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Analysis of a student satisfaction exit survey of a graduate data analytics program

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Abstract

Program and curriculum evaluation have been a major focus in higher education. Course and program Outcomes Assessment has been the de-facto standard of practice for determining the overall effectiveness of knowledge transfer. However, there is a point of debate as to who should be doing Outcomes Assessment, and how it should be done. The current research is a review of responses from an exit survey of graduating students (n=221) in a Master's level program. Responses to specific exit survey questions were studied in an effort to assess the degree of student satisfaction with a Master's level program in Data Analytics. Responses to open-ended questions were also examined for key words in order to identify the more technical aspects of the M.S. in Data Analytics program that may be lacking (in regard to curriculum content and software tools specifically required or expected by industry). The current curriculum was also compared to model Data Science and Analytics curricula recommended by the Association for Computing Machinery (ACM).

Keywords: data analytics, data science, higher education, Master's degree, student feedback, curriculum development

Introduction/Literature Review

The specifics of course and program evaluations conducted by institutions of higher education have been the subject of lengthy debate for a number of years. The controversy generally centers on how the evaluations are to be carried out, and how the results will be specifically used. It has been suggested that negative effects of the evaluations could be grade inflation and poor teaching performance (Stroebe, 2020). The generally agreed upon objective of these evaluations, however, is to use student feedback as a source of information, as a diagnostic tool to help improve curricula, and as a catalyst for favorably managed change in the program (McCuddy et al., 2008).

Continuous program improvement, based on the results of student surveys, might also be a critical factor in an environment of increased competition. For example, the results of an executive Master's in Business Administration (MBA) program outcomes assessment may be useful to the administration as they attempt to attract and retain qualified students in the face of ongoing competition with other MBA programs (Capozzoli & Gundersen, 2013).

Higher education is currently dealing with the constraints of financial limitations, the increased expectations of a shrinking student population, and the requirements of accrediting bodies. All of these exert pressure on colleges and universities to provide a quality education (that is also flexible) to students in their programs. This desire for institutions to be more accountable, and measure the quality of programs, has led to a greater emphasis on outcomes assessment at both the course and program levels.

Admittedly, these assessments have shortcomings. The negative implications can include the possibility of confusing information, conflicting outcomes, misinterpretation of results, or even the incorrect application of the results. Despite these limitations, student evaluations and program outcome surveys remain the basis for actionable information, and for the ongoing improvement of existing programs (Capozzoli & Gundersen, 2013). Without a more viable or generally accepted alternative, colleges and universities must rely on the information from such surveys and assessments.

Methodology

The focus of the current study is the evaluation and interpretation of student feedback to specific questions in a post-program exit survey. Our methodology follows an accepted standard for administering and analyzing post-treatment assessments (Aldridge & Rowley, 1998; Richardson, 2005). In the current work, we included only students in a Master of Science in Data Analytics program. The dataset used for the current study consisted of 221 Master's-level students who were enrolled an M.S. in Data Analytics degree program. The degree programs comprise fully-online, fully on-ground, and hybrid (i.e., partial online, partial on-ground) courses. It is possible to complete the programs using any mixture of these three course delivery formats.

We specifically focus on the overall satisfaction with the program among graduating students. The survey items used to determine student satisfaction included answers to the following statements:

1. **In total, my educational experience has prepared me for entry into the work force in my specialty. (Work Prep)**

2. **I have an ability to apply knowledge of Data analytics to the discipline. (Apply Knowledge)**

3. **My studies at [XYZ University] prepared me for a career that is related to my Master's Degree. (Career Prep)**

For each of these statements, graduating students were asked to provide a rating using the following ordinal scale: Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree. Thus, the possible responses on the ordinal scale provide objective, qualitative information only. However, the objective of the exit survey is to gain a general perspective on the extent to which each degree program is meeting the expectations of the Master's-level students.

Another objective of the study was to determine how the current Master's degree program meets employer expectations of graduates from an M.S. in Data Analytics program. A limitation to this goal was the fact that not all graduating students are employed in positions that are related to their Master's degree. The number of graduates working in a field related to Data Analytics was determined by the following exit survey question: "I am currently employed in a job that is related to my Master's degree?" Out of the 221 graduating students who completed the exit survey, only 82 (37%) reported that they currently work in a job that is related to Data Analytics.

In addition to the closed-ended questions on the ordinal scale, the exit survey also included several open-ended questions that allowed the respondents to elaborate on their Master's degree experience. These responses were evaluated in an effort to identify a general trend in the responses.

One objective was to identify the degree to which the Master's degree program may be lacking in the depth of technical components. Specifically, does the program adequately cover current technical topics perceived as valued skills by industry, such as Machine Learning and Big Data Analytics? And, does the program provide a high level of exposure and training in current software tools and platforms used in industry, such as R, Python, Spark, and Hadoop?

The specific exit survey items used to determine what program aspects could be improved were the following:

1. **What aspects of the [XYZ University] Master's Degree program do you feel need to be changed? (Need Changed)**

2. **What additional comments/suggestions do you have regarding your [XYZ University] Master's Degree program? (Additional Comments)**

One last question we wanted to answer, in light of the survey response, was: "How does the current program curriculum compare with model curricula for Data Science and Analytics?" We sought to answer this question by comparing the existing curriculum to a model curriculum presented by the Association for Computing Machinery (ACM).

Research Questions

The research questions evaluated in this study were as follows:

R_1 *Are students graduating from [XYZ University] Master of Science in Data Analytics program highly satisfied with the education they are provided?*

R_2 *Do students feel that the [XYZ University] Master of Science in Data Analytics program adequately prepares them for a career in the current workforce?*

R_3 *Are graduating students satisfied with the technical aspects of the Master of Science in Data Analytics program, as indicated by their mention of specific keywords in their responses to open-ended survey questions (e.g., R, Python, and SQL)?*

R_4 *Is there a need for more in-depth use of specific software tools such as R, Python, and SQL and more coursework in technical topics, such as Machine Learning, Big Data, and Data Mining?*

The responses were evaluated by comparing percentages, and from visualizations of the resulting data. From this analysis, the goal was to stipulate and infer a level of satisfaction. Comparisons were made among the different responses, and also by an analysis of the frequency of use of specific keywords. The keyword analysis was used to determine how satisfied students were with the inclusion of certain topics and tools within the Master's degree program, and whether the program could be augmented to include more attention to these tools and topics.

Results and Discussion

The first research question stated: "Are students graduating from [XYZ University] Master of Science in Data Analytics program highly satisfied with the education they are provided?" In order to answer R_1, the counts of the ordinal responses from the first closed-ended statement in the exit survey was summarized. In Table 1, the count of responses is shown for the first closed-ended statement: "In total, my educational experience has prepared me for entry into the work force in my specialty, data analytics." See **Table 1** and **Figure 1** below.

Table 1: Degree to Which the Master's Degree Prepared Student for Workforce

Ordinal Response	Count	Percent	Cum. Count	Cum. Percent
Strongly agree	76	34.39%	76	34.39%
Agree	127	57.47%	203	91.86%
Neutral	13	5.88%	216	97.74%
Disagree	5	2.26%	221	100.00%
Strongly disagree	0	0.00%	221	100.00%
Total	**221**	**100.00%**	**221**	**100.00%**

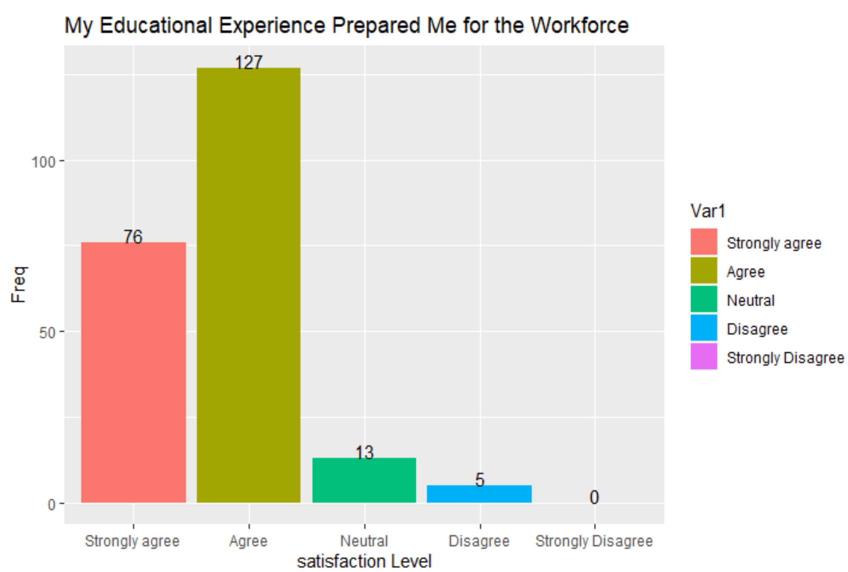

Figure 1: Degree to Which the Master's Degree Prepared Student for Workforce

The results in Table 1 can be viewed from more than one perspective. With an optimistic viewing, the count of responses, the percentage of respondents who "Agree" or "Strongly agree" that they are adequately prepared for the workforce is 91.86%. However, if exemplary programs are seen as the objective (i.e., programs that unquestionably prepare students for contributing to the Data Analytics industries), then the percentage of students who "Strongly agree" with this statement is only 34.39%. Stated another way, 65.61% of the graduating students did not "Strongly agree" that they are adequately prepared for the workforce.

The second research question stated: "Do students feel that the [XYZ University] Master of Science in Data Analytics program adequately prepares them for a career in the current workforce?" In order to answer R_2, the counts of the ordinal responses were summarized from the second closed-ended statement in the exit survey.

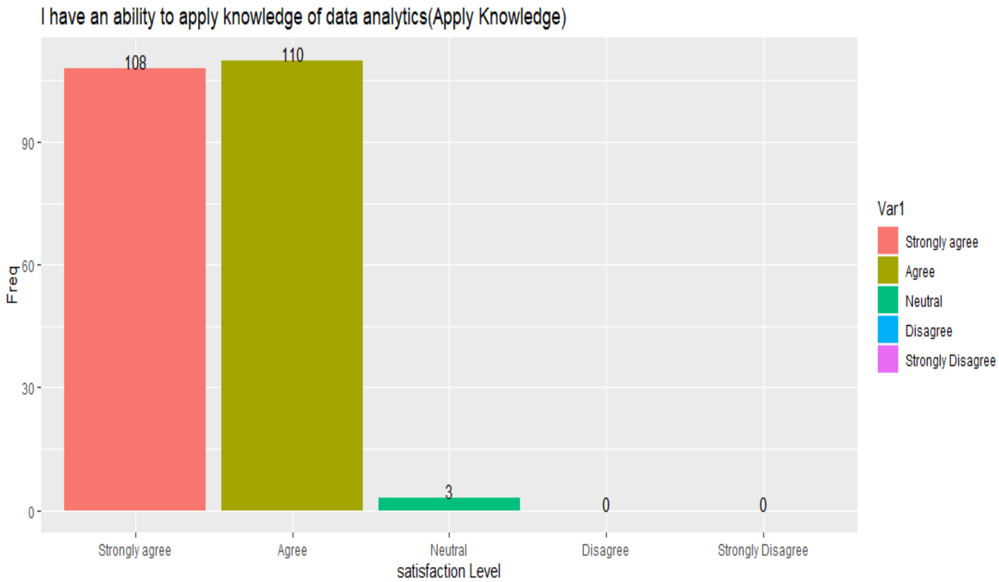

Figure 2: Degree to Which the Master's Degree Prepared Student to Apply Knowledge

In Table 2, the count of responses is displayed for the second closed-ended statement: "I have an ability to apply knowledge of data analytics." See **Table 2** and **Figure 2**.

Table 2: Degree to Which the Master's Degree Prepared Student to Apply Knowledge

Ordinal Response	Count	Percent	Cum. Count	Cum. Percent
Strongly agree	108	48.87%	108	48.87%
Agree	110	49.77%	218	98.64%
Neutral	3	1.36%	221	100.00%
Disagree	0	0.00%	221	100.00%
Strongly disagree	0	0.00%	221	100.00%
Total	**221**	**100.00%**	**221**	**100.00%**

As shown in Table 2, 98.64% of the graduating students "Agree" or "Strongly agree" that they are capable of applying knowledge gained in the program. However, only 48.87. % of the students strongly agreed with this statement. Stated another way, 51.13% of the graduating students do not "Strongly agree" that they are adequately prepared to apply knowledge gained in the program.

The third research question stated: "Are graduating students satisfied with the technical aspects of the Master of Science in Data Analytics program?" In Table 3, the count of responses is displayed for the third closed-ended statement: "My studies at [XYZ University] prepared me for a career that is related to my Master's Degree." See **Table 3** and **Figure 3** that follow.

Table 3: Degree to Which the Master's Degree Prepared Student for Related Career

Ordinal Response	Count	Percent	Cum. Count	Cum. Percent
Strongly agree	86	38.91%	86	38.91%
Agree	107	48.42%	193	87.33%
Neutral	21	9.50%	214	96.83%
Disagree	5	2.26%	219	99.09%
Strongly disagree	2	0.91%	221	100.00%
Total	**221**	**100.00%**	**221**	**100.00%**

As shown in Table 3, 87.33% of the graduating students "Agree" or "Strongly agree" that they are adequately prepared for a career in Data Analytics. However, only 38.91% of the students strongly agreed with this statement. Stated another way, 61.09% of the graduating students do not "Strongly agree" that they are adequately prepared for a career in Data Analytics.

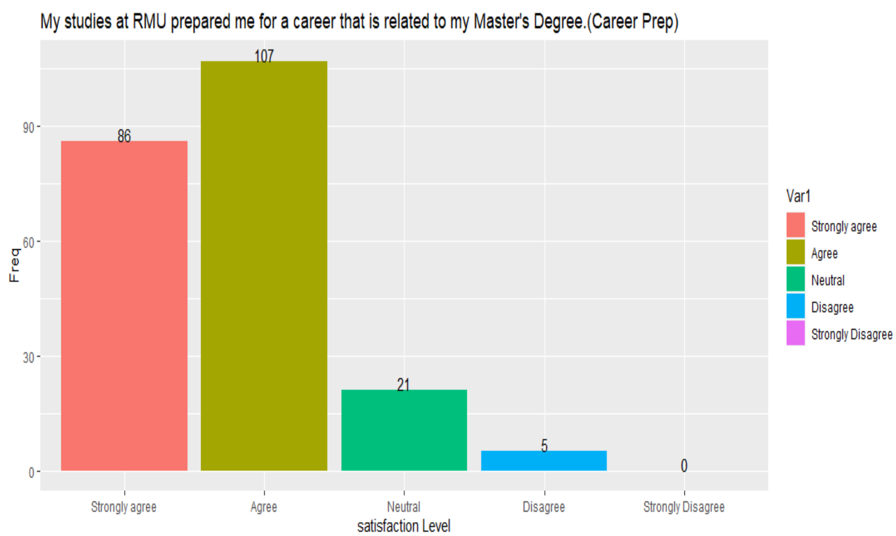

Figure 3: Degree to Which the Master's Degree Prepared Student for Related Career

The fourth research question stated: "Is there a need for more in-depth use of specific software tools such as R, Python, and SQL and more coursework in technical topics, such as Machine Learning, Big Data, and Data Mining?" The exit survey completed by the graduating students asked the students to list the Master's level courses that they felt were the most helpful to them throughout the degree program. In order to answer R_4, the most helpful courses (as reported by students) were tabulated from the open-ended responses. In Table 4, the count of courses is displayed for the open-ended statement: "What course or courses in your Master's degree did you feel helped you the most?" See **Table 4** below.

Table 4: Course or Courses in Master's Degree that were Most Helpful

Course Name	Count	Percent
Data Mining	80	36.20%
Database	71	32.13%
Python	29	13.12%
R	5	2.26%
Other	36	16.29%
Total	**221**	**100.00%**

We also wanted to determine the extent to which students mentioned specific drawbacks of the program in the open-ended questions. A word-count was conducted of specific topics and software tools. The answers to the question "What aspects need to be changed," suggested that the program be more rigorous, and include more depth on the application of specific skills like Machine Learning, Big Data Technologies, R, Python, and SQL. In our evaluation, counts of any mention of making the program more rigorous, and any mention of the need for more in-depth (or the lack of these specific skills) was included in the count.

This open-ended question sought to determine the degree to which a more rigorous and technical program was desired by the students. We also sought to determine if a more rigorous and technical program would provide graduates with skills that are desired by industry (Stewart & Davis, 2021; Krastev, 2020). The results showed that nearly one-fifth (18.5%) wanted more technical courses and exposure to software tools, like such as Python, R, and SQL. **Table 5** lists actual quotations on what aspects of the program need to be changed. **Table 6** lists additional comments and suggestions from the graduating students.

Table 5. Aspects of Master's Degree Program that Need to Be Changed

Quotation from Graduating Student
Could be beneficial to make one of the programming languages (R/Python) as a required course.
I think that an R language class should be required prior to the data mining course.
I wish Python, R and SQL were Required courses.
I feel that there needs to be more classes utilizing SQL, Python, and potentially R
Possibly make the Python a required course.
More content regarding data lakes and new data storage technologies. AWS, Azure, Hadoop, Spark etc. Companies want to see that we've worked with these technologies or that we can speak on them.

Table 6. Additional Comments/Suggestions regarding the Master's Degree Program

Quotation from Graduating Student
Need to have a programming language throughout the degree and have all the classes, like BI, Data Mining, Database Management, have you use Python or Java to complete the assignments.
I never went through a class where I actually used Python, R, SAS, SPSS or SQL. I would suggest that it should be a required course since it is what most Data Analyst.
Stronger coding for R and SQL. I learned the basic through courses but I had to learn a lot on my own.
Definitely needs more SQL, possibly a course on it. SQL comes up in many job descriptions but there was very little exposure to it.
Python and R programming languages should be used more prevalently throughout Data Analytics courses.
There is no big data specific training. This is becoming extremely important.

Comparison to Model Curricula

The results of the current study can also be evaluated with a comparison of the program curriculum to the model curricula proposed for *Data Science and Analytics*. The *Association for Computing Machinery* (ACM) has a recommended curriculum for Data Science and Analytics that includes a competency framework in nine *knowledge areas*. These knowledge areas proposed by ACM include: 1) computing fundamentals, 2) data acquirement and governance, 3) data management, storage, and retrieval, 4) data privacy, security, and integrity, 5) machine learning, 6) data mining, 7) big data, 8) analysis and presentation, and 9) professionalism (ACM, 2020, p. 29).

As shown in **Table 7**, the current required courses in the Master of Science in Data Analytics are compared to the courses/knowledge areas in the ACM Model Curriculum for Data Science and Analytics. As seen from the comparison in Table 7, the current M.S. in Data Analytics curriculum covers seven of the recommended courses/knowledge areas proposed by ACM. The remaining two knowledge areas (i.e., *Machine Learning* and *Professionalism*) are offered as elective courses, but are not currently required. Additionally, the current Data Integration for Analytics course introduces *Big Data* and discusses it at a cursory level. However, Big Data is not the primary focus of the course.

Some insight may be gained from the exit survey responses from the graduating M.S. in Data Analytics students when considering the ACM Curriculum for Data Science and Analytics. In comparing the responses from the graduating students to the nine knowledge areas, many of the open-ended comments from the students tie directly to the knowledge areas. For example, the open-ended response from a graduating student asked for " . . . more content regarding data lakes and new data storage technologies." Specifically, "AWS, Azure, Hadoop, and Spark" were mentioned in the responses.

These new data storage technologies and platforms tie directly to the ACM knowledge area of *Big Data*. The addition of a specific course related to Big Data to the M.S. in Data Analytics program would address such data storage platforms (both vendor-based and open-source). In addition, many of the graduating students specifically requested more classes utilizing open-source software tools, such as R and Python that are required for competency in industry employment.

Since R and Python are, by far the top open-source tools for performing machine learning, this detriment, highlighted by a large number of students, ties directly to the ACM knowledge area of *Machine Learning*. Similar to the course on Big Data, adding a specific Machine Learning course to the M.S. in Analytics curriculum would meet both the recommended knowledge area from ACM, and the request from students for more open-source tools for machine learning.

Table 7: Comparison to ACM Model Curriculum for Data Science and Analytics

ACM-Recommended Curriculum	MS in Data Analytics Curriculum
1. Computing Fundamentals	Decision Support Systems
2. Data Acquirement and Governance	Data Integration for Analytics
3. Data Management, Storage, and Retrieval	Database Management Systems
4. Data Privacy, Security, and Integrity	Computer Network Security
5. Machine Learning	*Not required, but can be taken as an elective*
6. Data Mining	Data Mining
7. Big Data	Data Integration for Analytics (Introduction)
8. Analysis and Presentation	Intro to Data Analytics, Geographic Info Systems
9. Professionalism	*Not required, but can be taken as an elective*

Results and Conclusions

The objective of this study was to obtain an assessment of how the Master's Level Data Analytics program was viewed by graduates. The analysis was made by evaluating both closed and open-ended exit survey questions. While limited information may be derived with answers from an ordinal scale of measurement, some information may be derived from the survey results. If one chooses to subscribe to a model of expecting superior ratings, the Master's degree program in question has some limitations with respect to and expectation of high standards and reputation. With the students' confidence in their knowledge and ability in the marketplace as less than superior, the resulting actionable focus should be on improving the programs to more closely meet the expectations of students and the industry stakeholders buying their skills.

The results show that a significant number of the students surveyed reported that the degree program lacked the rigor and depth they expected. Word counts of the open-ended questions suggest that the program be more rigorous and include more depth on the application of specific skills like Machine Learning, Big Data Technologies, R, Python, and SQL. Many students reported serious inadequacies in training in specific technical and software skills that are widely utilized in industry. Additionally, these responses (specific to these skills) were unsolicited, and no mention was made of the specific technologies in the questions. Such results should warrant a serious consideration of changes to the current content of associated courses.

It should also be noted that several courses that were reported as being "most helpful" by the graduating students are not required courses in the current M.S. in Data Analytics program. Specifically, R and Python were identified as being "most helpful" courses. However, both courses are *electives* in the current M.S. in Data Analytics degree, and therefore, are not required. Making courses on these subjects required (and other courses identified by the survey participants) in the Master of Science in Data Analytics program should be considered for the following reasons: 1) the graduating students listed these courses in the exit survey as being "most helpful courses," and 2) the literature review for the current study has revealed that experience in these tools is a strong industry requirement (Mills et. al., 2016; Radovilsky, & Hegde, 2022; Cegielski, & Jones-Farmer 2016; Bowers et. al., 2018).

A number of other studies support the inclusion of these specific languages in data analytics curricula. For example, Jones and Smith (2020) conducted a survey of introductory programming courses at business colleges within the United States. The researchers found that Python was the most popular language in college-level MIS curricula.

The same researchers conducted a 2021 study involving undergraduate students in U.S. colleges and universities. Their results revealed that the top three programming courses taught in the included schools were Java, Python, and C++ (Smith & Jones, 2021). Finally, Hudithi and Siddiqui (2021) conducted a comparative study of 22 universities in order to develop a Finance Technology (FinTech) curriculum for a leading business college in the Middle East. Their study, aimed at addressing gaps in their existing curricula, found that Python and R Programming are among the most sought-after technology topics in higher education.

The current study also compared the current course content of the Master of Science in Data Analytics degree to the model curriculum recommended by the ACM. The current curriculum was compared to the *ACM Model Curriculum for Data Science and Analytics*. A side-by-side comparison to the model curriculum identified several limitations in the current program curriculum. In addition, the gaps identified in the current curriculum can be mapped to the missing components of the program outlined by graduating students. Specific requests are for the inclusion of more Cloud Storage platforms and for more exposure to open-source machine learning tools.

Limitations of Study

A shortcoming of the current work is its general focus. In future studies it would be advantageous to look more closely at the open-ended questions, and compare the satisfaction of those graduates with data analytics experience in the workplace to those without such experience. Natural Language Processing and Machine Learning can be used to determine the overall sentiments contained within the open-ended responses. Consideration might be given to improve the survey instrument by revising the ordinal measurement scale to include a ranking from 0 to 10, in an effort to get a more refined view of student satisfaction.

Another limitation is that the study only examines one university's program and, therefore, may not be applicable to similar degree programs at other universities. However, there was an attempt to mitigate the effects of this by making a comparison to a standard curriculum. The study also involves subjective measures, such as "student satisfaction," that may limit the reliability of the results.

Future research in this area could pursue several promising avenues. One possibility is to conduct comparative studies of Data Analytics Master's programs and alternative educational pathways to discern the most effective training routes for different career objectives. Longitudinal studies, following program graduates over time, could yield valuable insights into career trajectories, salary growth, and the continued relevance of the skills acquired during their Master's programs. Research into the demographics of these programs and potential entry barriers for underrepresented groups could be undertaken. Comparative studies examining Data Analytics Master's programs across different universities and countries could offer a more comprehensive understanding of U.S. and global data analytics education. Lastly, further exploration into effective pedagogical approaches in data analytics education, such as project-based learning, remote versus in-person instruction, and balancing theory and application could have substantial implications for the future of these programs.

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