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Equip Public Managers with Data Analytics Skills: A Proposal for the New Generation of MPA/MPP Programs with Data Science Track

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Structured Abstract

Purpose: This research uses a multifaceted approach to develop an MPA/MPP curriculum to support a data science track within the existing MPA/MPP programs by identifying the core and elective areas needed.

***Design/methodology/approach*:** The approach includes (i) identifying a suitable structure for MPA/MPP programs which can allow the program to develop its capacity to train students with the data science and general public administration skills to solve public policy problems and leave explicit space for local experimentation and modification; (ii) defining bridging modules and required modules for the MPA/MPP programs; and (iii) developing of data science track thought to make suggestions for the inclusion of suitable data science modules into the data science track and benchmarking the data science modules suggested with the best practices developed by other professional bodies. We review 46 NASPAA-accredited MPA/MPP Programs from 40 (or 22.7%) schools to identify the suitable required modules and some potential data science and analytics courses that MPA/MPP Programs currently provide as electives.

Findings: The proposal includes a 3-course (6-9 credits, not counted in the program but as prerequisites) bridging module, a 9-course (27 credits) required module, and a 5 -course (15 credits) data science track/concentration.

Originality/value: This work can provide a starting point for the public administration education community to develop graduate programs focusing on data science to cater to the needs of both public managers and society at large.

Keywords: Curriculum design, data analytics, data science, master of public administration (MPA), master of public policy (MPP), Network of Schools of Public Policy, Affairs, and Administration (NASPAA).

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INTRODUCTION

In the past decade, the use of Big Data analytics by business enterprises for making real-time business decisions is becoming increasingly common (Barton and Court, 2012; Liu *et al.*, 2020). However, it is not the case for governments and non-government organizations (NGOs). While the use of Big Data analytics for improving their policymaking and planning (Desouza and Jacob, 2017; Kim *et al.*, 2014), as well as for general e-government services (Chen and Hsieh, 2014) are on the radar, the outcome is not so successful (CEP, 2017). One of the possible reasons for the not-so-successful implementation of data-driven policymaking is the decision-making process itself (Nguyen, in press). While data analytics can provide valuable insights for data-driven policymaking, it cannot take over the final step of the decision-making process. Policymakers usually need to make assumptions not included in the data or statistical models as those assumptions are not directly testable (Athey, 2017). Yet, both academics and practitioners agree that implementing data-driven public policymaking may create an opportunity for collaboration and co-creation of innovative policies and services between the government, public and private sectors, and citizens (Janssen *et al.*, 2017).

In the US, the Commission on Evidence-based Policy (CEP) (2017) has offered a roadmap and recommendations for implementing "Evidence-based Policymaking", a.k.a. data-driven policymaking. The roadmap stresses the importance of providing an infrastructure for allowing government and society to have secure access to data (Ho *et al.*, 2021; Beg *et al.*, 2022), improving privacy protections and transparency of data use (Nguyen *et al.*, in press; Wang *et al.*, 2021; Jiang *et al.*, 2022), and developing institutional capacity for building evidence for public policymaking. Network of Schools of Public Policy, Affairs, and Administration (NASPAA), an international accreditation association for graduate-level public administration programs, also called for a discussion of their roles in developing a new curriculum model for Master of Public Administration (MPA) and Master of Public Policy (MPP) for incorporating data science into the curriculum in 2019 (McFarland *et al.*, 2019). Inspired by the call from NASPAA and similar

recent trends in Library and Information Science (Ashiq and Warraich, in press; Yew *et al.*, 2022; Lo *et al.*, 2017b; Chiu and Ho, 2022a; 2022b), we present this work to address it by conducting research using a multifaceted approach to develop an MPA/MPP curriculum with a data science track by identifying the core areas and elective areas needed.

BACKGROUND AND METHODOLOGY

Public administration curriculum design

Public administration has been an academic discipline for over 100 years (Farrell *et al.*, 2022). As the discipline is developed, Denhardt (2001, p. 526) asked the following four questions about the direction of the evolution of public administration education, which can be grouped into (i) theory-based or practice-based curriculum; (ii) career preparation; (iii) MPA program delivery; and (iv) public administration educators' commitments. With the rapid development of the Internet and social media (W. Cheng *et al.*, in press; Wong *et al.*, in press; Leung *et al.*, in press; Yang *et al.*, 2022), it is evident that the public administration curriculum needs to be constantly updated to keep up with the latest technological trends in society. Indeed, as mentioned, the Big Data available on the Internet and social media would help understand the public sentiment on society and the public policies developed (Mir *et al.*, 2022; He *et al.*, 2022; Fang *et al.*, 2021). Furthermore, recent literature has started to discuss how to implement the Internet of Things (IoT) for public services (Chohan *et al.*, in press; Ma *et al.*, 2020a, 2020b).

Connecting with the public via social media is not new and has been discussed for over a decade (Ho *et al.*, 2014). However, as we observed during the COVID-19 pandemic, which has seriously affected citizens' daily life (Huang *et al.*, 2021; 2022; Meng *et al.*, in press; Yu *et al.*, in press; Fasae *et al.*, 2021; Guo *et al.*, 2021), some public and governments have a massive distrust. For example, many people disbelieved the advice from governments and health authorities, such as using contact-tracing apps and maintaining social distancing during the pandemic (Ho *et al.*, 2022; in press). In addition, most governments cannot effectively use the Internet and social media to explain their policies, debunk misinformation and fake news circulating in the cyber world (Ho *et al.*, 2022), and encourage people to use contact tracing apps to contain the virus (Ho *et al.*, in press; Nguyen, *et al.*, 2022). Further, they could not efficiently utilize the

latest mobile technology, such as contract tracing apps, to create the synergy for offering excellent public services (Chan *et al.*, 2022; Yip *et al.*, 2021). There is a gap to bridge to help our next generation of public administrators prepare for this everchanging world.

As mentioned earlier, NASPAA, the leading international accreditation body for graduate-level programs in public administration, had called for including data science/data analytics in the curriculum to prepare for the next generations of public officers. NASPAA (2019) has established seven accreditation standards for MPA/MPP Programs, including (1) Managing the Program Strategically, (2) Matching Governance with the Mission, (3) Matching Operations with the Mission: Faculty Performance, (4) Matching Operations with the Mission: Serving Students, (5) Matching Operations with the Mission: Student Learning, (6) Matching Resources with the Mission, and (7) Matching Communications with the Mission. There is a growing need for public officers' data science/data analytics skills, matching Accreditation Standard #5 on student learning.

Within the Accreditation Standard #5 on student learning, the NASPPA (2022b) also developed five core competencies, namely (1) to lead and manage in the public interest, (2) to participate in and contribute to the policy process, (3) to analyze, synthesize, think critically, solve problems, and make evidence-informed decisions in a complex and dynamic environment, (4) to articulate, apply and advance a public service perspective, and (5) to communicate and interact productively in culturally responsive ways with a diverse and changing workforce and society at large. Data science and data analytic skills are particularly vital to Competency #3 for developing evidence-informed decisions and Competency #5 for equipping the new generation of public managers with data analytic skills to interact productively and responsively for this changing society at large. Haupt *et al.* (2017) also reported that public managers understood its importance.

There have been discussions on updating the public administration curriculum in the past few years (Connolly and Moseley, 2021). A quick review of recent literature would show that public administration scholars and practitioners considered a range of essential courses/areas for the MPA/MPP curriculum. These courses/areas include comparative public administration (Manoharan *et al.*, 2018), data science

(Overton and Kleinschmit, 2022), financial condition analysis (Maher *et al.*, 2020), e-government and information technology (McQuiston and Manoharan, 2021), ethics (Baradei, 2021; Fuertes, 2021), project-based quantitative method (Cordova *et al.*, in press), strategic learning (Mitchell and Buckingham, 2021), service-learning (Mitchell and Buckingham, 2021), and sustainability management (Rangarajan and Joshi, 2018). Prior research emphasizes the balance of hard (technical) and soft (human) skills (Mergel *et al.*, 2016) in public administration education. At the same time, Braga (2020) argued that public administration discipline is at a critical point of decline, suggested the discipline reposit itself, and mentioned the importance of Big Data analytics in public administration. Of course, we also need to consider the impact of the COVID-19 pandemic since 2020, which has generated more uncertainty about curriculum design and delivery and student expectation issues (McDonald, 2021; Meng *et al.*, 2021; Ye and Ho, in press; Chang *et al.*, in press; C. Wang *et al.*, in press; Hsieh *et al.*, in press).

In recent years, there have been more and more discussions on developing data science curricula (Fayyad and Hamutcu, 2021; Irizarry, 2020), and in particular, data science-related curricula for business (Clayton and Clopton, 2018) and information systems programs (Lawler and Molluzzo, 2015). Skills like web scraping (Dogucu and Çetinkaya-Rundel, 2021) and data visualization (Loy *et al.*, 2019; Pu *et al.*, in press; Chuang and Chen, 2022) are essential for data science education. It has also been evident as a critical skill for transmuters, i.e., people looking to switch to a new profession to find new jobs (Ramzan *et al.*, in press; Ng *et al.*, 2022; Lo *et al.*, 2017a).

There have also been discussions on analyzing the program design of MPA/MPP programs (Morçöl *et al.*, 2020) and the inclusion of data science and information technology components for the MPA/MPP curriculum (McQuiston and Manoharan, 2021; Overton and Kleinschmit, 2022). In our study, we attempt to amalgamate a suitable curriculum for MPA/MPP programs that can reasonably accommodate the essential courses for the programs and with an option to include a data science/information technology focus. Developing a model for the graduate degree for the academic discipline is quite common in computer science and related disciplines (for example, Topi *et al.*, 2017 and Si *et al.*, 2013), and we hope this work can provide an early discussion of the (re)development of MPA/MPP curriculum using this approach.

Methodology

This study uses a multifaceted approach comprising a series of inquiries to develop the new MPA/MPP program generation that supports a data analytics track/concentration. The objectives of this study include (i) identifying a suitable structure for MPA/MPP programs that can allow the program to develop its capacity to train students with the data science and general public administration skills to solve public policy problems and leave explicit space for local experimentation and modification; (ii) defining bridging modules and required modules for the MPA/MPP programs; and (iii) developing data science track thought to suggest the inclusion of suitable data science modules into the data science track and benchmarking the data science modules suggested with the best practices developed by other professional bodies. We want to identify the core areas and elective areas needed in the data analytics track/concentration and blend them with the core requirements of the MPA/MPP Program by analyzing reputable samples of existing programs. This arrangement can help develop a new generation of public and nonprofit executives equipped with updated data analytics knowledge for their needs (McFarland *et al.*, 2019).

DATA COLLECTION AND ANALYSIS

Data collection

The NASPPA-accredited MPA/MPP programs are used as the primary data sources. As of AY2021-2022, 189 schools were shown in the 2021-2022 Roster of Accredited Programs, of which 176 (93.1%) are from the US (NASPAA, 2022a). In our data collection, we randomly selected 40 US-based schools, representing 21.2% of 189 schools worldwide or 22.7% of the 176 schools in the US. The 40 schools in our sample host a total of 46 NASPAA-accredited programs, as some schools have more than one graduate program in MPA/MPP. For the 46 programs, we collected secondary data, such as their 2021-2022 catalog and other documents, from their official websites for data analysis. Table 1 provides the descriptive statistics of the 40 schools analyzed in this study. The name and program(s) reviewed by this study are listed in Appendix A.

Table 1. Descriptive statistics (based on the number of programs)

	Public University (n = 33)	Private University (n = 13)	Total (n = 46)
Program format:			
➢ Face-to-Face	32 (97.0%)	13 (100.0%)	45 (97.8%)
➢ Online	15 (45.5%)	6 (46.2%)	21 (45.7%)
Program title:			
➢ Master of Public Administration	28 (84.8%)	9 (69.2%)	37 (80.4%)
➢ Master of Public Affairs	3 (9.1%)	0 (0.0%)	3 (6.5%)
➢ Master of Public Policy	1 (3.0%)	2 (15.4%)	3 (6.5%)
➢ Others	1 (3.0%)	2 (15.4%)	3 (6.5%)
Program Structure			
➢ Average Overall Credits	40.5	42.4	41.0
➢ Maximum of Overall Credits	54	58	58
➢ Minimum of Overall Credits	36	35	35
➢ Average Core Credits	23.9	26.9	24.7
➢ Maximum of Core Credits	33	40	40
➢ Minimum of Core Credits	15	19	15

Notes:
(1) All universities, except one, offer face-to-face programs, and 15 also offer online programs, as stated in their catalogs. Only one university offers an online program, i.e., Texas A&M International University.
(2) As some universities use quarter systems, we convert all quarter credits to semester credits with a conversion rate by dividing them by 1.5 and rounding them to the nearest number. The credit hours presented in the table are semester hours.

Our random sample consists of 31 public and 9 private universities. Only one of them solely offered an online program, i.e., Texas A&M International University. The other 39 universities all offered face-to-face programs, and 15 of them also offered the online option. We understand that most face-to-face-only programs were offered online due to the COVID-19 pandemic restriction. Still, our analysis classified them face-to-face as these online offerings were temporary arrangements. Among the 46 programs analyzed, the vast majority (37, 80.4%) are Master of Public Administration programs. The remaining are 3 Master of Public Affairs programs, 3 Master of Public Policy programs, and 3 programs with special focuses, namely International Affairs (Columbia University), International Development (University of Pittsburg), and Public Service Management (DePaul University). Furthermore, the average credit hours per program is 41.0 semester credits, of which 24.7 semester credits were core credits. This finding is equivalent to an average of 8 core courses within a 14-course program, assuming that each course is 3 semester credits.

Identifying a suitable structure for MPA/MPP programs

Some academic disciplines have developed recommended curricula for their graduate programs, helping their community find the best curriculum design practices (Li and Chiu, 2022). In particular, the Association for Computing Machinery (ACM) has developed model curricula for more than two decades for K-12 to graduate degrees (ACM, 2022) for computer engineering, computer science, cyber security, data science, information systems, information technology, and software engineering. As this study aims to propose a new generation of MPA/MPP programs with a data science track, we develop our curriculum structure referencing the ACM proposed curricula for the master of science in information systems (MSIS) (Topi *et al.*, 2017) as well as the relevant undergraduate curricula of cyber security (Bishop *et al.*, 2018), data science (Danyluk and Leidig, 2021), and information system (Leidig and Salmela, 2021).

Using a similar design developed by the Joint ACM/AIS MSIS 2016 Task Force (Topi *et al.*, 2017) for developing their proposed model of graduate programs in information systems (MSIS Model), we group the courses of MPA/MPP programs into (i) bridging module; (ii) core module; and (iii) electives. Like the MSIS model, the bridging module contains foundation courses that potential students would have learned in their undergraduate programs. The core module contains courses that should be included in the MPA/MPP curriculum for students to learn the required competencies. As we are interested only in the data science and analytics areas, we focus on evaluating elective courses within their curricula and see if some universities have already jumpstarted them. From there, we want to find potential data science and analytics courses as electives and/or a specific track/certification to develop their data science skillset. We also try to justify the inclusion of these data sciences electives by benchmarking them with relevant professional qualifications. In brief, we hope our findings can help us pin down the structure of our MPA/MPP programs with a technical background in data science.

Defining bridging module

Among the 46 programs reviewed, ten have specified in the catalog that their applicants must meet some prerequisite requirements to help them bridge to their MPA Programs. If not, before formally being admitted to the program, the applicants will be required to take those undergraduate courses or relevant graduate-level courses not counted towards their degree as foundation courses. Table 2 summarizes our

findings for the bridging modules.

From Table 2, we note that the three most common bridging modules are *Economics* (7 out of 9, as one of these 10 universities does not provide the listing of the bridging courses required), *Political System or Government in the US* (6 out of 9) and *Statistics* (5 out of 9). It is not surprising that economics and political systems are the most common bridging module as they are two of the most critical foundational knowledge areas that the applicants need to know if they want to pursue a public service career. Statistics is another essential skill required for public managers as they need to handle and interpret data and statistics to evaluate the program's performance.

Based on the above observed, we suggest that the future MPA/MPP Programs can include the above three courses (9 credits) as bridging modules, which helps the applicants who do not have a public administration / political science / public policy background to gain the foundation knowledge required for pursuing their MPA/MPP degree. These courses under the bridging module would not necessarily be counted as their graduate credits (and are subject to individual programs to decide). They can be waived if the applicants have taken undergraduate courses in these areas or tested out of them.

Table 2. The bridging module of MPA/MPP programs

	Public University (n= 33)	Private University (n = 13)	Total (n= 46)
Program with Bridging Module:	8 (24.2%)	2 (15.4%)	10 (21.7%)
Module courses			
➢ Economics (Micro/Macro)	6	1	7
➢ Political system or government in the US	5	1	6
➢ Statistics	3	2	5
➢ Computer applicants	2	0	2
➢ Accounting	0	1	1
➢ Human resources management	0	1	1
➢ Management	1	0	1
➢ Public administration	1	0	1
➢ Research methodology	1	0	1
➢ Social science	1	0	1

Notes:
(1) The 40 universities reviewed offered 46 programs.
(2) One public university indicates that incoming students need to take some "foundation courses" but does not provide the listing.

Defining core modules

As shown in Table 1, programs run by public universities, on average, have two credits less than private universities (40.5 vs. 42.4 credits). The main difference is an average of one 3-credit core course less than private universities (23.9 vs. 26.9 credits). We propose that the sample MPA/MPP curriculum has 42 credits (14 3-credit courses) and 27 credits for core modules (9 3-credit courses). Therefore, it will have 15 credits (5 3-credit courses) left for electives/data analytics modules.

We reviewed all the core courses listed in the selected programs and tabulated the results in Table 3. We also noted that Morçöl *et al.* (2020) recently presented their analysis of the core courses in MPA/MPP programs, and we compare our findings with Morçöl *et al.*'s (2020) findings. Table 4 compares the top 10 most frequently offered core courses from this study and the study of Morçöl *et al.* (2020). There is a perfect overlap between the top listed courses from these two studies. Note that the two studies differ slightly in how courses are counted. This study counts public policy as one combined course, whereas in Morçöl *et al.* (2020), policy procedures and policy analysis are counted separately, and the same happens with the research methodology course, where this study lists two separate courses. Despite the slight difference, all 10 top-listed courses in this study appear in the top 9 courses in Morçöl *et al.* (2020) and vice versa. Thus, defining these 9 core courses as the module for the proposed MPA/MPP curricula is reasonable. The nine courses are (i) capstone (including thesis, internship, practicum, and seminar), (ii) public budgeting and finance, (iii) public policy, (iv) foundation in public administration, (v) research methods, (vi) program evaluation, (vii) ethics and leadership, (viii) human resources management, and (ix) organizational studies.

Table 3. Core courses in MPA/MPP programs

Core courses	This Study (N = 46)	Morçöl *et al.* (2020) MPA (N = 43)	MPP (n = 8)	Total (n = 51)
Research methods and quantitative methods		100.0%	100.0%	100.0%
➢ Research methods	26 (56.5%)			
➢ Quantitative methods	29 (63.0%)			
Public budgeting and finance	40 (87.0%)	97.7%	87.5%	96.1%
Organizational studies	22 (47.8%)	69.8%	25.0%	60.8%
Human resources management	25 (54.3%)	72.1%	25.0%	62.7%
Public policy	36 (78.3%)			
➢ Public policy procedures		46.5%	87.5%	52.9%
➢ Policy analysis		46.5%	37.5%	45.1%
Economics	17 (37.0%)			
➢ Economics (Theory/Concepts)		14.0%	62.5%	21.6%
➢ Economic analysis		16.3%	50.0%	21.6%
Public Management/Program Evaluation				
➢ Foundations	36 (78.3%)			
➢ Public management and program evaluation	28 (60.9%)			
➢ Public administration/Public service		79.1%	50.0%	74.5%
➢ Program evaluation		37.2%	12.5%	33.3%
Government and politics	7 (15.2%)	18.6%	37.5%	21.6%
Law	10 (21.7%)	20.9%	12.5%	19.6%
Ethics and leadership	26 (56.5%)	32.6%	25.0%	31.4%
Professional skills	8 (17.4%)	11.6%	25.0%	13.7%
Information technology/MIS	10 (21.7%)	16.3%	12.5%	15.7%
Nonprofit	0 (0.0%)	9.3%	0.0%	7.8%
Community development	1 (2.2%)	4.7%	0.0%	3.9%
Capstone, thesis, internship, practicum, and seminar	45 (97.8%)	100.0%	100.0%	100.0%

Notes:
(1) The 40 universities reviewed offered 46 programs.
(2) The total is calculated based on the data reported in Table 1 by Morçöl *et al.* (2020).

Table 4. Most Frequently Offered Core Courses

Core courses	Morçöl *et al.* (2020). (n = 51)	This Study (n=46)
Research methods and quantitative methods	100.0%	
➢ Research methods		56.5%
➢ Quantitative methods		63.0%
Capstone, thesis, internship, practicum, and seminar	100.0%	97.8%
Public budgeting and finance	96.1%	87.0%
Public administration/Public service	74.5%	78.3%
Human resources management	62.7%	54.3%
Organizational studies	60.8%	47.8%
Public policy		78.3%
➢ Public policy procedures	52.9%	
➢ Policy analysis	45.1%	
Program evaluation	33.3%	60.9%
Ethics and leadership	31.4%	56.5%

Defining the data science modules

We use the following principles and guidelines to develop the Data Science Track. First, the courses to be included in the track should serve to fulfill the five guiding principles stated in the Report of the Commission on Evidence-Based Policymaking (2017), i.e., (i) privacy, (ii) rigor, (iii) transparency, (iv) humility, and (v) capacity. We would review some data science programs and existing data science and information technology electives of the MPA/MPP programs we reviewed to identify suitable courses for the track. Last but not least, we will take into account relevant professional qualifications in data science and analytics and curriculum designs proposed by the ACM (Topi *et al.*, 2017; Bishop *et al.*, 2018; Danyluk and Leidig, 2021; Leidig and Salmela, 2021) as our guiding principles for the selection.

Table 5 lists the data science and related courses we surveyed during our 46 MPA/MPP programs review. Among these 46 programs, eight have provided these courses as electives or courses under a concentration. As shown in Table 5, the six most common data science courses offered are data analytics, Big Data analytics, data visualization, e-government, geographic information systems, and web and statistical programming languages.

Table 5. Data Science and Related Courses offered in MPA/MPP Programs Surveyed

Data Science and Related Course	Number of courses
Data analytics	11
Big Data analytics	4
Data visualization	4
E-Government	4
Geographic information systems	4
Programming languages	4
Data management	3
Data mining	3
IT management	3
IT ethics	2
Predictive analytics	2
Social media	2
Computational statistics	1
Information security	1
Management science	1
Text mining	1

In addition, Danyluk and Leidig (2021) report the latest curriculum design for the data science program developed by the ACM. In their design, they propose that there are 11 knowledge areas for the

data science curriculum, i.e., (i) analysis and presentation, (ii) artificial intelligence, (iii) Big Data systems, (iv) computing and computer fundamentals, (v) data acquisition, management, and governance, (vi) data mining, (vii) data privacy, security, integrity, and analysis for security, (viii) machine learning, (ix) professionalism, (x) programming, data structures, and algorithms, and (xi) software development and maintenance. Looking at the six most popular courses in Table 5, we noted that they could be mapped to analysis and presentation (for data analytics and data visualization), Big Data systems (for Big Data analytics), data acquisition, management, and governance (for e-government and geographic information systems), and programming, data structures, and algorithms (for web and statistical programming languages).

Based on the five guiding principles, we propose to include three courses as the foundation-level courses for the track. First, an E-Government course should provide learners with basic knowledge of the five guiding principles. It is also one of the six most popular data science and IT electives for MPA/MPP programs and is also related to one of the knowledge areas of data science (Danyluk and Leidig, 2021). The second foundation-level course we propose is a course on cybersecurity that provides introductory concepts for the standards, guidelines, and practices for protecting information in the cyber world. Even though this course is not one of the popular electives in Table 5, it is anchored in privacy principles. In addition, this is in line with the National Security Agency (NSA) for addressing the nation's cybersecurity talent gap (NSA, 2020). We suggest that this course be packed with Cybersecurity Fundamentals Certificate offered by the Information Systems Audit and Control Association (ISACA) (ISACA, 2021). The third course is an introductory course on data science, which provides an overview of data science concepts, data management, and the data science process. This course can also be packed with ISACA's Data Science Fundamentals Certificate (2021).

We propose to include at least two more courses in the track, of which we propose nine courses so students can choose to fit their career goals. In this list, we propose MPA/MPP programs consider offering courses, with the help of their computer science and information systems faculty, to develop courses in Big Data analytics, data visualization, geographic information systems, applied statistics (including multivariate

statistics, and R programming), introduction to programming (as a foundation class for Web-mining techniques and covering Python programming), text mining and sentiment analysis, social media analytics, and with a possibility of offering data science Internship. The selection of the portfolio of courses should be tailored to the faculty skills available and the focus of the programs.

We would also suggest the track be designed to cater to students to pursue other professional qualifications, such as the Certified Analytics Professional Program, awarded by the Institute for Operations Research and the Management Sciences (INFORMS), which provides the guidelines for using analytics "as the scientific process of transforming data into insight for making better decisions" (Taber *et al.*, n.d.). This arrangement will help the students to gain more value from the program.

Discussions

The above discussion outlines the possibility of developing a model MPA/MPP curriculum catering to the next generations of public managers, who are expected to have data science skills. Table 6 presents the design of this program.

The first group of courses, i.e., *the bridging module*, is included to help students prepare to go through the academic journal of MPA/MPP programs. The three courses are economics, political system or government in the US, and statistics. These three courses can provide the foundation for students to understand our political system, how the economy and policy work, and acquire the basic tools to analyze the data available to help them make evidence-based decisions.

Table 6. Sample of MPA/MPP Programs with Data Science Track

Course Title	Credits
Bridging Module – 3 Courses (Note 1)	
Economics (Micro/Macro)	3
Political system or government in the US	3
Statistics	3
Bridging Module Totals:	**9**
Core Module – 9 Courses (Note 2)	
Foundation in public administration	3
Research methods	3
Public budgeting and finance	3
Human resources management	3
Public policy	3
Public management/Program evaluation	3
Organizational studies	3
Leadership and ethics	3
Capstone (thesis, internship, practicum, or seminar) (Note 3)	3
Core Module Total:	**27**
Data Science Track – 5 Courses	
Introduction to E-Government	3
Introduction to data science	3
Information security	3
Electives (Choice 2 from the list):	6
(i) Big Data analytics, (ii) data visualization, (iii) geographic information systems, (iv) applied statistics (including multivariate statistics and R programming), (v) introduction to programming (as a foundation class for Web-mining techniques and covering Python programming), (vi) text mining and sentiment analysis, (vii) social media analytics, and (viii) data science internship.	
Data Science Track Total:	**15**

Notes:
(1) Courses under the bridging module can be waived if students have taken undergraduate courses in these areas or have tested out of these courses.
(2) The programs have the flexibility to select the nine courses. The courses suggested are based on our review of sample catalogs. Other courses, such as organizational behavior, advanced economic analysis, etc., are suitable options to replace some of the courses in the proposed list.
(3) Depending on the program design, students may have a thesis, an internship, a practicum course, or a graduate seminar as their capstone.

The second group of courses, i.e., *the core modules*, focuses on developing our students' graduate-level public administration / public policy competencies. We propose to include nine courses in this group. This should be kicked off with a foundation course in public administration or public policy to provide an overview of the whole program. It should have a research method class to cover advanced research methodologies and quantitative skills (theoretical/applied), which will build up the research capability of the students (Cordova *et al.*, in press).

For practical skills, the core module should include a course in public budgeting and finance (Maher *et al.*, 2020), a course in human resources management, and a course in organizational studies. In addition, courses in public policy, public management/program evaluation (Manoharan *et al.*, 2018), and leadership and ethics (Baradei, 2021; Fuertes, 2021) should be included. The last course in this category is the capstone course, which can be a thesis, an internship arrangement, a practicum, or a seminar. The choice of the capstone format should strike a balance between students' needs and the program requirement. Students' opinions and needs should be factored into the design as it will always be better for the students and faculty co-design their programs (Elliott *et al.*, 2021).

The remaining five courses will be used for the data science track, including three nucleus courses, i.e., data science (Overton and Kleinschmit, 2022), E-government (Sarantis *et al.*, 2019), and information security. The remaining two courses are electives to be chosen by our students. Programming courses should be included (Scheller, 2022) as they are now essential skills for performing web analytics.

The proposed MAP/MPP program curriculum matches the NASPAA universal required competencies. We use a curriculum map to show the coherence of the proposed program. Table 7 delineates NASPAA universal competencies as they relate to the curricular contexts in which different knowledge bases and skills are attained by instruction in various courses in the proposed MPA/MPP curriculum. All five core competencies are well covered by different courses in which students' knowledge and skills are introduced, practiced, or assessed.

The above design will allow students to develop their data science skills to complement their public administration training. This can provide a foundation for them to excel in their career, which expects them to be a new generation of public managers for evidence-based decision-making training.

Table 7. Proposed MPA/MPP Program Curriculum Map with NASPAA Core Competencies

Course Title	NASPAA Core Competencies				
	#1	#2	#3	#4	#5
Bridging Module – 9 Courses					
Economics (Micro/Macro)			I, P	I	P
Political system or government in the US		I		I	
Statistics			I, P		I, P
Core Module – 9 Courses					
Foundation in public administration	I		I	I	P
Research methods			I, P	I	I, P
Public budgeting and finance		I	I		P
Human resources management	I				P
Public policy		I	I, P	I	I, P
Public management/Program evaluation		I	I, P	I, P	P
Organizational studies	I		I		P
Leadership and ethics	I		I	I	P
Capstone (thesis, internship, practicum, or seminar)	A, P	A, P	A, P	A, P	A, P
Data Science Track – 5 Courses					
Introduction to E-Government			I, P	I	P
Introduction to data science			I, P	I	P
Information security			I, P	I	P
Electives (Choice 2 from the list):			I, P	I	P

Keys: I=Introduced; **P**=Practiced; **A**=Assessed
Notes:
NASPAA Core Competencies: (1) to lead and manage in the public interest; (2) to participate in, and contribute to, the policy process; (3) to analyze, synthesize, think critically, solve problems, and make evidence-informed decisions in a complex and dynamic environment; (4) to articulate, apply and advance a public service perspective; and (5) to communicate and interact productively in culturally responsive ways with a diverse and changing workforce and society at large.

CONCLUSIONS

To conclude, we anticipate the next generation of public managers will have better data analytics skills than their predecessors, which will help the government make data-driven policymaking possible. However, we should still remind ourselves that good data analytics skill is just one of the essential elements of evidence-based policymaking. The human factor is still essential for decision-making (Athey, 2017). Also, we should prepare our public managers with the ability to learn and be aware of emerging technology, such as IoT (Chohan *et al.*, in press; Ma *et al.*, 2020a, 2020b), blockchain (Hasan *et al.*, 2021; Alam *et al.*, in Press) and the latest learning technology for implementing them into the public services, such as MOOC (Al-Omairi *et al.*, 2021; Cheng, in press; J. Cheng *et al.*, in press; W. Wang *et al.*, in press), mobile learning (Jiang *et al.*, in press), social media aids (Leung *et al.*, in press; Lei *et al.*, in press; Lam *et al.*, in press), and

communication tools (Dong *et al.*, 2021; Guo *et al.*, 2022; Tsang and Chiu, 2022). We hope this work can provide a starting point for our community to develop better programs to cater to the needs of both public managers and society at large.

This research also has its limitations. In particular, we only reviewed 46 programs from 40 NASPAA-accredited universities in the US. The result may more or less present the curriculum design preferences of US-based universities. We propose that faculty and public administration researchers look into this particular issue further and refine the MPA/MPP curricula to develop better public managers in the future to support the development of our society. Also, future research should consider selecting universities from R1, R2, and teaching schools across different regions and, if possible, including interviews with a few relevant program directors to gather more insights.

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Appendix A: NASPAA accredited schools surveyed in this study (in alphabetical order)

Institute	Program
Alabama	
1. University of Alabama, Birmingham	Master of Public Administration
Arkansas	
2. Arkansas State University	Master of Public Administration
California	
3. California State University, Chico	Master of Public Administration
4. California State University, Long Beach	Master of Public Administration
5. California State University, Stanislaus	Master of Public Administration
6. University of La Verne	Master of Public Administration
Colorado	
7. University of Colorado, Denver	Master of Public Administration
District of Columbia	
8. George Washington University (2 programs)	Master of Public Administration
	Master of Public Policy
Florida	
9. Florida State University	Master of Public Administration
10. Nova Southeastern University	Master of Public Administration
11. University of North Florida	Master of Public Administration
Georgia	
12. Augusta University	Master of Public Administration
13. Valdosta State University	Master of Public Administration
Hawaii	
14. University of Hawaii, Mānoa	Master of Public Administration
Illinois	
15. DePaul University (3 programs)	Master of Public Administration
	Master of Public Policy
	Master of Science in Public Service Management
16. University of Illinois at Chicago	Master of Public Administration
Indiana	
17. Indiana University, Bloomington	Master of Public Affairs
Kansas	
18. Wichita State University	Master of Public Administration
Kentucky	
19. University of Louisville	Master of Public Administration
Louisiana	
20. University of New Orleans	Master of Public Administration
Maryland	
21. University of Maryland, College Park	Master of Public Policy
Massachusetts	
22. Northeastern University	Master of Public Administration
Michigan	
23. Oakland University	Master of Public Administration
Nevada	
24. University of Nevada, Las Vegas	Master of Public Administration
New Jersey	
25. Rutgers University – Newark	Master of Public Administration

New York	
26. Columbia University (2 programs)	Master of Public Administration
	Master of International Affairs
27. Marist College	Master of Public Administration
28. Syracuse University	Master of Public Administration
North Carolina	
29. University of North Carolina, Greensboro	Master of Public Affairs
Ohio	
30. Bowling Green State University	Master of Public Administration
Oklahoma	
31. University of Oklahoma	Master of Public Administration
Pennsylvania	
32. The Pennsylvania State University, Harrisburg	Master of Public Administration
33. University of Pittsburgh (3 programs)	Master of Public Administration
	Master of Public and International Affairs
	Master of International Development
Texas	
34. Texas A&M International University	Master of Public Administration
35. University of Texas, Arlington	Master of Public Administration
36. University of North Texas	Master of Public Administration
Utah	
37. Brigham Young University	Master of Public Administration
Virginia	
38. George Mason University	Master of Public Administration
39. Old Dominion University	Master of Public Administration
Washington	
40. Eastern Washington University	Master of Public Administration

RESPONSES TO REVIEWER'S COMMENTS:

Reviewer: 1 (Minor Revision)

Comments:
Well-written paper. The paper could be improved based on the above comments. This curriculum design paper could be more suitable for an educational journal related to data science and technologies.

Response: Thanks for your comment. As Library Hi Tech would publish papers related to the use of technology in education, we believe that it fits the journal's scope.

Additional Questions:
1. Originality: Does the paper contain new and significant information adequate to justify publication?: Yes. However, this paper is about curriculum design which is more suitable for an educational journal.

Response: Thanks for your comment. As Library Hi Tech would publish papers related to the use of technology in education, we believe that it fits the journal's scope.

2. Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: The paper could add more literature review about data science education programs and curriculum design for similar subjects.

Response: Thanks for your comment. We now include a review of literature about data science education programs and curriculum design in our literature review.

3. Methodology: Is the paper's argument built on an appropriate base of theory, concepts or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: Very good. The authors may consider selecting universities from R1, R2 and teaching schools across different regions. Interviewing a few relevant program directors would generate rich insights if possible.

Response: Thank you for your comment and suggestion. We now include it in our conclusion as a future research direction.

4. Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: Very good.

Response: Thank you very much for your positive comment.

5. Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is

the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: Overall, I feel that this curriculum design paper could be more suitable for an educational journal related to data science and technologies. The authors need to explain how this paper is related to this particular journal.

Response: Thanks for your comment. As Library Hi Tech would publish papers related to the use of technology in education, we believe that it fits the journal's scope.

6. Quality of Communication: Does the paper clearly express its case, measured against the technical language of the fields and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: well written.

Response: Thank you very much for your positive comment.