

*SPECIAL ISSUE:
TEACHING CASES*

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The **Information Systems Education Journal** (ISEDJ) is a double-blind peer-reviewed academic journal published by **ISCAP** (Information Systems and Computing Academic Professionals). Publishing frequency is six times per year. The first year of publication was 2003.

ISEDJ is published online (<http://isedj.org>). Our sister publication, the Proceedings of EDSIGCON (<http://www.edsigcon.org>) features all papers, panels, workshops, and presentations from the conference.

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Teaching Case

Encouraging Analytics Skills Development in All Undergraduates: A Taste of Microsoft Data Analytics

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Abstract

During the past decade, digital transformation enabled by big data and analytics emerged as a key theme in the business world. It promises to continue be a theme of major importance in the 2020s. Digital transformation comes at the cost of grappling with and analyzing the ever-growing volume of data. Data visualization techniques are seen as a main solution for dealing with this immense data growth. Finding talent with the skills and knowledge to glean analytics insights is one of the critical issues in organizations. Given the talent gap, there is a growing call for most employees in organizations to adopt self-service analytics and enforce a data driven culture. In addition to meeting industry demands for analytics skills, institutions of higher education must strive to expose all students to analytics. This would enable organizations to operate as data driven decision making entities by making analytics pervasive through the organization. Educators tasked with teaching the introductory IS course have an opportunity to help in this organizations in this mission by exposing all undergraduate students to analytics curriculum early in their educational career. The addition of data visual analytics curriculum to the introductory information systems course would give all students an interesting hands-on experience with analytics that would help them appreciate analytics and also potentially prompt them to incorporate analytics into their program of study.

Keywords: Analytics Experiential Learning, Data visualization, Power BI, Real world data sets

1. INTRODUCTION

We live in a data driven era where the acquisition and analysis of the almost inestimable amounts of data for decision making dominates the success of organizations (Pappas et al 2018). The increase in the collection of data, characterized by high volume, velocity (i.e., the frequency of incoming data that needs to be processed such as a stock ticker tape), and variability (e.g., twitter feed, images, transaction data, social media), is creating new challenges for organizations to survive but more importantly to succeed. IT teams are burdened with ever-growing requests for data, ad hoc analyses and one-off reports. Decision makers are frustrated as it takes hours or days to get

answers to questions. Every industry is faced with the challenges of acquiring, manipulating and making sense of data, that typically has a short life span as a valuable input, for timely decision making.

The adoption of data analytics is seen as the golden ticket to overcoming competitive pressures. In 2019, the business analytics market was assessed at 67.92 billion dollars and is expected to reach 103.65 billion by 2025 at a compound annual growth rate of 7.3 percent (Mordor Intelligence 2019). This growth proves that data driven decision making and achieving digital transformation by adopting business analytics has become mission critical for companies.

While big data analytics has a lot of potential to gain valuable insights, it can also be a burden. Finding skilled professionals to conduct complex big data analyses is near impossible as there is a global shortage of analytics skills. Wallen (2019) states that there will be an extra 250,000 job offerings for data scientists by 2024 in the United States alone. There appears to be a seemingly insatiable demand for data analysts and scientists with little evidence of a resolution to this issue in the near future (Violino 2019).

With limited options, organizations are looking for alternatives and creative solutions to meet demands for analytics professionals. Some are retraining existing decision support staff and partnering with institutions of higher education to get first dibs on analytics graduates (Harper 2019). Others are pushing for a self-service analytics environment within the organization that would encourage employees to develop citizen data scientist skills (Tapadinhas and Idoine 2016). Citizen data scientists are individuals capable of performing simple to moderate analytical tasks (i.e., descriptive, predictive analytics) on data such as exploration using techniques such as visualization.

Data visualization can have a significant impact on how organizations can gain insight from its data. "A picture is worth a thousand data points (Noble 2016)." This is the mantra among organizations that are collecting, storing, and analyzing massive amounts of data to effectively compete in the marketplace (Hardy 2019). Data visualization is a quick, easy way to convey concepts in a universal manner. With interactive visualization, decision makers can take the concept a step further by using technology to drill down into charts and graphs for more detail. Kumar and Goyal (2016, p121) describes the importance of visualization to analytics as follows. "Almost all fields of study and practice sooner or later will confront the big-data problem. Visualization has proven effective for not only presenting essential information in vast amounts of data but also driving complex analyses." The data analytics field presents new opportunities to the computer graphics and visualization community to enhance data comprehension and help glean insights. Data visualization is becoming a crucial component of advanced analytics in the age of big data.

The data visualization project described in this paper proposes to give freshman and sophomore students in the required introduction to information systems course an opportunity to experience data analytics using a data visualization tool. This would enable students to

get a 'taste' for data analytics and consider further exploring data analytics as a subject of interest as well as a future career option during their college career. The exposure will also enable students to become more aware of and more easily acculturated to the data driven work environment in organizations.

First, this paper presents potential instructors with more information on the importance of visual analytics to education as motivation to consider using this curriculum in the classroom. Next, it describes the data visualization project and the lesson plan that was used in an introductory MIS course along with other resources that would be beneficial to help an instructor adopt this project, such as a grading rubric and sample student presentations. Finally, the paper discusses feedback and results. The author had success in encouraging students, who had not previously considered analytics as an option to add analytics as a major or minor in to their program of study as well as to pursue more analytics related course work. This work is described with hope that other faculty will have the necessary information to be able to replicate this success in the class room.

2. VISUAL ANALYTICS

Data visualization is the presentation of data in a pictorial or graphical format. Using charts or graphs to visualize large amounts of complex data is easier than pouring over spreadsheets or reports because of the way the human brain processes information (Fiaz et al 2016). The human brain is incapable of processing large quantities of numbers of text at once. Almost 50 percent of brain activity is focused on visual processing (Jerath et al 2015). The brain is able to process visuals 60,000 times faster than numbers or text (Shafipoor et al 2016). Almost always, the brain needs a visual representation of data to make sense of massive amounts of data available and translate it to tangible ideas and concepts.

By increasing visualizations, organizations can make data driven decisions more effectively and efficiently. The use of visualizations increases the functionality of decision makers as they are able to ask better questions from the data (Runkler 2016). It creates linkages between data points that seemingly do not have links. It creates higher data quality as analysts can identify clean versus dirty data. This leads organizations to maximize their productivity as well as increase the value of the information they collected.

As a result, as the demand for big data continues to grow, the need for expertise in data visualization has begun to increase (Bhatia 2019, Hale 2018). Data visualization skills are one of the top ten technical skills with the highest increase in demand according to a study commissioned by Baylor University (Kauflin 2017). Data analysts who are able to utilize various data visualization analytics techniques to analyze data have become extremely highly sought after professionals in the industry.

3. THE IMPORTANCE OF AND PERCEPTION OF ANALYTICS

Globally the shortage of people with analytical skills is continuing to grow (Holak 2019, LinkedIn Workforce Report 2018). According to the Bureau of Labor Statistics (2018), the job market for Computer and Information Research Scientists, (i.e., the closest equivalent to data analytics experts) is positioned to grow by nearly 20 percent by 2026. As described in the introduction, organizations are exploring various alternatives as a means of addressing the skills shortage. Pushing for employees to adopt a self-service analytics environment where they gain citizen data scientist skills such as data visualization is at the fore front of some of the alternatives currently entertained by industry (Harper 2019).

Both nationally and locally, employers as well as students (especially MBA students) who are aware of the importance of analytics are requesting more content and programs on analytics, big data and data visualization skills from institutions of higher education. In response to these requests, universities are creating courses in advanced analytics, using real world data sets for course projects, and developing programs in analytics for graduate and undergraduate students (Clayton and Clopton 2019). Concentrations and certifications in analytics have also gained traction as a means of encouraging citizen data scientist skills.

However, the majority of students in liberal arts higher education institutions often do not comprehend the meaning of 'analytics.' As most analytics curriculum is offered through IS/IT related departments, they equate it with programming. It is often difficult to dispel this myth (Gandomi 2015). Equally, parents of incoming students hesitate to direct students to undergraduate programs that have an analytics focus in fear of heavy statistics and mathematical programming in the curriculum (Holsapple, Lee-Post & Pakath 2014). Many students fear and lack confidence in their math

abilities and see analytics solely as a field akin to statistics.

Dispelling these misnomers are challenging. Attracting students to get exposure in analytics and explore analytics as an educational option is difficult. Enabling students to see the broad spectrum of possibilities in analytics roles from citizen data scientist to specialist data scientist with a wide range in skills and knowledge needed ranging from data visualization to machine learning, advanced statistics and artificial intelligence can be a daunting task. Existing courses in IS programs provide little room for the addition of new content.

4. MICROSOFT ANALYTICS PROJECT IN THE INTRODUCTORY MIS COURSE

The introductory MIS course exposes all undergraduate students to a broad array of topics in information systems. Typically, the course plays an important role in the overall IS curriculum as a vehicle to recruit IS majors and minors. Modaresnezhad and Schell (2019) argue that this role played by the introductory IS course has two flaws: "(1) focusing too much on recruiting IS majors and not enough on educating non-IS majors and (2) too much emphasis on technology itself and not enough on how technology enhances decision making" pp. 40. Given the current challenges faced by organizations described in section 3, Modaresnezhad and Schell's statements are specifically potent in suggesting that a fresh perspective of the introductory MIS course is needed to expose all students to analytics content that help them be better citizen data scientists in self-service analytics environments.

Additionally, given the multidisciplinary nature of analytics, Wymbs (2016) and Wright (2016) suggest that it is important for all students to be exposed to analytics skills and be able to apply them to real world problems regardless of the student's chosen field of study. The visualization project described in this paper proposes learning analytic skills in line with the ideas mentioned by Modaresnezhad and Schell (2019) as well as Wymbs (2016) and Wright (2016). This project can be a first step in helping organizations create successful data driven decision making environments.

Data visualization skills are one of the latest high demand skill requirement in the big data and analytics space (Bhatia 2019, Hale 2018). To introduce the concepts of data analytics early to college students, a data visualization based real world data project is introduced to freshman

and sophomore students who take the required Introduction to Management Information Systems course. The project was designed with the following overall goals in mind: (1) Give students a taste of data analytics, (2) Help them understand that there is a full spectrum of analytics roles and tasks in this field, (3) Help them dispel myths that one needs heavy statistics and math skills to be working in this field, (4) Enable them to realize that manipulating data and decision making through visualization should be a skill in their arsenal irrespective of if they are a analytics major/minor or not, (5) Create excitement around working with real world data related to the major or course work that they are passionate about, (6) Give them exposure to an experiential learning activity that would help them consider analytics as a career option.

The project was incorporated during the mid-point of the introductory MIS course. Typically this course focuses on Microsoft Office applications as well as giving students an overview of information systems concepts. While teaching hands-on skills with MS Access and MS Excel, the students are exposed to Excel Pivoting, integrating different data sets and then finally introduced to Microsoft Power BI. Students are given the choice of either using the Power BI cloud service or the desktop version to conduct more visual analyses on a data set. Finally over the course of the semester, students are asked to complete milestones towards the accomplishment of a final project. They used MS Excel, MS Access as well as MS Power BI to complete the project. A detailed lesson plan that involves project milestones is described next.

5. LESSON PLAN

When possible, all relevant teaching content has been provided in the Appendix (Please note, the number item described below is used to locate content included in the Appendix). Others are attached with this submission.

1. Present the Final Project description on the first day of the course at the beginning of the semester as something students need to work on as part of the course (Included in Appendix). Emphasize the value of the project as helping them better navigate and succeed in a data driven business environment.
2. Teach existing course lessons on introducing and working with Excel Pivoting (Content not included here)

3. Assign the Article on Data Visualization ahead of class. Review examples of data visualization in class with students - <https://blog.hubspot.com/marketing/great-data-visualization-examples#sm.0000j2cg9qcqhehix7m24aw8fgzf3>

(This article very simply explains what data visualization is as well as provides some interesting and fun visualizations related to sports, current affairs, famous people, etc... that would be interesting to students)

4. Assign students to complete the Power BI tutorial – (Included in Appendix).
5. Suggest and help students identify a good data set for analysis. Students are encouraged and given individualized attention to identify a data set that is relevant to their major or chosen career. This enhances their interest in completing the project with greater enthusiasm and interest. It also helps them incorporate the project accomplishments to their internship and fulltime employment interviews.
6. Final project presentations (Presentation guide – slides and Rubric – included in Appendix).
7. Sample presentation slides that you can share with students to give them ideas of what they could do.

At every stage of the lesson plan presented here, students are reminded of the value of data analytics to business and its ability to glean insights that drive impactful decision making. Whenever possible, efforts were made to find and give students articles or other resources relevant to the data set and the questions a student was interested in exploring. This helped the student become more invested in their project work. For example, a couple of articles on how sustainability dashboards are being used for farming and irrigation was shared with a student who worked on a European dataset focused on effective agricultural techniques and crop productivity. The student later interned in Spain on a sustainability project and indicated that her experience with the analytics project helped her with the work on the internship.

6. RESULTS

Results upon completing the data visualization project was overwhelmingly positive. Students were pleasantly surprised at how they could visualize and chart data to get a general overview of the data. Then most of them drilled deeper into the data to understand nuances. Their explanations were often well thought out

for the results that they gained and some spent painstaking time to prepare the data, analyze the data and develop visuals that were pleasing and effective. Many walked away with confidence and a feeling that "data analytics is not so bad (quote from one student)." Another student, a human resources major, approached me after class to state that she had shared her experience at an interview and the employer had been very interested in her final project. There have been multiple such stories recounted to the instructor in the six iteration of the course. Students in fields as diverse as healthcare administration, nursing, criminal justice, in addition to business majors, have recounted the positive feedback and interest they received from potential employers that heard about the analytics project they completed in the introductory MIS course.

No negative student feedback has been recorded either in person or through anonymous survey during the six semesters in which this project was incorporated to the course. Many students have since started taking other analytics courses leading to the addition of Analytics as a double major or minor. Members organizations of the IS Advisory Board have provided positive validation and feedback for the efforts made with the project. Several recruiters have also shown interest in recruiting students for internships with exposure to an analytics tools and worked with real world data early in their academic career. Overall feedback received from students suggested that they felt working on the analytics project gave them a sense of what self-service analytics and knowledge work in the future may look like.

Integrating Microsoft Power BI and data visualization through a real world project into the introductory information systems course has been a successful venture so far. The total class time and prep work required has been minimal. Through the project students have been exposed to data visualization techniques and the principles for visualization. Students gained hands-on exposure to a data visualization application that gave them a taste of what analytics may involve. By engaging in the project, students are exposed to analytics through data visualization based experiential learning that can become a great means of attracting students to analytics programs.

7. CONCLUSION

Analytics continues to grow as an area of major importance to industry that has a significant skills shortage. This paper describes a project

that could help student self-select themselves to analytics based programs and curriculums by giving them an opportunity to experience analytics hands-on in one of the first information systems courses they take as undergraduates. Data visualization skills are the latest high demand skill requirement in the big data and analytics space (Bhatia 2019, Hale 2018). Irrespective of their field of study, students can gain a small appreciation for analytics, become more amenable to engaging in data analytics without fear or anxiety and can potentially become more data savvy employees in organizations by engaging in this analytics project.

By creating an opportunity to engage in a data analytics project where students work with real world data, students gain an understanding of what a role in data analytics might entail. In so doing, the project gives instructors the ability to engage students in analytics early in their college career. Use of the project described in the paper in courses six times have proven that it can have an impact on student perception of data analytics.

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Appendix

1. Final Project Description

The ability to collect a data set, analyze, gain insights and communicate results in a manner that is powerful to a business client requesting business insights are a key set of skills that employers are currently demanding. Through this individual project, each of you will practice these skills by taking a real world data set and taking it through the different steps listed below. Your grade will be based on the complexity of the analysis provided, the discoveries you make and the story you develop to communicate your analysis

In this project, first you will choose a real world data set (Excel based) and analyze it to find interesting links and trends. Here are a couple of possible sources: data set list 1 (<https://sqlbelle.wordpress.com/2015/01/16/data-sets-for-bianalyticsvisualization-projects/>), data set list 2 (<https://public.tableau.com/s/resources>). You are free to use another source if you wish.

IMPORTANT - CHOOSE your data set wisely:

1. Make sure the Excel data set has at least 300 rows.

2. Examine and make sure you have interesting columns provided that can be used for analysis.(i.e., 5-8 descriptive variables/dimensions such as gender, product categories, location AND 2 or more numeric measures such as income, sales revenue). Make sure that 'time' is one of the variables you have in the data set. List the descriptive and numeric variables in your dataset. Selections will be awarded on a first come basis.

3. Identify 3-5 major questions you plan to investigate using the data set. I realize these may change as you analyze. However, make sure that you have 3-5 broad questions. Submit your questions along with your dataset.

4. Analyze the data using MS Excel, MS Access, Power BI and any other tools you choose. NOTE - Choosing a good data set is critical as it will drive the analysis you can do. Your grade will be based on the complexity of the analysis provided, the discoveries you make and the story you develop to communicate your analysis.

5. Present your findings at the end of the semester to the entire class.

The Three Major Milestones of the Project are:

Part One

In this first milestone, identify the questions you would like to address with the data set as well as the different types of variables in your dataset. The deliverables for Part One: (1) The 3 to 5 major questions, (2) List of descriptive variables and numeric variables submitted to the TEXT BOX on Canvas, (3) An Excel file with the data set you picked.

Part Two

In this project, first you will chose an existing data set, identify 3-5 main questions to investigate. Now you will analyze it to find interesting links and trends.

Provide analysis of data using techniques learned in class. This may include the use of pivot tables and charts, or spreadsheets with averages, formatted as tables, charts, etc. In addition, you will also use a BI tool - Power BI to visualize and further analyze the data.

Part Three (Presentation Slides)

Present your project to the class according to the details and rubric described by the instructor

Some guidelines on how to structure the presentation are provided to you as PowerPoint slides by the instructor. Make note that this is a FIVE MINUTE presentation.

Submit your presentation to this assignment. Please note that instead of a word document that provides a narrative of your analysis and discoveries with screen shots of analysis that explain your narrative, you can include more slides and other information to your presentation slides to give the instructor more insight into the overall analyses that you conducted.

4. **Power BI Tutorial**

In order to learn the basics on Power BI, please do the following:

1. Read the section on Building Blocks of Power BI (external link - <https://docs.microsoft.com/en-us/learn/modules/get-started-with-power-bi/#step-3>) to become familiar with the basic areas of this analysis tool.

2. Use the data set on financial data and follow this very short video (external link - <https://www.youtube.com/watch?v=e2wDqspleNk>) to create a two paged report using Power BI desktop (available the lab). Note that the presenter goes through the video at a fast pace. You may need to slow it down to create the two page report. You can try to use the Power BI online version if you like.

Save your report with your name on it and submit to Canvas.

3. Watch the following tutorials found in this guided learning link (external link - <https://docs.microsoft.com/en-us/learn/modules/visuals-in-power-bi/#step-1>) to become familiar with various types of visualization which you can use to analyze data. This is help you better analyze your final individual project data set.

1. Visualizations 2m
2. Create and Customize Simple Visualizations 8m
3. How to Use Combination Charts 5m
4. Create and format slicers 7m
5. How to Use Map Visualizations 11m
6. How to Use Tables and Matrixes 8m
7. How to Use Scatter Charts 9m
8. How to Use Waterfall and Funnel Charts 5m
9. How to Use Gauges and Single Number Cards 7m
10. How to modify colors in charts and visuals 5m

6. Final Project Presentation Guide

Project Presentation Guidelines

Focus on the Story

- Stories have a beginning, middle, and end
- Describe the current situation, provide an analysis, lay out the options, make a recommendation, describe the likely outcomes
- Include specific examples



Establish the Setting

- Describe the setting in a way that is relevant to the listener
- Identify the business issues and challenges
- Support the description with data and let listeners know its source, accuracy, and relevance
- Try to take a unique and interesting perspective



Define the Characters

- Identify who is being affected – company's bottom line, customers, management, or employees
- This is where a personal experience can be effectively used



Define the Problem/Conflict

- Be strategic and keep the presentation simple, uncluttered, and tasteful
- Highlight the critical parts
- The more interesting the data analysis/visualization, the more time and attention the audience will give it



Show the Resolution and Future

- Use data analysis/visualizations to make predictions, layout alternatives, identify a recommended course of action, and show likely outcomes



Final Project Presentation Guide Rubric

Name _____

Presentation _____/50 Total Points

The presentation is a critical part of this project. It should be conducted professionally and should present a story surrounding the data context and the analysis.

The presentation should be 5 minutes long. You need to address why you chose the project, the need for data analysis, the analysis conducted & discoveries made and conclude by making recommendations, discussing unique insights or future direction. Make sure you tie it back to business, society or individuals that the data impacts.

	Strongly Disagree				Strongly Agree
The presentation was well organized.	1	2	3	4	5
Visual aids were well designed and used effectively.	1	2	3	4	5
The speaker had good presentation skills.	1	2	3	4	5
The presentation effectively described the background and relevant research questions for analysis	1	2	3	4	5
Effectively described the data analysis using techniques discussed in class	1	3	5	8	10
Effectively communicated the story behind the data analysis project	1	3	5	8	10
Concluded with recommendations, unique insights gained and/or future analysis options for your project.	1	3	5	8	10