44.

Table A2

Summary of the Surveys That We Conducted Regarding Data Analytics Curriculum Innovation

When	Target survey respondents	Main purposes	Main findings
Fall 2016	Our business school faculty	1. Gauge the interest level among faculty. 2. Identify courses that could be revised/replaced. 3. Identify data analytics topics that faculty would like to see covered.	1. Our faculty was interested to see data analytics in the curriculum. 2. Four potential courses that could be revised/replaced. 3. Data analytics topic areas that faculty wanted to see covered.
Spring 2017	Industry advisory board members	1. Ask each respondent to rate the importance of a list of data analytics topics. 2. Ensure there is no important topic that we missed.	1. Ratings of the importance of a list of data analytics from the industry perspective. 2. Ensured that we did not miss any important topic.
Fall 2022	Industry advisory boards and other accounting professionals	1. Ask each respondent to rate the importance for accounting graduates to have degrees in data analytics. 2. Identify data analytics topics that should be covered in courses for graduate accounting students.	1. Official data analytics degrees, such as dual masters or concentration in data analytics, send a positive signal to accounting firms. 2. Identified a list of topics to be covered in analytics courses for graduate accounting students.

Table A3

Previous Curriculum vs. the New Curriculum, and the Concentration for Data Analytics at Undergraduate and Graduate Levels

Area of improvement	Previous curriculum	New curriculum
Undergraduate required core courses	Computer Software Competency (1 credit) Information Systems and Technology (3 credits) Quantitative Methods 1 (3 credits) Quantitative Methods 2 (3 credits)	Introduction to Spreadsheet Applications (1 credit) Introduction to Data Analytics (3 credits) Intermediate Data Analytics (3 credits) Advanced Data Analytics (3 credits)
Undergraduate data analytics minor (concentration) for accounting students	N/A	Data Management for Business Analytics (3 credits) Data Mining (3 credits) Data Visualization for Business Analytics (3 credits) Data Analytics Internship (3 credits)
Graduate data analytics minor (concentration) for MAcc students	N/A	Analytics for Accounting and Finance (3 credits) Big Data Strategy (3 credits) Business Analytics (3 credits) Analytics Concepts and Consulting (3 credits)

Table A4
Learning Outcomes in the Syllabi of the DATA Courses

Course	Student learning outcomes
DATA 200 Introduction to Spreadsheets	1. Develop hands-on skills for using business spreadsheets, specifically, Microsoft Excel® 2. Develop practical skills for preparing business reports 3. Develop practical skills for performing calculations using Excel 4. Develop practical skills for creating charts using Excel
DATA 201 Introduction to Data Analytics	1. Develop analytical and critical thinking skills through the potential and application of data analytics to solve problems a. Problem identification and description b. Analysis and logical thinking c. Actions to obtain and organize relevant data needs d. Capabilities necessary to analyze data, generate a solution, and logically present and defend results 2. Understand basic data concepts a. Sample and population b. Data types c. Relationships of variables d. Descriptive statistics 3. Perform basic probability calculations a. Properties of probabilistic events b. Conditional probability c. Mean and variance of random variables d. Normal distributions e. Binomial distributions 4. Perform basic statistical analysis a. Descriptive statistics b. Measures of central tendency c. Measures of variability d. Hypothesis testing concepts e. Hypothesis testing for one sample such as confidence intervals 5. Students will learn Excel skills, preparing them for the Excel Certification should they choose to take it.
DATA 301 Intermediate Data Analytics	1. Develop analytical and critical thinking skills through the understanding and application of data analytics to solve problems 2. Conduct data analytics using Microsoft Excel® 3. Conduct basic data analytics using database software such as Microsoft Access 4. Conduct basic data analytics using visual analytics software such as Tableau 5. Basic concepts of data and information storage 6. Data and variables 7. Conditional logic 8. Data sorting and filtering 9. Basic concepts of databases 10. Primary and foreign keys 11. Data joining and merging 12. Basic data visualization 13. Statistical analysis based on visual analytics 14. Statistical inference and hypothesis testing 15. Statistical analysis involving multiple samples such as two-sample t-tests
DATA 401 Advanced Data Analytics	1. Understand why data analytics is an asset to businesses 2. Understand the process of data mining and how it fits into business operations 3. Learn more than one predictive analytics tool, such as decision trees and regressions. 4. Compare the tools so that they know which situations are appropriate for their use, and learn how to evaluate the resulting models 5. Communicate the results of a data study both in writing and in a presentation

Table A5

Summary of Data Analytics Courses in Our Curriculum

Panel A: Undergraduate

Course	Credits	Required for all accounting majors?	Description	Technologies employed
DATA 200 Introduction to Spreadsheet Applications	1	Yes	This course introduces students to the study of data analytics through a focus on analyzing business problems, questions, and decision-making using spreadsheets. This course includes an emphasis on thinking analytically about problem-solving, and problem-solving commonly occurring in business settings using spreadsheets. Co-req: DATA 201.	Microsoft Excel®
DATA 201 Introduction to Data Analytics	3	Yes	This course provides students with the fundamental concepts and tools needed to understand the role of statistics and data analytics in business organizations. By developing and embracing an analytical mindset, students will gain a foundational understanding of probability and statistics for data analysis used in business decision-making. Evaluating these alternatives and gaining insight from past performance is the essence of data analytics. This course is designed as an introduction to data analytics, an area of business administration that considers the extensive use of data, methods, and fact-based management to support and improve decision-making. Co-req: DATA 200.	Microsoft Excel®
DATA 301 Intermediate Data Analytics	3	Yes	This intermediate level course builds on both DATA 200 and DATA 201 through a focus on data management using diverse software applications, data analysis using Excel to test hypotheses in order to answer business questions, and communicating insights gained through the analysis. Prereqs: DATA 200 and DATA 201.	Microsoft Excel® Microsoft Access® Tableau®
DATA 401 Advanced Data Analytics	3	Yes	Students in this course will continue their exposure to data analytics by studying advanced statistical techniques and methods, managing and manipulating large data sets in order to produce actionable information, and communicating this information to interested parties. Prereq: DATA 301.	Microsoft Excel® R Studio
DATA 402 Data Management for Business Analytics	3	Not required for all students. Required for data analytics concentration.	This course builds on DATA 301 (Intermediate Data Analytics), to prepare students for practical business needs of data collection and data management. Focus is on the process from collecting data and preparing data for further analysis. This is a hands-on course with all assignments and exams in the computer laboratory. Prereq: DATA 301.	SQL Python
DATA 403 Introduction to Data Mining	3	Not required for all students. Required for data analytics concentration.	Data mining is the process of selecting, exploring, and modeling large amounts of data to uncover previously unknown patterns of data. By applying data mining techniques, data analysts can fully exploit large databases, identifying potentially useful patterns and behavior, and gain a greater understanding of the data. The goal of data mining in business applications is to produce new knowledge that decision-makers can act upon. This model produces patterns in the information that can support decision-making and predict new business opportunities. Prereq/Co-req: DATA 401.	Microsoft Excel® R Studio

Table A5
(Continued)

Course	Credits	Required for all accounting majors?	Description	Technologies employed
DATA 421 Data Visualization for Business Analytics	3	Not required for all students. Elective for data analytics concentration.	Data visualization for business analytics introduces students to the field of business analytics. Students learn fundamental concepts and skills of data visualization. This practical course aims to help students advance in their career field of interest.	Tableau
DATA 444 Topics in Data Analytics	3	Not required for all students. Elective for data analytics concentration.	This course is a study of topics in data analytics of current interest. The course provides the opportunity to obtain additional depth of knowledge in areas such as data warehousing, data management, data mining, strategic uses of data, and data analysis techniques and applications. Topics are subject to change; see class schedule for course title.	Varies
DATA 499 Data Analytics Internship	3	Not required for all students. Required for data analytics concentration.	This is an individualized, experiential learning program structured through a variety of business organizations. This course is project-oriented, merging theory learning in the classroom with the workplace environment. It includes seminars, presentations, and career counseling in conjunction with on-site learning at the business organization. This course exposes students to the world of data analytics and the career planning process. Grading is pass/fail. Prereq: DATA 301	Varies

Table A5
(Continued)
Panel B: Graduate

Course	Credits	Required for all MAcc students?	Description	Technologies employed
DATA 511 Big Data Strategy	3	Not required for all students. Elective for data analytics concentration.	This course offers an overview of concepts related to the strategic use of "big data" and analytics in corporate settings. Course topics will include discussion on how organizations are leveraging data to solve traditional problems, identify new opportunities, and create value through other unique means. This is not a programming or technical course, but rather a look at big data from a 30,000-foot view of strategic decision-making.	Microsoft Excel®
DATA 521 Data Visualization for Business Analytics	3	Not required for all students. Elective for data analytics concentration.	This course introduces students to the field of business analytics. Students learn fundamental concepts and skills of data visualization. This practical course aims to help students advance in their career field of interest.	Tableau
DATA 531 Data Analytics in Accounting and Finance	3	Yes	This course employs a project-based pedagogy in the study of data analytics within accounting and finance. Students will become proficient in the practice of analytics using the IMPACT cycle process. This course will have an emphasis on using various contemporary tools, software, and technologies to (1) prepare data for analysis, (2) analyze data, (3) communicate insights from analysis, and (4) track outcomes from the analysis.	Microsoft Excel® Microsoft Power BI® Alteryx
DATA 551 Business Analytics	3	Not required for all students. Elective for data analytics concentration.	This course prepares students to apply analytical skills through various technological tools to business decision-making. Students will develop critical thinking and quantitative reasoning skills throughout the course by learning prescriptive, predictive, and descriptive techniques and tools.	Microsoft Excel®
DATA 599 Analytics Concepts and Consulting	3	Not required for all students. Elective for data analytics concentration.	This course uses the case teaching method to introduce students to real-world problem-solving by applying data analytics. One part of the course uses cases that were previously developed to teach foundational data analytics skills. The other part of the course has students work as team consultants to a real-world business needing to make a decision.	Microsoft Excel®

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