# TEACHING CASE: CALIFORNIA DREAMIN' HOUSING MARKET VISUALIZATIONS & PREDICTIONS

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## ABSTRACT

This article describes two teaching cases that use a fictitious real-estate organization, Orchard Grove, with real data for teaching data analytics to university students. Students will relate theoretical concepts to a real-world business problem by applying their learned data analytics skills. The students take on the role of data analysts and will create visualizations and market value predictions of real estate properties in a California county. In these assignments, the students will use Tableau and JMP, statistical software. The students deliver a written report and present their findings to their manager, the instructor, to drive decisions.

**Keywords:** Data Analytics, Visualization, Predictions, Real Estate, Teaching Case

## INTRODUCTION

It is well established that teaching using case studies is beneficial [2] [3] [4] [5] [6]. Students are more engaged when learning through solving real-world issues [6]. When students are given case studies to complete, they are not just given answers but must use their critical thinking skills to solve problems [4] [5]. This is even more relevant to quantitative courses such as business analytics. To be successful, students need to not only understand the quantitative data but also the qualitative data presentation that comes with solving a real-world issue through case studies [1]. engage students in the case and learning process. Students find case studies to be useful and interesting which assists them in completing the learning goals of the assignment [3]. It is important for students to get experience conducting data analysis that reflects a real-world scenario. However, teaching data analytics through real-world case studies requires large amounts of data that is not always readily available. The current data sets and problems found in textbooks are not comprehensive, "messy", large. The data sets are sometimes realistic but come prepared for analysis with little or no preprocessing requirement. The real estate data set "Boston Housing" market data set that is used extensively in textbooks and courses is small and outdated so it is difficult for students to relate to the results. The instructor was looking for an updated, large data set that could be incorporated into a comprehensive assignment for students to demonstrate their understanding of data analysis. It was desired that the data set be updated, large, and complex enough that would require students to apply all stages of analysis from cleansing to reporting including (exploration, mining, visualization,

and model building and selection). The assignment should also be realistic and engaging for the students. When the assignment is realistic and engaging, students are better able to digest and understand the material. In these case studies, Visualizations in Tableau and Predication in JMP are tools used by students to solve real-world problems in a case study framework.

## CASE PURPOSE & LEARNING OBJECTIVES

Students are assigned the visualization case after a few lessons on how to create graphs and charts using Tableau. The purpose of the visualization project is for students to improve their analytical skills through data visualization and storytelling. Later, they have the opportunity to extend the scenario, and thus their learning, using the same data set in the prediction case. The purpose of the prediction project is to help students develop their technical skills in data modeling and problem-solving through a methodological approach. Therefore, together the teaching cases provide a realistic scenario for students to apply data analysis techniques using a large, real-world data set in a comprehensive analysis.

The student learning objectives include:

1. Students will understand the types of data and data relationships.
2. Students will be able to prepare data and apply data analytics with a real dataset.
3. Students will be able to execute and interpret the results of key statistical data mining techniques.
4. Students will be able to prepare an effective graph or chart.
5. Students will be able to prepare an effective dashboard of graphs and charts.
6. Students will be able to recognize and articulate the opportunities and concerns about the application of data analytics to predictions and decisions.
7. Students will be able to apply regression, decision trees, and neural network algorithms.
8. Students will understand machine learning principles such as model selection, cross-validation, and performance evaluation of the models developed.
9. Students will be able to recognize, articulate, and present the analysis outcome.

## REAL ESTATE DATA

The data set consists of 96,309 residential properties sold during 2008-2021in the San Joaquin Valley in California. The data set contains 22 variables to be used in the case such as the listing date and selling date as well as attributes such as total bedrooms and total bathrooms (see Table 1 below). You may want to purposefully leave some of the variables out of the student file to require students to create calculated fields for any missing variables. For example, you may want to leave out the variable DOM and have students calculate the DOM field by subtracting the selling date from the listing date.

**Table 1: Real Estate Data Dictionary**

| Variables | Description |
|---|---|
| # of Fireplaces | Number of fireplaces in the property |
| Address - ZIP | Postal code used to provide a location of a property to the United States Postal Service (USPS) |
| APN | Assessor's Parcel Number - identification number assigned to parcels of property by the tax assessor of a particular jurisdiction |
| Total Bathrooms | Number of bathrooms on the property |
| Bedrooms | Number of bedrooms on the property |
| DOM | Number of days the property was on the market before being sold |
| Financing Desc | Type of financing used by the buyer to purchase the property |
| Garage_Spaces | Number of spaces for cars to fit in the garage |
| Listing Date | Date property is listed on the market for sale |
| HOA Dues | Homeowners Association fees |
| HOA Frequency | Number of HOA payment occurrences |
| ML_Number | Multiple Listing Service number |
| Listing Price | The initial suggested selling price of the property |
| Lot Size | Size of the land according to boundary lines |
| Pool | Whether the property has a pool or not, Y = Yes/N=No |
| Roofing Desc | Type of roof on the property |
| School District Desc | School district where the property is located |
| Selling Date | Date property is sold |
| Selling Price | Price of the property when sold |
| Solar Display | Whether the property has a solar or not, Y = Yes/N=No |
| SP%LP | Difference between the selling price and listing price |
| Square Footage | Size of the property in square feet |
| Year Built | Year the property was first built |

## THE CASE ASSIGNMENT

The real estate market value cases can be assigned individually or together to facilitate a more comprehensive data analysis; however, an instructor may wish to only assign one case as an individual project. The scenario sets the students as data analysts at a fictional real estate organization, Orchard Grove. Orchard Grove would like to assist their clients through a better understanding of the real estate market in their area. The student data analysts will report their findings to help their managers make data-driven business decisions. The students are first tasked with creating a storyboard and visualizations of the real estate data. Later, the students continue as data analysts at Orchard Grove with a new project assignment to build prediction models for market value. The case assignments are enriched by including business problems and questions to guide the students' thought processes. An example of the case questions can be found below.

**Case Questions**

1. How did market growth change across the years? Explain any drastic changes.
2. Is there a difference in selling price based on financing e.g., cash, mortgage, etc.?
3. How do selling prices vary by the school district? Would you recommend clients move into a particular school district?

**Assignment Deliverables**

Both assignments require students to provide a description of the problem as well as a description of the data. Each assignment has its own methods and approaches within the parameters of the software program tool, Tableau or JMP, used for each assignment as described in the following section.

**Visualizations in Tableau**

Students will create visualizations to provide evidence and support for their responses to the case questions. A deliverable of the case is the Tableau visualizations packaged as a single Tableau workbook (.twbx) file. Student workbooks should sequence the visualization tabs so the story they want the viewer to explore comes first. Supporting worksheets or dashboards should be placed after the presentation tabs. This assignment could include a written report or an oral presentation that covers the findings, evidence, and recommendations.

If students are asked to prepare a report, they should provide the following information:

1. A professionally written report that discusses each of the tabbed items in your workbook by name
2. Describe the main message(s) of your analysis and final recommendation that you intended the viewer to receive from your storyboard
3. Report how you incorporated the elements of 'Foundation' in your work.
4. Report how you incorporated the elements of 'Structure' in your work.
5. Detail any opportunities for the viewer to use selection and filtering to explore the visuals
6. Any additional aspects of your workbook that you'd like to mention

If students are asked to prepare a Tableau presentation for the class, then follow these guidelines:

1. All team members should understand how the Tableau workbook views were created and how the workbook functions.
2. The instructor reserves the right to ask a team member to recreate an element in the submitted workbook.
3. The intent is for everyone on a team to earn the same marks, but if there is evidence that the work was not evenly distributed then different scores can be assigned to team members.

**Housing Market Predictions Using JMP**

Students will use the analysis tools in JMP in order to respond to the case questions after interpreting their results. The deliverable of the case is the submission of a single packaged workbook (.jmp) file. The students will also submit a professionally written report of their findings, evidence, and recommendations.

The required report should include the following details:

Your report should detail the process and steps involved in each step of the process.

1. You should add images and tables to support your message (e.g., screenshots from JMP).
2. It should include sections discussing your findings and recommendations.
3. The report should accomplish a formal, professional writing style and include important writing elements such as Title Page, Table of Contents, Introduction, etc.

If you are asked to prepare a presentation for the class, then use the following guidelines:

1. All team members should understand how the JMP workbook scripts were developed and how to run them if requested.
2. The instructor reserves the right to request that a team member recreate any scripts in the submitted workbook.
3. The goal is for everyone on a team to earn the same grade, but if there is evidence that the work was not distributed equitably, then different scores can be given to individual team members.

## RESULTS & STUDENT PERFORMANCE

The cases were assessed directly and indirectly for efficacy. The direct assessments were conducted independently by two instructors. The indirect assessments were completed by students for each case. The students were asked to complete a pre- and post-assessment about their self-perceived ability to perform the different tasks in the case assignment. There was a total of 22 respondents, all of which were complete and valid, and therefore, kept for analysis. Note that the data analysis is not fully complete so only a partial analysis is being reported in this paper. The following figures report a sampling of questions from the post-assessments.

Figure 1 shows the results for the student's self-perceived ability to execute data mining techniques. The majority (85%) of the students somewhat to strongly agree that they know how to execute data mining techniques in JMP. A minority of 10% of the students somewhat disagreed.

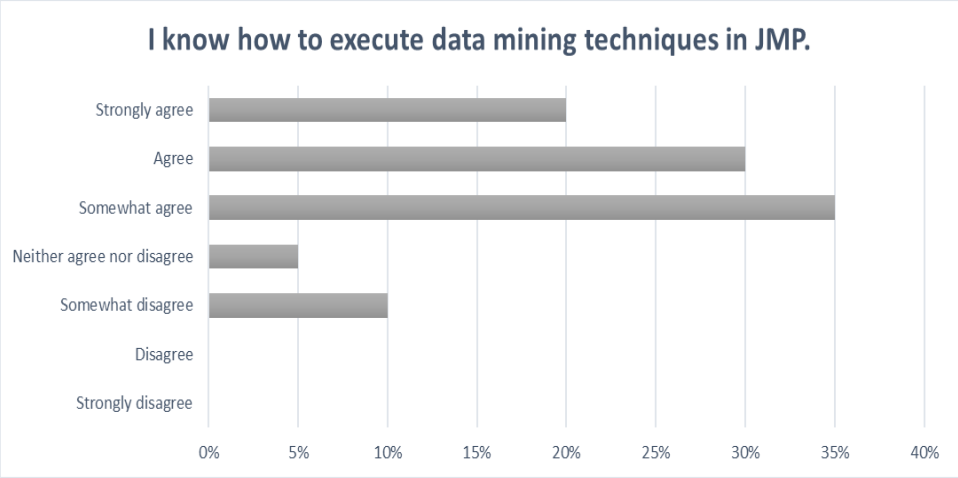


***Figure 1:*** *Execute Data Mining Techniques*

Figure 2 shows the self-perceived responses for students about their ability to prepare data and apply data analytics with a real data set. The majority (90%) of the students reported that they agreed to strongly agreed that they felt prepared. A minority (10%) neither agreed nor disagreed and zero students disagreed.

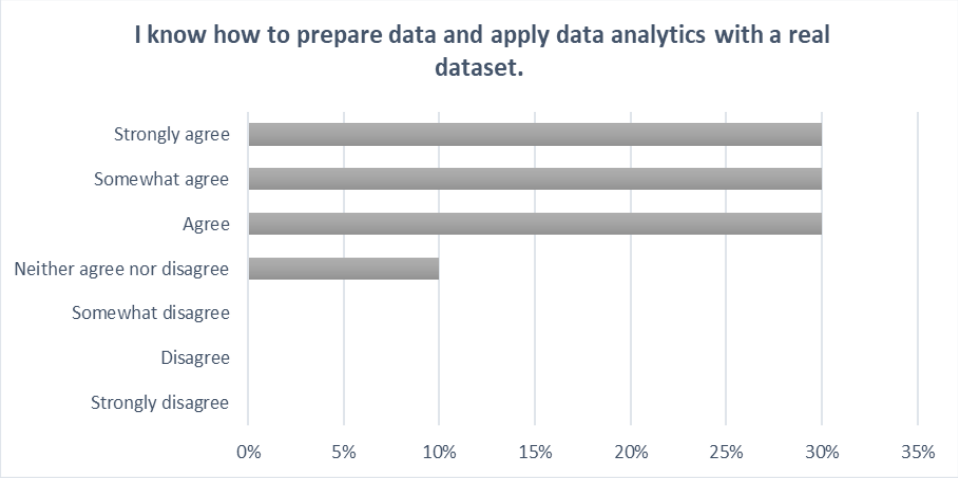


***Figure 2:*** *Prepare and Apply Data Analytics with Real Dataset*

The students were asked to report their perceived ability to interpret the results from data mining techniques. Figure 3 shows 85% of the students somewhat agreed to strongly agreed to the statement, whilst 15% neither agreed nor disagreed and zero students reported that they disagreed to any extent.

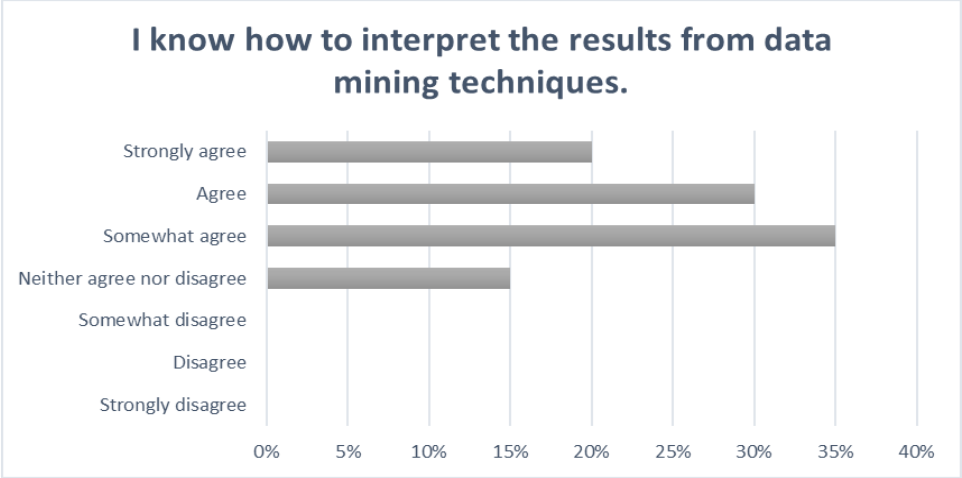


***Figure 3:*** *Interpret Results from Data Mining Techniques*

When asked to report the extent to which they agreed with the statement about comfort using JMP for prediction modeling, 90% of the students agreed to strongly agreed to feeling comfortable using JMP. Only 10% neither agreed nor disagreed with the statement and zero students disagreed with the statement. Figure 4 shows the results of the analysis.

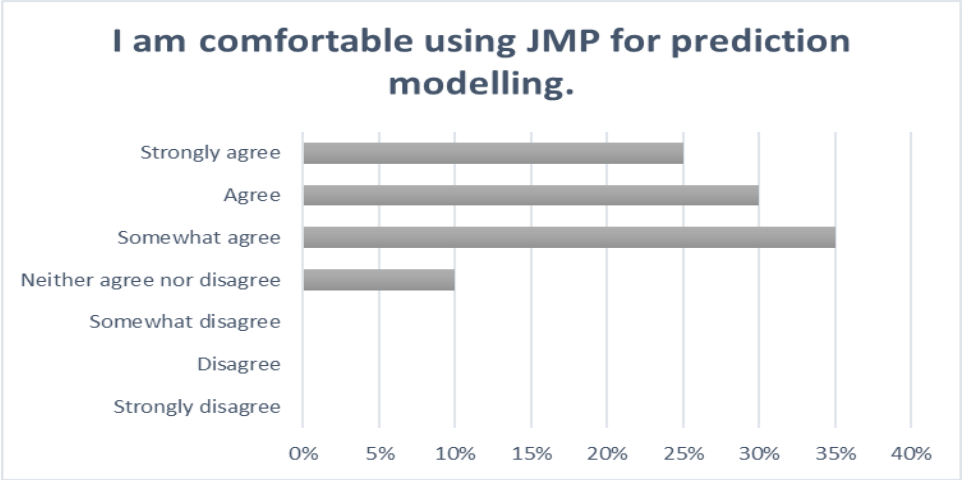


***Figure 4:*** *Comfortable using JMP for Prediction Modeling*

The student respondents reported that they felt comfortable working with large data sets in Tableau. The majority of the students, 88.89%, agreed to strongly agreed to feeling comfortable as shown in Figure 5. There were a few students that neither agreed nor disagreed (5.56%) or somewhat disagreed (5.56%) with feeling comfortable with large data sets.

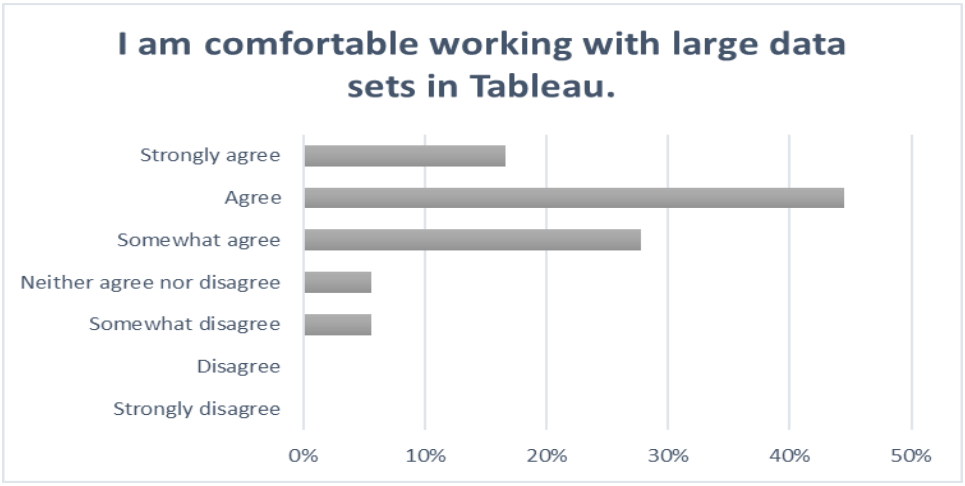


***Figure 5**: Comfortable Working with Large Datasets*

Figure 6 shows the results of self-perceived ability to identify patterns using Tableau. Most of the students (94.44%) agreed to strongly agreed that they knew how to use Tableau to determine patterns in the data. A few students (5.56%) somewhat disagreed with knowing how to find patterns using Tableau.

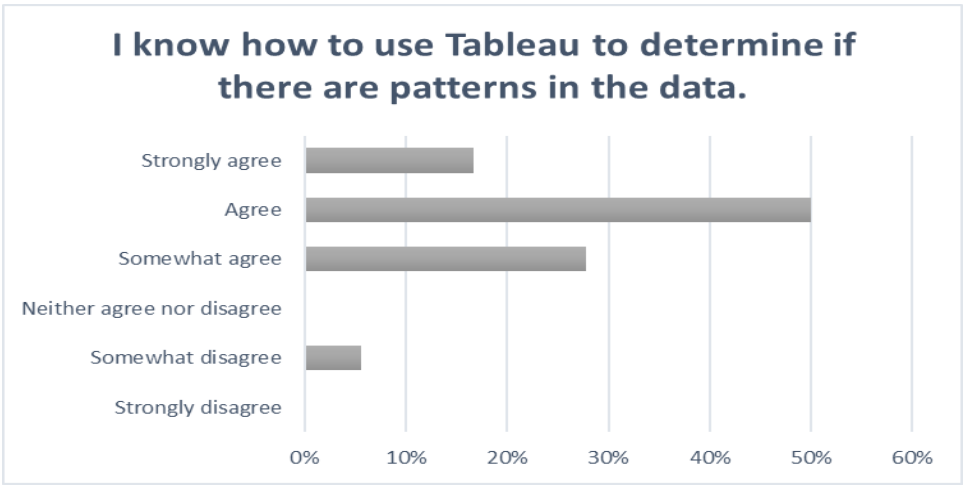


***Figure 6**: Use Tableau to Determine Patterns in the Data*

Overall, 88.89% of the students agreed to strongly agreed that the case was interesting and engaging as shown in Figure 7. However, a few (11.11%) of the students somewhat disagreed when asked if the case was interesting and engaging.

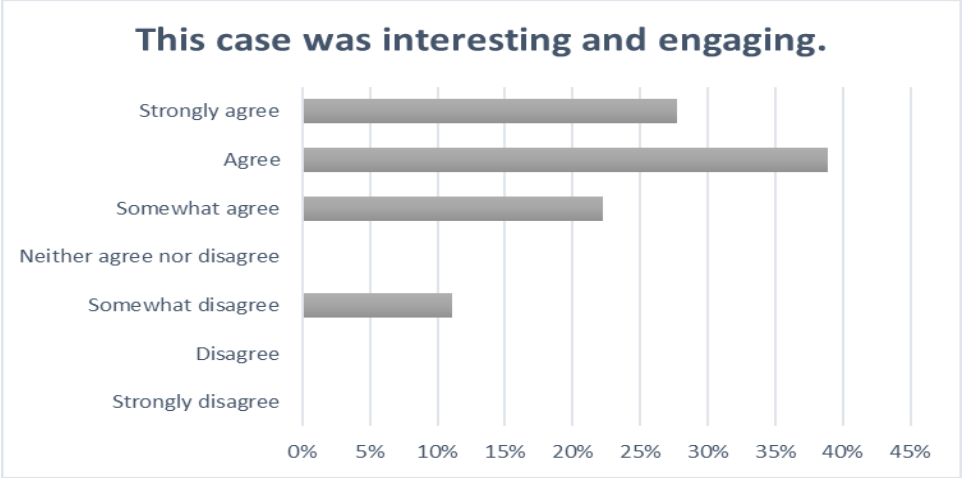


***Figure 7:*** *Case was Interesting and Engaging*

Lastly, students were asked if the instructor should continue to give the case to students. 88.89% of the students agreed to strongly agreed as shown in Figure 8. A minority of students (11.11%) neither agreed nor disagreed to thinking the case should continue to be given to future students.

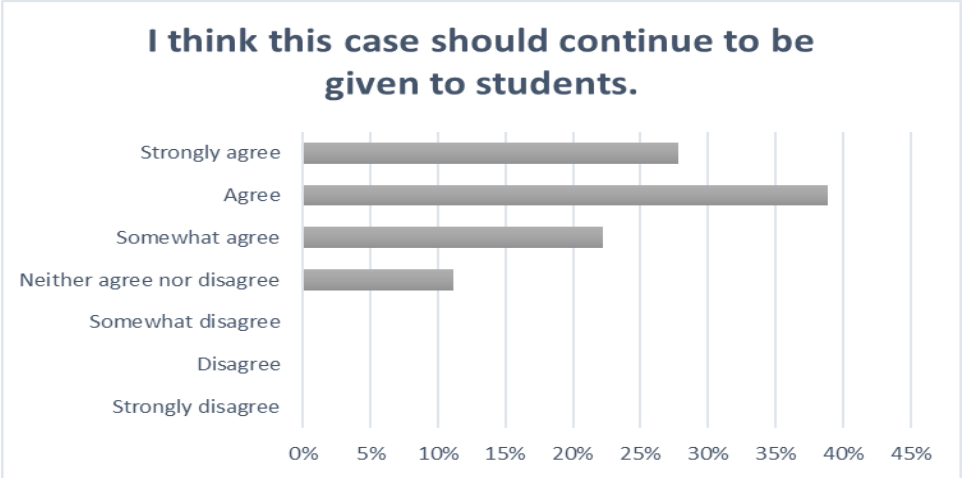


***Figure 8:*** *Case Should Continue to be Given*

## CONCLUSIONS

Students can have a deeper understanding and an opportunity to apply their skills through case-based assignments. It is typical for instructors to use the prepackaged cases provided by the publisher; however, these assignments do not always offer the complete "messy" experience as the real-world will actually bring forth. Additionally, data sets are smaller and become outdated as the case with the Boston Housing data set. The two real estate case assignments offer instructors an updated version with additional complexity to traditional case assignments. Instructors can choose to assign one of the two cases alone or combine them for a more comprehensive exercise. In the Tableau case study, students were able to create Tableau visualization and present the storyboards to faculty and professionals at a business school. Professionals could visually conclude what changes were happening in the market. In the JMP case study, students were able to analyze the data and make predictions of future market value. These were also

presented to faculty and professionals at a business school. Both case studies proved to be very effective in assisting students' understanding of both software tools and the use of meaningful, large data. The initial data collection suggests that students learn from case-based assignments that are a reflection of a real-world scenario. Overall, the students seemed to find the assignment engaging and interesting. The students also felt the cases should be used in future classes. A limitation of the study is that the two case assignments have only been used in one semester at one university. Data collection included a pre- and post-indirect assessment from students' self-perceived learning as well as a direct assessment for both cases. The data has not been fully analyzed so only a partial analysis of the indirect assessments was reported in this paper. Future work includes expanding the data collection to additional semesters at the same university and additional data collection from a second university.

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