Using Data to Improve Students' Learning

SPRING 2022

Using Data to Improve Students' Learning
Course Syllabus, SPRING 2022

I. Course Instructor and schedule

Instructor:

Ibrahim is a chemistry teacher who began teaching at Department of Pharmacology at Dubai Higher College of Technology. He is currently at the Applied Technology High School in Ras Al Khaimah, where he teaches AP chemistry. He holds a BSc in chemistry from Bethlehem University.

Ibrahim was recognised in 2018 when he was named the ATHS Teacher of the Year. He won Ras Al Khaimah Award for Educational Excellence for the academic year 2019/2020 and, he selected as a Microsoft innovative Educator Expert for 2020/2021. Ibrahim believes that good teachers not only work with their existing knowledge, but strive to stay on top of the latest research in education, hence teaching that 'comes alive' for learners. Ibrahim is keen on contributing to the community, and it's evident in his multiple participations, with the latest of which was the success of his team, which he supervised in the second place in the Aoun Community Service Competition organized by Emirates Red Crescent.

Workshop dates:

Sunday, April 24th ,2022 (Online)
Sunday, May 8th ,2022 (In-person)
Sunday, May 22nd ,2022 (Online)
Sunday, June 5th ,2022 (In-person)
Sunday, June 19th ,2022 (Online)

Time: 10:00AM to 12:00 PM *(Blended Training)*

II. Course Overview

Course Description:

Data has potential to be the key lever that leads to exceptional student results. In a world where there are endless metrics—expanding spreadsheets, charts, report cards, and data points— often many educators are overwhelmed with data points yet lack relevant data. With the innumerable amounts of data points, we need to draw out patterns, trends, and insights that show meaningful data about particular areas of the teaching and learning process.

Data collection and analysis of students' work are part of how schools report and track performance. This involves more than simply calculating a class grade average and percentage of successful and 'failing' students, but reshaping the way students learn as well as teaching dynamics because it highlights what students learn, when they learn it and at what level and goes further to determine what a student masters or does not master. This course will explore data analysis, demonstrate how teachers can use data to plan, effectively make data-driven decisions, solve problems, and rethink new teaching methods.

Therefore, in this five-week course participants will analyze academic performance according to standard criteria and use this data to close achievement gaps, reduce the failure rate of underserved students, and meet accountability requirements with emphasis on promoting equity within a culturally proficient school environment.

Learning Objectives:

After completing this course, participants should be able to:

- Explain how academic achievement data can be used to improve student learning and engagement

- Demonstrate understanding how data is linked to learning depth

- Make meaningful use of assessment data across their curriculum
- Adapt teaching strategies from data analysis
- Adapt schemes of work for students' learning and achievement
- Use of meaning data across the curriculum
- Prepare students for EMSAT, PISA, TIMMS and PIRLS through teaching and data
- Preparing students for EMSAT, PISA, TIMMS and PIRLS through teaching and data analysis

Content:

- ★ Workshop 1
  - o What is academic achievement analysis?
  - o Effectiveness of academic achievement analysis
  - o Explore why to do academic achievement analysis
  - o Explore the best models of academic achievement analysis
  - o Explain how academic achievement analysis can be used to promote student learning and engagement.
  - o Academic achievement analysis models include the following basic principles:
    - Academic failure analysis
    - Poor academic performance analysis
    - Causative factor in poor academic achievement and scholastic malfunctioning
    - Basic cognitive skills.
  - o Factors influencing academic achievement
    - Individual differences influencing academic performance
    - Non-cognitive factors
    - Extracurricular activities
    - Successful educational actions
  - o The Educational Situation Quality Model
    - Interpersonal level
    - Intrapersonal level
    - Academic level
    - Expectancy for success

- ▪ Expectancy for enjoyment

- ▪ Expectancy of control

- ★ Workshop 2
  - o Direct measures of learning analysis:
    - ▪ Capstone projects-based analysis
    - ▪ Papers based analysis
    - ▪ Standardized tests-based analysis
    - ▪ Observations of students in practical setting
    - ▪ Quiz questions that align with a key area of knowledge needed
  - o Embedded assessments analysis
  - o Attitudes analysis:
    - ▪ Surveys
    - ▪ Interviews
    - ▪ Focus groups

- ★ Workshop 3
  - o Data segregation
  - o Data monitoring
  - o Data tracking
  - o Data customization
  - o Data segregation tools
  - o Types of Data:
    - ▪ Qualitative
    - ▪ Quantitative

- ★ Workshop 4
  - o Summary of academic achievement analysis
  - o Discussion of academic achievement analysis
  - o Implications of academic achievement analysis for practice

- o   Choose among alternatives
- o   Take action
- o   Review your decision & its consequences
- ★   Workshop 5
  - o   Graduation project
  - o   Planning
  - o   Presentation
  - o   Discussion
  - o   Voting for the best graduation project use what was presented on this course effectively and professionally

III. Certificates

At the end of the 5th workshop series, participants will receive a certificate of excellence for:

- 100% workshop attendance (10 hours)
- Completion of all in-workshop assignments
- Completion of all homework assignments.

IV. Course Outline

<u>Workshop 1:</u>

- Objectives:

  The following objectives will be covered in workshop 1:

  - Define what academic achievement analysis is

  - Explore the academic achievement levels

  - Explore the importance of analyzing student achievement data to support instructional decision making

  - Explore how to make data analysis part of an ongoing cycle of instructional improvement

  - Explore how to collect and prepare a variety of data about student learning

  - Explain expectations and assessment criteria

  - Explain how academic achievement analysis can be used to promote student learning and engagement.

  - Case studies presentation and discussion

- Activities

  - Introductions and course overview
  - Icebreaker: 'Childhood Dream' activity
  - Creating working groups
  - Video: case studies of importance of effective academic achievement analysis in problem identification followed by discussion
  - Application of scale score cut points
  - Presentation of achievement-level data
  - Application of data preparation steps
  - Creating analysis criteria
  - Using academic achievement analysis planner form to conduct sample of phase one analysis
  - Design activity, collect data and share your findings with and without academic achievement analysis.

- o Create a plan for effectively academic achievement analysis into curriculum
- o Workshop Summary, Homework Explanation, Q & A
- Homework
  - o See RAKTN for homework
- Evaluation Tool

  Teachers are considered to have successfully completed the requirements of this workshop if they achieve the following:
  - o Successfully participated in all discussions raised on the topic
  - o Creating activities, collect data and apply what has been explained so far
  - o Completion of all in-workshop assignments
  - o Completion of all homework assignments
  - o Sharing samples of work on RAKTN

Workshop 2:
- Objectives:

  The following objectives will be covered in workshop 2:
  - o Data collection
  - o Initial preparation of data
  - o Data selection
  - o Data cleaning
  - o Derivation of new variables
  - o Data preprocessing
  - o Demonstrate practically how to promote student learning and engagement depending on academic achievement analysis
  - o Master the different types of data preprocessing, how to form them, and when to use them
  - o Provide the opportunity for participants to practice what has been explained and conduct academic achievement analysis
  - o Demonstrate practically how to promote student learning and engagement using academic achievement analysis

- Activities
  - Icebreaker
  - Data collection process steps:
    - ◊ Primary Data Collection
      - ✓ Formative Data: Short quizzes, question and answer drills and a simple show of hands generates a certain kind of data
      - ✓ Observational Data: Teachers learn to watch their students
      - ✓ Standardized Tests, Key Milestone Exams and Project Work: Summative data is collected from the examinations given at the end of unit or the end of year
      - ✓ Student Files: To have some reference points from which to compare the data from within the class.
      - ✓ Student Reported Data: To gain more insight into how the student perceives their own accomplishments and ability.
  - Data preprocessing
    - ✓ Binning Method
    - ✓ Regression
    - ✓ Clustering
  - Data Transformation
    - ✓ Attribute Selection
    - ✓ Discretization
    - ✓ Numerosity Reduction
  - Group activities for application
  - Creating activities, collect data and apply what has been explained so far
  - Workshop Summary, Homework Explanation, Q & A

- Homework
  - See RAKTN for homework
- Evaluation Tool

  Teachers are considered to have successfully completed the requirements of this workshop if they achieve the following:
  - Successfully participated in all discussions raised on the topic
  - Creating activities, collect data and apply what has been explained so far
  - Completion of all in-workshop assignments
  - Completion of all homework assignments
  - Sharing samples of work on RAKTN

Workshop 3:

- Objectives

  The following objectives will be covered in workshop 3:
  - Normalization of numeric attributes
  - Discretization
  - Convert to numeric variables
  - Combining levels
  - Imbalanced datasets
  - Data mining implementation
  - Data mining models
  - Data mining tools
  - Provide the opportunity for participants to practice what has been explained
- Activities
  - Icebreaker
  - Create multiple activities for:
    - Dimensional analysis
    - Analysis using encoding mechanisms
    - Synthesis and evaluation

- - - Interaction and practice

    - Reflection

    - Acquire feedback

    - End a course

- Group activities for application

- Creating activities, collect data and apply what has been explained so far

- Workshop Summary, Homework Explanation, Q & A

  - Homework
    - See RAKTN for homework
  - Evaluation Tool

    Teachers are considered to have successfully completed the requirements of this workshop if they achieve the following:
    - Successfully participated in all discussions raised on the topic

    - Creating activities, collect data and apply what has been explained so far

    - Completion of all in-workshop assignments

    - Completion of all homework assignments

    - Sharing samples of work on RAKTN

Workshop 4:
- Objectives

  The following objectives will be covered in workshop 4:
  - Results evaluation
  - True Positive (TP)
  - False Positive (FP)
  - True Negative (TN)
  - False Negative (FN)
  - Data reporting
  - Reporting Tools

- How to make data-driven decisions
- Successful Decision-Making
- Provide the opportunity for participants to practice what has been explained

- Activities
  - Icebreaker
  - Create multiple activities for:
    - Sensitivity and specificity to determine the value of a test
    - Interpreting predictive value
    - False positive rate activity
    - The receiver operating characteristic (ROC) curve

- Group activities for mastering data-driven decision making

- Creating activities, collect data and apply what has been explained so far

- Workshop Summary, Homework Explanation, Q & A

  - Homework
    - See RAKTN for homework
  - Evaluation Tool
    Teachers are considered to have successfully completed the requirements of this workshop if they achieve the following:
    - Successfully participated in all discussions raised on the topic
    - Creating activities, collect data and apply what has been explained so far
    - Completion of all in-workshop assignments
    - Completion of all homework assignments
    - Sharing samples of work on RAKTN

Workshop 5:

- Objectives
    - Plan, construct and implement the graduation project so that each group will practice Academic achievement analysis starting from pre-data collection up to decision making
    - Provide the opportunity for participants to prepare their projects and include what has been presented in this course
- Homework
    - See RAKTN for homework
- Evaluation Tool

    Teachers are considered to have successfully completed the requirements of this workshop if they achieve the following:

    - Conducting Academic Achievement Analysis

    - Applying what has been presented in this course
    - Voting for the best graduation project use what was presented on this course effectively and professionally
    - Completion of all in-workshop assignments
    - Completion of all homework assignments
    - Sharing samples of work on RAKTN

V. Discussion

Academic achievement or academic performance is the extent to which a student has attained their short or long-term educational goals. Completion of educational benchmarks such as secondary school diplomas and bachelor's degrees represent academic achievement.

Academic achievement is commonly measured through examinations or continuous assessments but there is no general agreement on how it is best evaluated or which aspects are most important—procedural knowledge such as skills or declarative knowledge such as facts. Furthermore, there are inconclusive results over which individual factors successfully predict academic performance, elements such as test anxiety, environment, motivation, and emotions require consideration when developing models of school achievement.

Data Collection: Types and Tools

There are four types of data collected for academic achievement analysis purposes:

- ✓ Demographic Data

The demographic data include enrollment, attendance, status, involvement, mobility, and participation rates. Some sources of demographic data include a student information system, or other sources.

- ✓ Achievement Data

Achievement data include student performance on standard tests like EmSAT, AP, SAT or nationally normed tests. Local assessments can also be used to report achievement data. These could include grade level testing and common end-of-course assessments.

- ✓ Process Data

Process data involves the rules, guidelines, and protocolsto guide of the operations.

- ✓ Perception Data

Perception data involves gathering the opinions, comments, and recommendations about our students from parents, teachers/staff, community members, and students.

Importance of academic achievement analysis

It will:

• Improve standards.

• Facilitate the need to give consideration to the issue of individual differences.

• Serve as feedback mechanism for the re-evaluation of curriculum.

• Serve as a measure to promote efficiency in practices.

Key Concepts In Academic Achivement Analysis

• Academic failure

Performance that falls below a specified standard or criterion of excellence

• Poor academic performance

   ✓ Performance that falls below a desired standard.

   ✓ Can span from zero to 100

   ✓ Poor performance depending on the expectation or standard desired.

• Causative factor in poor academic achievement and scholastic malfunctioning

   o Causes Resident in the Individual Child:

      ✓ Physical and Health Factors

      ✓ Lack of Basic Cognitive Skills

      ✓ Emotional Problems

- ✓ Lack of Necessary Background knowledge and Skills

- ✓ Poor Study Habits/Deficient Examination Strategies

- ✓ Continuous Failure

- ✓ Low or Poor Achievement Motivation

o Causes Resident at home:

- ✓ Nature of Home Discipline

- ✓ Family Relationship

- ✓ Level of Cognitive Stimulation

- ✓ Available Financial Resources

- ✓ Availability of Medical Facilities

o Causes resident at School:

- ✓ Deficient Physical Environment

- ✓ Location of the School

- ✓ Individual Buildings:

- ✓ Poor Interpersonal Relationships with the School

- ✓ Poor Quality of Teaching Staff

- ✓ Existence or non-existence Teaching

- ✓ Inadequacy of Teachers

- ✓ Training of Teachers and teacher years of experience

- ✓ Method of Teaching

- ✓ Evaluation of Learning

- ✓ Inadequate Teaching and Equipment Facilities

- ✓ Teacher Poor Condition of Service

- ✓ Inadequate Curricula

o Causes resident in the society:

- ✓ Un-equitable Distribution of Resources

- ✓ Social Class Differences

- ✓ Inadequate Medical Facilities

- ✓ Ethnic Conflicts

- ✓ Anti-Intellectual Value in a Society

- ✓ Inadequacies of the Educational System

- ✓ Intermittent Strike Actions

Collect and prepare a variety of data about student learning

To gain a robust understanding of students' learning needs, teachers need to collect data from a variety of sources. Such sources include but are not limited to

- ✓ annual assessments

- ✓ curriculum-based assessments

- ✓ chapter tests

- ✓ classroom projects

In most cases, teachers and their schools already are gathering these kinds of data, so carrying out data collection depends on considering the strengths, limitations, and timing of each data type and on preparing data in a format that can reveal patterns in student achievement. Moreover, by focusing on specific questions about student achievement, educators can prioritize which types of data to gather to inform their instructional decisions.

Examples of classroom and other data

• Curriculum-based unit tests

• Class projects

• Classwork and homework

• Attendance records

• Records from parent meetings and phone calls

• Classroom behavior charts

• Individualized educational plans (IEPs)

• Prior data from students' cumulative folders

Data Mining

It is the process of finding patterns in large volumes of data to translate it into valuable information.

★ Types of Data Mining Models and Techniques
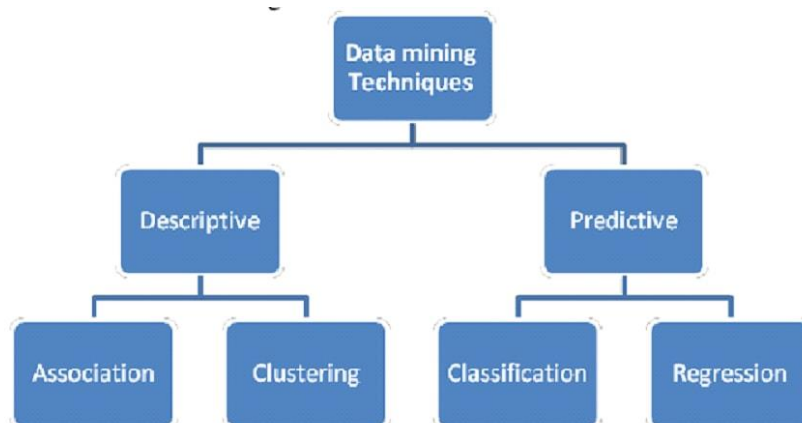
1) Descriptive Models

Descriptive Models are used to build meaningful subgroups such as demographic clusters by describing trends in existing data.

Some of the Descriptive techniques used are:

- o Association: Data is created by analyzing the relationship between objects in a data set.

- Clustering: Here, data is considered as an object that is kept in classes that are automatically defined. In other words, data is organized into clusters based on their similarities.

2) Predictive Models

Predictive Models can be used to anticipate explicit values based on patterns seen in previous outcomes.

- Classification: This process involves breaking down data into categories and groups. It allows you to categorize leads into different groups.

- Regression: In a precise data object, this is used to forecast a range of numeric values.

<u>Data Mining Tools</u>

Most widely used, most accessible, and most powerful tools available to the educational data mining

Microsoft Excel/Google Sheets.

EDM Workbench.

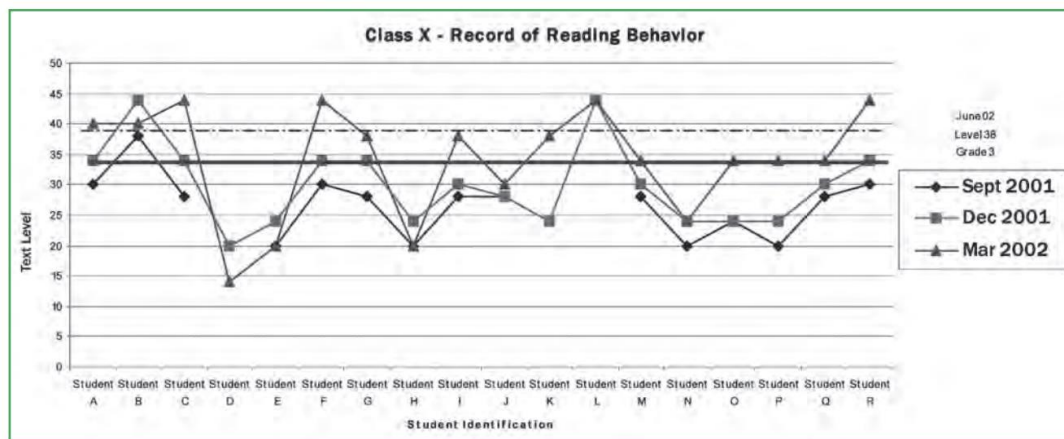Python and Jupyter notebook

SQL

WEKA

SPSS

Orange

KEEL

Tableau

D3js

Example of classroom running records performance at some School

Data Clustering Methods

Cluster analysis is a statistical method for processing data. It works by organising items into groups, or clusters, on the basis of how closely associated they are.

Types of Clustering Methods:

- ✓ Connectivity-based Clustering (Hierarchical clustering)

- ✓ Centroids-based Clustering (Partitioning methods)

- ✓ Distribution-based Clustering

- ✓ Density-based Clustering (Model-based methods)

- ✓ Fuzzy Clustering

- ✓ Constraint-based (Supervised Clustering)

Different Types of Data Analysis

- ✓ Descriptive analytics

    Descriptive analytics looks at what has happened in the past. As the name suggests, the purpose of descriptive analytics is to simply describe what has happened; it doesn't try to explain why this might have happened or to establish cause-and-effect relationships.

- ✓ Diagnostic analytics

  Diagnostic analytics seeks to delve deeper to understand why something happened. The main purpose of diagnostic analytics is to identify and respond to anomalies within your data.

- ✓ Predictive analytics

  Predictive analytics seeks to predict what is likely to happen in the future. Based on past patterns and trends, data analysts can devise predictive models which estimate the likelihood of a future event or outcome.

- ✓ Prescriptive analytics

  Prescriptive analytics looks at what has happened, why it happened, and what might happen to determine what should be done next. In other words, prescriptive analytics shows you how you can best take advantage of the future outcomes that have been predicted. What steps can you take to avoid a future problem? What can you do to capitalize on an emerging trend?

Academic Achievement Analysis Planner

<u>Basic questions in cluster analysis</u>

1. What measure of inter-subject similarity is to be used and how is each variable to be "weighted" in the construction of such a summary measure?

2. After inter-subject similarities are obtained, how are the classes to be formed?

3. After the classes have been formed, what summary measures of each cluster are appropriate in a descriptive sense; that is, how are the clusters to be defined?

4. Assuming that adequate descriptions of the clusters can be obtained, what inferences can be drawn regarding their statistical significance?

Graduation Project Planner

Name	Role	Responsibility	Contact Information

Lesson Plan Template

I. Background Information

- Title:

- Subject:

- Grade(s):

- Group size: ☐ any, ☐ whole class, ☐ small group, ☐ partners, ☐ independent

II. Description

- Introduction: What is the lesson about?

- What are the objectives of the lesson? (i.e. Students will be able to…)

- Explain how the lesson plan will promote critical thinking and creativity.

- Explain how this lesson plan encourages students to use digital tools and resources to research, explore real world issues and to collaborate.

- How long will the lesson take to implement? (i.e., one 45 minute period, three 60 minute periods)

III. Materials

- What technology tools are required for the lesson? (Please use what you have learned so far.)

- What additional materials are required for the lesson?

IV. Procedures

- Introduction: Tell students what to expect and lesson objectives.
- Outline lesson steps including all teacher presentations, student activities, and assessments.

V. Assessment

- Describe in detail how students will be assessed. Attach quizzes, answer keys, and evaluation rubrics (if needed).