Preliminary Analysis of Student Feedback from a Master's Degree Program in Data Analytics

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Abstract

Program evaluation has been at the forefront of higher education in recent years. Course and program Outcomes Assessment has been the overwhelmingly accepted practice for gauging educational effectiveness. However, there has been significant debate as to who should be doing Outcomes Assessment and how it should be done. The current research involves a review of responses from an exit survey of graduating students (n= 121) in a Data Analytics Master's level program. We looked at responses to specific exit survey questions in an attempt to determine the level of student satisfaction with a fairly new Master's level program in Data Analytics. Student responses to open-ended questions were also examined in the survey. The responses to these open-ended questions were analyzed in an attempt to determine what technical aspects of the M.S. in Data Analytics program may be improved, in regard to content and software tools specifically requested by industry.

Keywords: Data Analytics, Data Science, Higher-Education, Master's Degree, Student Feedback, Curriculum Development

1. INTRODUCTION/LITERATURE REVIEW

Course and program evaluations conducted by institutions of higher education have been controversial since their inception. The controversy often centers on how the evaluations should be conducted, and how existing programs should be impacted by the results. Often, negative implications of the evaluations may result in grade inflation and poor teaching performance (Stroebe, 2020). The objective of these evaluations, however, is to essentially use student feedback as a source of information and a diagnostic tool to help improve curricula and manage change (McCuddy et al., 2008).

Continuous improvement from such evaluations becomes even more critical in an environment of increased competition. For example, the results of an executive Master's in Business Administration (MBA) program outcomes assessment may be analyzed and interpreted in an effort to attract and retain qualified students in an increasingly competitive field of MBA programs (Capozzoli & Gundersen, 2013).

The current state of higher education is constrained by limited budgets, continually increasing expectations of students, and the increasingly stringent requirements of accrediting bodies. All of these elements create more

pressure on colleges and universities to provide higher quality education (that is also flexible) in order to attract more and more students to their programs. Consequently, there is a desire for institutions to be more accountable, and to objectively measure the quality of individual degree programs. There is then, an increased emphasis and need for outcomes assessment at both the course and program level.

Such assessments are not without their shortcomings. Negatives of such assessments can include the potential for confusing information, conflicting outcomes, misinterpretation of information, or even the improper application of results. Even with their many limitations, student evaluations and program outcome surveys remain as the basis of actionable information for continuous improvement of existing programs (Capozzoli & Gundersen, 2013). In the absence of more viable data collection methods, colleges and universities must do their best to interpret and gain the most useable information from such surveys and assessments.

2. RESEARCH METHODOLOGY

The focus of the current study is the preliminary evaluation of student feedback to specific questions in a post-program exit survey. Our methodology is fairly standard and straightforward for administering and analyzing post-treatment assessments (Aldridge & Rowley, 1998; Richardson, 2005). The researchers of this study 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 consist of fully-online, fully on-ground, and hybrid (i.e., partial online, partial on-ground) courses. Master's level students enrolled in this program can complete the programs using any mixture of these three course delivery formats.

For this initial evaluation of the exit survey data, the current study focused specifically on the overall satisfaction with the program among graduating students. The specific exit 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 statement, graduating students were asked to rate each statement using the following ordinal scale: Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree. The possible responses on the ordinal scale provide objective, quantitative information only. However, the objective of the exit survey is to gain a general and preliminary view of how well each degree program is meeting the needs of the Master's-level students. The authors of this study also wanted to determine how the current Master's degree program meets the needs of employers who hire the M.S. in Data Analytics graduates. However, 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 their Master's degree 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 their Master's degree. In order to capture responses from a higher percentage of graduates working in a Data Analytics-related position, the survey would have to be repeated at some point in the future (e.g., five years after graduation).

In addition to the closed-ended questions involving an ordinal scale, the exit survey also included several open-ended questions and topics. These open-ended questions and topics allowed the graduating students to elaborate on their Master's degree experience. The researchers of this study evaluated the open-ended responses from the graduating students in an effort to identify ways that the degree programs could be improved. Specifically, the objective was to identify the degree to which the Master's degree programs should be more technical. There was also an interest in determining if the current Master's degree program covered Data Analytics at a sufficient level of detail. The researchers also wanted to determine if any aspects of the Data Analytics Master's program were perceived as "extraneous" or "impertinent" to the graduating students.

Additionally, the current work seeks to determine whether the current Master's degree programs

lacked any meaningful and/or substantive technical components. Specifically, does the program adequately cover current technical topics that are now valued as skills by industry, such as Machine Learning and Big Data Analytics? And, does the program provide a high enough level of exposure and training in current software tools and platforms used in industry, such as R, Python, Spark, and Hadoop?

As previously stated, the authors of this study used graduating student responses to *open-ended* questions to assess what aspects of the degree programs could be improved. 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)

Sampling Method

A post-curriculum survey of a total of 221 graduates from a Master of Science in Data Analytics program was performed. This total of 221 student subjects was comprised of all graduating students from the program during the past four years. Most questions on the exit survey involved an ordinal scale of measurement (i.e., Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree).

In addition, an evaluation was conducted on the responses to open-ended questions in order to evaluate the inclusion of certain keywords (e.g., Python, R, SQL, Machine Learning, Big Data, Data Mining et al.). The analysis of these keywords was performed in order to determine how well the Master's programs are meeting the technical expectations of students. The text responses from the graduating students were split in order to isolate keywords for counting.

Two additional open-ended questions sought to determine the shortcomings of the Master's programs (i.e., what aspects of the programs should be improved). Within these open-ended questions, the researchers looked for indications from the graduating students that the programs require more components related to the specified keywords. The responses to the open-ended questions were analyzed to determine if there is a significant lack of inclusion of specific content and skills in the program. In summary, an analysis of keywords was used to determine if the program lacked specific technical topics and tools that are valued by graduating students and by industry.

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 objective of the current work is to gain insight from the research questions by comparing percentages and from visualizations of the data. From this analysis, a level of satisfaction can be stipulated. Comparisons were made among the different responses, and also by determining 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 programs. The keyword analysis was also used to determine if the current degree programs should be augmented to include more attention to certain tools and topics.

3. RESULTS AND DISCUSSION

Our methodology and analysis is straightforward and generally standard for the administration and analysis of post-treatment assessments (Aldridge & Rowley, 1998; Richardson, 2005).

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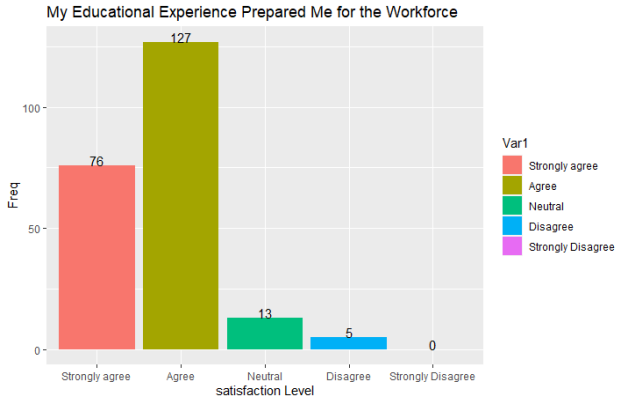
The first research question stated: "Are students graduating from [XYZ University] Master of Science in Data Analytics program highly satisfied with the education they are provided?" In order to answer R_1, the counts of the ordinal responses from the first closed-ended statement in the exit survey was 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, such as, but not limited to data analytics, web development, software development, networking, database administration, systems analysis, project management, information security, information systems, I/T auditing, information assurance, or accounting information systems." 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%

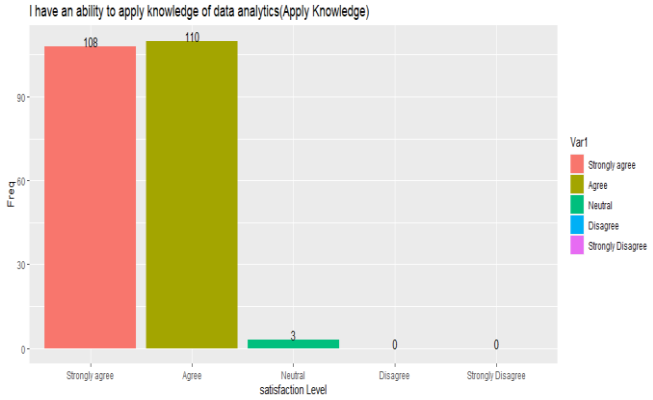
Figure 1. Degree to Which the Master's Degree Prepared Student for Workforce



The results in Table 1 can be viewed in a number of ways. For example, 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 the goal (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 do 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 information systems, programming, data analytics, information security, or project management appropriate to the discipline." 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 can adequately apply knowledge gained to their discipline. However, only 48.87% of the students

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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 to their discipline.

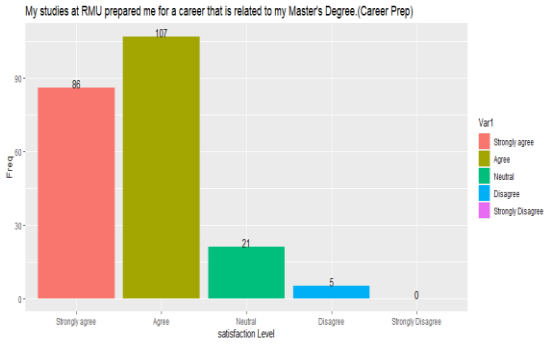
The third research question stated: "Are graduating students satisfied with the technical aspects of the Master of Science in Data Analytics program, as indicated by their mention of specific keywords in their responses to open-ended survey questions (e.g., R, Python, and SQL)?" In order to answer R_3, the counts of the ordinal responses from the second closed-ended statement in the exit survey were summarized. 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 follows.

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 related 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 percentage of students who mentioned specific drawbacks of the program in the open-ended questions. In this case students were answering the question This comprised a word count of specific topics and software tools. The answers to the question "What aspects need to be changed," that 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 of the responses, we counted any mention of making the program more rigorous. Any request for more in-depth and/or mention of a lack of these specific skills was included in the count.

In summary, this study component sought to determine responses that called for a more rigorous and technical program that better prepared students with skills that are required 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 from the graduating students 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.

4. CONCLUSIONS

While the results in this initial review of the data are, by definition, preliminary, the researchers were able to make some general conclusions and suggestions based on some visual and cursory trends. The objective of this study was to obtain an initial and general assessment of how the Master's Level Data Analytics program was viewed by graduates. The assessment was made by analyzing both closed and open-ended exit survey questions. Arguably, limited information can be obtained with answers from an ordinal scale of measurement, and criteria for interpretation can be factor in how the results are perceived. In any case, if one chooses to subscribe to a model of expecting superior ratings, the Master's degree program in question has fallen short of the high standards and reputation sought for this program. With a range of 50 to 66% rating of the programs (and the students' confidence in their knowledge and ability in the marketplace as less than superior), the focus should be on improving the programs to more closely meet the expectations of students and the industry stakeholders buying their skills.

The final component of our analysis was a word count of specific topics and software tools. One open-ended question addressed how the program could be improved. We counted the answers that 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. Any mention of making the program more rigorous or more in-depth and/or mentioned a lack of specific skills was included in the count.

The results show that 18.5% of the students who were surveyed reported that the degree program lacked the rigor and depth required for these skills. Even though the percentage might seem low, nearly a fifth of the students reported serious inadequacies in training in specific software skills widely accepted by industry. Further, these responses, specific to these skills were unsolicited, as not mention was made of these in the question. Such results should warrant 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. Requiring these courses (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).

Requiring these courses in the Master of Science in Data Analytics program (and other courses identified by the survey participants) should be

considered, since the graduating students listed these courses in the exit survey as being "most helpful courses." In addition, numerous other studies support the inclusion of these specific languages in higher education 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 2021 study 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.

Limitations of Study

A shortcoming of the current work is its general and preliminary focus. In future studies the authors plan to look more closely at the open-ended questions. Natural Language Processing and Machine Learning can be used to assess general sentiments contained within the open-ended responses from the graduating students. It can be suggested that consideration should be given to 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.

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