

# Utilizing Team-based learning (“TBL”) data to analyze student performance, predict student outcomes and optimize learning outcomes



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## INTRODUCTION

### Background

- Data has been described as the “new natural resource” and is transforming many fields from business to sports.
- Team-based learning (“TBL”) with its frequent assessments has the potential to generate over 100,000 data points in a course.
- The components of TBL consist of pre-work before class, Individual Readiness Assurance Test (IRAT), Team Readiness Assurance Test (TRAT), peer evaluations, clarification as well as applications.
- With technology being more frequently used in TBL, data can be tracked and analyzed more easily.
- It is an opportune time to identify approaches to using TBL data.

### Hypothesis

- TBL data can be used to analyze student performance, predict outcomes and optimize learning.

### Method

- Three case studies of how TBL educators use TBL data.

## TBL DATA COLLECTION

### Example of how 120,000 data points can be generated

For each IRAT & TRAT:

Answers

Whether the answer was changed?

Time taken for each question

Total number of data points per student: 20MCQ x 3 (IRAT) + 20MCQ x3 (TRAT) ≈ 120

Total number of data points per student: 120 x 10 TBL sessions per term ≈ 1,200

Overall number of data points : 1,200 x 100 ≈ 120,000 (For a class of 100 students)



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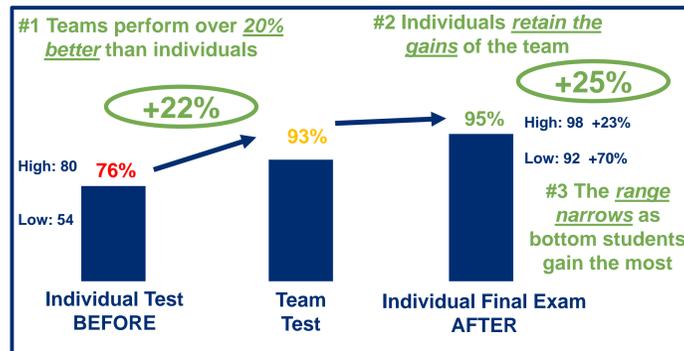
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## CASE 1: IRAT vs TRAT vs FINAL



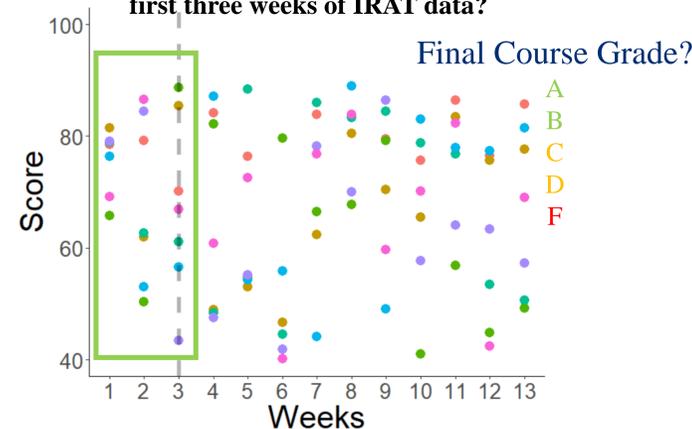
By comparing the scores of IRAT, TRAT and Final Examinations, the effectiveness of exam performance of students can be shown. These three effects include:

- An increase in TRAT vs IRAT scores of over 20%
- A narrowing of the range between the highest and lowest scores between the IRAT and Final Examination
- Final Examination scores closer to TRAT than IRAT

Source: Embry-Riddle Aeronautical University, Bachelor of Science in Aviation Business undergraduate course in Airport Administration and Finance

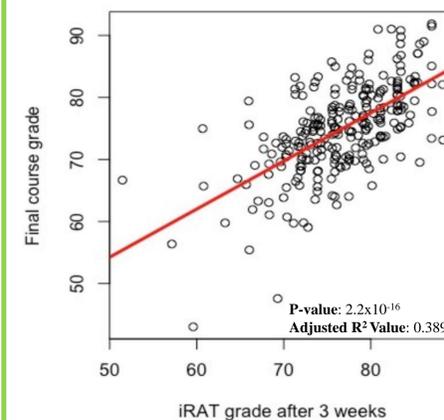
## CASE 2: PREDICTION

Can prediction of Final Course Grade be made using first three weeks of IRAT data?



The aim of this analysis is to determine if IRAT results from the earlier weeks can be used to predict the final course result. Data points of the first three weeks of IRAT tests were used for predictive models.

Early iRATs Predict Final Course Grade



Regression analysis is one of the most popular statistical method to make predictions. A linear regression model (red line) can be fitted on data points extracted previously. The fitted linear regression model can now be used to predict final course grade.

## CASE 3: ADAPTIVE READINESS ASSURANCE TEST

Week 1		Week 2		Week 3	
Questions:	Results:	Questions:	Results:	Questions:	Results:
Q1 Q2 Q3 Q4 Q5	Q2 Q3 Q6 Majority correct	Q2 Q3 Q6 New Questions	Q1 Q2 Q3 Q6 Majority correct	Q1 Q2 Q3 Q6 New Questions	Q1 Q2 Q3 Q4 Q5 Q6 Majority correct
Q1 Q4 Q5 Q20	Q1 Q4 Q5 Majority wrong	Q1 Q4 Q5 Recycled Questions	Q4 Q5 Majority wrong	Q4 Q5 Recycled Questions	Q20

## DISCUSSION

- The cases represent examples of three approaches on how to use the data generated by TBL.
- The data in Case One is based on less than 50 students in Embry-Riddle Aeronautical University. The data in Case Two is based on 800 students in Yale-NUS College.
- These analysis were not designed to reach definitive conclusions per se but rather to provide examples of TBL data could be used with the objective of laying the groundwork for more detailed and robust analysis in the future.

## CONCLUSION

- There is enormous potential to use TBL data to analyze, predict and optimize outcomes.
- However, care must be taken not to blindly apply analysis from one set of learners to another
- What could be done is to develop several models for TBL data analysis that could be easily tested, customized and applied in various populations

## ACKNOWLEDGEMENTS

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## AUTHORS



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Dr Timothy Wertz received his bachelor’s degree from Alma College, where he majored in Mathematics, Physics, and Foreign Service. He went on to obtain a Master’s degree in Mathematics from San Francisco State University, for which his research focused on interpolation and sampling in spaces of analytic functions. He completed his Ph.D. at the University of California, Davis, where his dissertation research concerned eigenvector localisation and related phenomena.