

STEM Transitional Math – Unit 1 UBD

Modeling Our Learning: Using Computational Thinking and Simulation to Understand Growth in Transitional Math

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Introduction

This unit introduces students to Computational Modeling and Simulation (CMS) as a powerful way to understand and improve their own learning processes. Using tools like Pearson MyLab, CODAP, and Desmos, students will collect, organize, and analyze data about their academic behaviors and outcomes. They'll develop simple models of their learning and run simulations to explore how changes, such as increased study time, repeated practice, or targeted intervention affect performance on machine learning (ML)-generated metrics within Pearson MyLab. By the end of the unit, students will not only understand how CMS works, but also how to apply it to set goals, monitor growth, and make informed academic decisions throughout the school year.

Stage 1 – Desired Results

Unit Goals

- Introduce students to computational modeling and simulation (CMS) as tools for analyzing learning and growth.
- Help students recognize patterns in their own academic performance and represent those patterns using mathematical models (e.g., linear, exponential, piecewise).
- Develop students' understanding of how machine learning (ML) systems function, especially how they use historical data to generate predictions and feedback.
- Foster students' ability to collect, organize, and visualize their own data using platforms like Desmos, CODAP, and Pearson MyLab.
- Support students in becoming critical users of learning technologies by understanding their role as both data producers and decision-makers in a tech-supported learning environment.
- Empower students to monitor, reflect on, and adjust their learning strategies using quantitative evidence.
- Lay the foundation for interdisciplinary thinking by connecting mathematical modeling with computational thinking, data literacy, and self-directed learning.
- Engage students in project-based learning that emphasizes reflection, communication, and application of mathematical concepts to real-world learning contexts.

Essential Questions

- How can I use math to model my own learning and growth over time?
- What do patterns in my learning data tell me about how I improve and where I need support?
- How do machine learning systems use data to make decisions, and what can I learn from that process?
- In what ways am I contributing to or shaping the learning technologies I use?

- What makes a mathematical model useful or accurate in describing real-world situations?
- How can computational tools like Desmos and CODAP help me see and understand patterns I might miss otherwise?
- Why does the quality and accuracy of data matter in both personal learning and machine learning?
- What responsibilities do I have as a producer of data in a technology-supported classroom?
- How can thinking like a data scientist or data analyst help me become a better learner?

Transfer Skills

- Modeling growth using mathematical functions: Apply linear, exponential, and other mathematical models to represent and interpret change over time.
- Interpreting and analyzing personal data: Use real-world data (e.g., test scores, practice habits) to draw conclusions about learning patterns and progress.
- Making data-driven decisions: Evaluate trends to set academic goals, identify areas for improvement, and adjust learning strategies accordingly.
- Understanding system behavior: Recognize how patterns in data inform predictions and how this mirrors the logic behind machine learning systems.
- Communicating insights from data: Create visual and verbal representations (graphs, tables, written reflections) to explain trends, conclusions, and next steps.
- Practicing computational thinking: Break complex problems into parts, recognize patterns, and develop step-by-step processes to analyze and model learning.
- Self-monitoring and self-regulation: Reflect regularly on progress, effort, and habits to take ownership of one's academic development.
- Navigating a technology-enhanced learning environment: Responsibly use learning platforms, simulations, and data tools to support academic growth.
- Recognizing one's role in a learning ecosystem: Understand how individual input contributes to the accuracy and usefulness of adaptive learning systems and ML tools.

Understandings

- Mathematical models can represent real-world phenomena, including patterns in personal learning and growth.
- Computational modeling and simulation (CMS) are powerful tools for exploring systems, making predictions, and visualizing complex patterns.
- Machine learning (ML) systems rely on input data to generate meaningful output; the quality of the output depends on the quality of the input.
- Students are not just users of educational technology. they are contributors to an adaptive learning ecosystem that responds to their choices and behaviors.
- Analyzing personal data helps students take ownership of their learning, make informed decisions, and set actionable goals.
- Patterns in data, such as rates of improvement or decline, can be described and predicted using functions like linear, exponential, and piecewise models.
- Computational thinking enables students to break down complex problems, identify patterns, and use data systematically to find solutions.

- Being able to interpret and communicate data visually and verbally is a key skill in both STEM and everyday decision-making.

Acquisition of Knowledge

- What are computational modeling and simulation (CMS) and why they matter in STEM.
- How machine learning (ML) systems rely on input data to generate feedback and predictions.
- Mathematical models (e.g., linear, exponential, piecewise) can describe real-world change.
- The basic components of computational thinking: decomposition, abstraction, pattern recognition, algorithms.
- The importance of accurate and complete data in understanding trends and making predictions.
- Their role in an adaptive learning ecosystem as data producers and interpreters.

Acquisition of Skills

- Collect, organize, and manage personal learning data.
- Apply linear and exponential models to analyze growth over time.
- Create and interpret graphs and simulations using tools like Desmos or CODAP.
- Use computational thinking strategies to break down problems and model learning.
- Reflect on data to set learning goals and monitor progress.
- Explain the function and logic of machine learning systems in student-friendly terms.
- Communicate insights from data using mathematical reasoning, visual representation, and written reflection.

Stage 2 – Evidence

Performance Tasks

Competency 1.0.0: Modeling and Monitoring Learning Using Mathematical and Computational Tools

Performance Indicator 1.1.0: Use mathematical models and computational tools to represent and interpret patterns in personal academic growth.

- Learning Target 1.1.1: In three out of four trials, SWBAT collect and organize personal academic data (e.g., scores, time on task, completion rates) for modeling.
- Learning Target 1.1.2: In three out of four trials, SWBAT construct graphs in Desmos or CODAP that accurately represent learning trends using linear, exponential, or piecewise functions.
- Learning Target 1.1.3: In three out of four trials, SWBAT interpret their graphs to explain areas of growth, consistency, or decline in learning performance.

Competency 2.0.0: Understanding the Role of Machine Learning in Adaptive Education

Performance Indicator 2.1.0: Demonstrate understanding of how machine learning systems use historical data to generate feedback and predictions.

- Learning Target 2.1.1: In three out of four trials, SWBAT explain the role of input data in shaping ML feedback and adaptive learning reports.
- Learning Target 2.1.2: In three out of four trials, SWBAT identify and describe their role as data contributors in a technology-supported learning environment.
- Learning Target 2.1.3: In three out of four reflections, SWBAT connect their own learning behaviors to trends visible in ML-generated dashboards or CMS models.

Evaluation Criteria

- Accuracy and Completeness of Data Collection: Student data logs or trackers are complete, accurate, and include relevant learning metrics (e.g., test scores, time on task, growth).
- Correct Use of Mathematical Models: Students apply appropriate models (e.g., linear, exponential) with accurate calculations and appropriate function selection based on context.
- Clarity and Effectiveness of Graphical Representations: Graphs or visualizations (via Desmos or CODAP) clearly reflect trends in learning data, include proper labels, and are easy to interpret.
- Insightfulness of Analysis and Reflection: Students identify meaningful trends or patterns in their learning; reflections connect data to learning behavior and growth areas.
- Conceptual Understanding of ML and CMS: Student explanations demonstrate clear understanding of how machine learning systems use data and how CMS tools function as modeling environments.
- Communication of Findings: Students clearly present their findings—verbally or in writing—using appropriate vocabulary, visuals, and supporting evidence from their data.
- Engagement with the Learning Ecosystem: Students recognize their role in contributing to and interacting with adaptive systems; show metacognitive awareness of how learning behaviors affect feedback.

Stage 3 – Learning Plan

To support students in learning how to model and monitor their academic growth, this unit uses principles from Computational Modeling and Simulation (CMS). Students will collect and organize data about their learning behaviors, such as time on task, assessment results, and intervention usage, and use these data points to build simplified models of their own academic performance. By analyzing trends and simulating changes, like increasing study time or completing additional interventions, students will explore how different variables impact outcomes. The table below outlines the key variables students will use to drive their models and simulations.

Key Variables for Modeling and Simulation

Variable Name	Type	Values	Description
Test_Score	Numerical	0 to 100 percent	Overall percentage score on each MyLab test.
Objective_Mastery	Categorical	Mastered, Not Mastered	Indicates whether a student has mastered a particular skill or objective in MyLab.
Time_on_Task	Numerical	Minutes or hours	Time spent actively working on a MyLab activity.
Repetition_Count	Numerical	Whole numbers	Number of times a student repeated a task or activity in MyLab.

Variable Name	Type	Values	Description
Targeted_Module_Use	Numerical	Whole numbers	Number of times a student accessed or used targeted intervention modules.
Intervention_Engagement	Categorical	Yes, No	Whether a student engaged with a targeted intervention when prompted.
Helpfulness_Rating	Ordinal	1 to 5 scale	Student self-rating of how helpful the targeted intervention was.
Do_Now_Reflection	Text	Open-ended	Student responses to reflective Do Now questions each day.
Guided_Practice_Score	Numerical	0 to 100 percent	Score from embedded questions in the mini-lesson.
DFA_Score	Numerical	0 to 4	Number of correct answers on the daily formative assessment.
Lab_Completion	Categorical	Complete, Incomplete	Whether the student completed the hands-on lab task.
Attendance	Categorical	Present, Absent	Whether the student attended the day's lesson.
On_Time_Completion	Categorical	On Time, Late	Whether the student submitted the day's work on time.
Confidence_Rating	Ordinal	1 to 5 scale	Student's self-rated confidence in their understanding of the day's content.

Aligned Standards

Mathematics Standards (CCSS-M)

Modeling with Functions:

- HSF.LE.A.1: Distinguish between situations that can be modeled with linear and exponential functions.
- HSF.LE.A.2: Construct linear and exponential functions, including arithmetic and geometric sequences, given a context.
- HSF.IF.C.7: Graph functions expressed symbolically and show key features of the graph.
- HSS.ID.B.6: Represent data on two quantitative variables and describe relationships between the variables.

Data Analysis & Interpretation:

- HSS.ID.A.1: Represent data with plots on the real number line (dot plots, histograms, box plots).
- HSS.ID.C.9: Distinguish between correlation and causation.

Mathematical Practices:

- MP4: Model with mathematics.
- MP3: Construct viable arguments and critique the reasoning of others.

Computer Science Standards (CSTA)

Data & Analysis:

- 1B-DA-05: Collect and present data in various visual formats.
- 2-DA-08: Represent data using multiple encoding schemes.
- 3A-DA-11: Create interactive data visualizations to help others explore and interpret data.
- 3B-DA-06: Use data analysis tools and techniques to identify patterns and trends.

Impacts of Computing / Ethics:

- 3A-IC-25: Evaluate the social and ethical implications of computing systems.

Computational Thinking Practices:

- 1B-AP-10: Create programs that use variables to store and modify data.
- 2-AP-13: Decompose problems and create solutions using constructs such as loops, conditionals, and functions.

Science Standards (NGSS)

Science and Engineering Practices:

- SEP 1: Asking questions and defining problems
- SEP 4: Analyzing and interpreting data
- SEP 5: Using mathematics and computational thinking
- SEP 7: Engaging in argument from evidence
- SEP 8: Obtaining, evaluating, and communicating information

Crosscutting Concepts:

- CCC – Cause and Effect: Mechanism and explanation
- CCC – Systems and System Models: Represent systems and their interactions
- CCC – Patterns: Use patterns to make predictions and support claims

Disciplinary Core Ideas:

- ETS1.A: Defining and delimiting engineering problems
- ETS1.B: Developing possible solutions
- ETS1.C: Optimizing the design solution

Daily Learning Events

To reinforce the unit's focus on computational modeling and machine learning, each lesson follows a structured daily cycle that mirrors the logic of adaptive learning systems. Students move through a progression of activities that include data generation, model construction, interpretation, and feedback. This agenda supports the development of CMS-aligned habits such as pattern recognition, data-informed decision-making, and iterative improvement, all within a real-time, tech-enhanced classroom environment.

Daily Lesson Agenda Structure:

Do Now (10 min): Digital warm-up or journal entry

Mini-Lesson (10 min): Teacher-led direct instruction via shared real-time slide deck

Guided Practice (10 min): Gamified whole-class problem solving embedded in the mini-lesson

Lab (34 min): Small-group, real-world themed task and discussion

DFA (10 min): Digital multiple-choice formative assessment

Intervention/Acceleration (30 min): Personalized follow-up based on DFA scores

- DFA score < 3 → short instructional video + targeted adaptive/personalized practice
- DFA score 3–4 → targeted adaptive/personalized practice only

The following outlines the core instructional content for each day's lesson.

DAY 1: CLASS INTRODUCTION

Do Now:

1. What are you hoping to achieve in this STEM Transitional Math class?
2. What has your experience with math been like so far? What are you hoping will be different or the same this year?"

Mini-Lesson Learning Objective:

In three out of four trials, students will identify and describe the course outline, classroom expectations, and the purpose of key digital tools (e.g., Pearson MyLab, CODAP).

Guided Practice:

Students will answer gamified check point questions embedded in the mini-lesson (whole class) on the course rules and tools.

Lab:

Theme - "Getting to Know Our Tools". *Activity:* Students will work in groups to log into Pearson MyLab and CODAP to ensure they have access. They'll also get a brief overview of each tool's purpose in the course.

DFA:

Students answer four multiple choice questions overing the syllabus and classroom procedures.

Intervention/Acceleration:

- Intervention (DFA Score < 3): Edpuzzle instructional video: "WHAT YOU NEED TO KNOW before your last year of high school // college apps, senioritis, adulting. After completing the instructional video, students will complete the acceleration activity.
- Acceleration (DFA Score 3–4): Within Pearson "MyLab Math Resources to Help You" section, students will complete the "Quick start: MyLab and Mastering student" activity.

DAY 2: WHAT IS A LEARNING ECOSYSTEM?

Do Now:

1. What is a model, and where have you seen one used before?
2. In what ways do you think your learning data is used or shared?

Mini-Lesson Learning Objective:

In three out of four trials, students will be able to identify the components of a CMS and describe their role within a learning ecosystem. They will receive a mini-glossary with key terms (CMS, ecosystem, feedback loop, etc. to build academic language and accessibility.

Guided Practice:

Students will answer gamified check point questions embedded in the mini-lesson (whole class) concerning the components of CMS, the learning ecosystem.

Lab:

Theme - "Data Trails" – With their groups, students brainstorm examples of data they generate in school (tests, clicks, logins, time on task, etc.) and map where that data might go and how it

might be used by a CMS. With their groups, students will answer “What part of the CMS model do you think has the biggest impact on your learning? Why?” and “How is the CMS components related to tools like Pearson MyLab, CODAP, and Desmos?”

DFA:

Students answer four multiple choice questions identifying parts of a CMS or ML tool and data in a mock math classroom setting.

Intervention/Acceleration:

- *Intervention (DFA Score < 3):* Edpuzzle instructional video: “Machine Learning Basics”.
- *Acceleration (DFA Score 3–4):* Using the CODAP website, students will go to the Getting Started CODAP Basics (<https://codap.concord.org/get-started/codap-basics>) and open and save a CODAP sample document from a Google Drive. Students will then learn how to import and export CSV, CODAP and TXT files using CODAP.

DAY 3: WHAT IS DATA AND HOW DO WE COLLECT IT?

Do Now:

1. What kinds of learning behaviors do you think are most important to track?
2. What patterns do you think your learning data might reveal about you?
(Students write quick reflections in their journals.)

Mini-Lesson Learning Objective:

In three out of four trials, students will be able to define types of learning data and demonstrate how to collect and organize it using CMS tools.

Guided Practice:

Students will answer gamified check point questions embedded in the mini-lesson (whole class) concerning classifying, collecting, and organizing data in CMS tools.

Lab:

Theme - With their groups, students will explore data using data portal from California residents by completing a challenge activity within CODAP.

<https://codap.concord.org/releases/app/dg/en/cert/index.html#shared=82989>

DFA:

Students complete a four-question multiple-choice quiz on identifying types of variables and matching data sources to learning activities.

Intervention/Acceleration:

- *Intervention (DFA Score < 3):* Edpuzzle video: “What Counts as Data? Understanding Learning Analytics in Simple Terms”.
- *Acceleration (DFA Score 3–4):* Students will export their lab-generated data from CODAP into a format compatible with Desmos and create at least one meaningful visualization that represents a pattern or insight in the data.

DAY 4: WHAT IS A VARIABLE?

Do Now:

1. What’s the difference between a number and a category when organizing information?
2. Why might it be helpful to classify your learning data into types?

Mini-Lesson Learning Objective:

In three out of four trials, students will be able to distinguish between numerical, categorical, and ordinal variables and describe their role in computational models.

Guided Practice:

Students will answer gamified check point questions embedded in the mini-lesson (whole class) where they distinguish between data types.

Lab

Theme - "Variable hunt" – Students will work in groups using a shared Excel spreadsheet with an embedded form to explore both sample and self-generated learning data (Data Learning Tracker). They will begin by analyzing sample student data logs within a spreadsheet, identifying and labeling each variable as numerical, categorical, or ordinal, and explaining how each could be used in a computational learning model. Next, students will submit their own recent learning data, such as time spent on task and DFA data, using the same process.

DFA:

Students complete a four-question multiple-choice quiz that asks them to identify the correct type of variable (numerical, categorical, or ordinal) for a given learning data point.

Intervention/Acceleration:

- Intervention (DFA Score < 3): Edpuzzle video: "Types of Variables: How to Organize Data for Modeling"
- Acceleration (DFA Score 3–4): Students will compete an MyLab activity in Pearson MyLab 7th edition of Statistics: Informed Decisions Using Data by Michael Sullivan III (Chapter 2 sections 2.1 and 2.2) to explore qualitative and quantitative data and their graphs.

DAY 5: HOW DO WE EXPLORE DATA VISUALIZATION IN CODAP?

Do Now:

1. Why is it important to keep your data organized when building a model?
2. What challenges might come up when entering or tracking your own learning data?

Mini-Lesson Learning Objective:

In three out of four trials, students will be able to enter, label, and organize learning data in a CODAP dataset for use in computational modeling and simulation.

Guided Practice:

Students will answer gamified check point questions embedded in the mini-lesson (whole class) a step-by-step walkthrough to create a new CODAP table, enter sample data, label columns with variable names, and save their dataset. They discuss how consistent data entry affects the accuracy of their model.

Lab:

Theme-"Digital Data Diaries" – With their groups students will update their Data Learning Tracker for data from the prior lesson. They will then create a CSV file and import their CVS file into CODAP and create simple data visualizations. Students will begin a daily routine of entering their learning data into their Data Learning Tracker.

DFA:

Students complete a four-question multiple-choice quiz that checks their understanding of basic table structure, variable labeling, and how CODAP stores data.

Intervention/Acceleration:

- Intervention (DFA Score < 3): Edpuzzle video: "Getting Started with CODAP: Entering and Managing Your Own Data"
- Acceleration (DFA Score 3–4): Students will complete an MyLab activity in Pearson MyLab 7th edition of Statistics: Informed Decisions Using Data by Michael Sullivan III (Chapter 3 sections 3.4 and 3.5) to explore how to identify errors in data sets.

DAY 6: HOW DO WE EXPLORE MODELING IN DESMOS?

Do Now:

1. What does a graph show that a table might not?
2. How can visualizing your learning data help you make decisions about your study habits?

Mini-Lesson Learning Objective:

In three out of four trials, students will be able to use Desmos to visualize, manipulate, and interpret linear models. explaining how changes in slope and intercept affect predictions.

Guided Practice:

Students will answer gamified check point questions embedded in the mini-lesson (whole class) concerning the use of Desmos to visualize, manipulate, and interpret models.

Lab:

Theme - "*Model Sandbox*" – With their groups, students enter their own regression model from CODAP into Desmos and use sliders to explore how changes in slope and intercept affect the graph. They test what happens when values increase, decrease, or turn negative, and write brief reflections on what each change means in the context of their learning. Students also use their models to make simple predictions, such as, "If I study 30 minutes, my model says I'll score...". As an extension, they can compare their model to a peer's and discuss differences.

DFA:

Students complete a four-question multiple-choice quiz interpreting slope and intercept in context and predicting outcomes from a given equation.

Intervention/Acceleration:

- Intervention (DFA Score < 3): Edpuzzle video: "*Lesson 12-3 Use Linear Models to Make Predictions*".
- Acceleration (DFA Score 3–4): Students will complete an MyLab activity in Pearson MyLab 7th edition of Statistics: Informed Decisions Using Data by Michael Sullivan III (Chapter 14 sections 14.2 and 14.6) to explore using data to make informed decisions.

DAY 7: HOW DO WE SET SMART GOALS BASED ON OUR DATA?

Do Now:

1. Based upon your learning data, which learning habits are helping you?
2. One area I would improve is ____ because my data shows ____."

Mini-Lesson Learning Objective:

In three out of four trials, students will be able to set a measurable academic goal informed by trends (SMART Goals) in their personal learning data.

Guided Practice:

Students will answer gamified checkpoint questions in the mini-lesson to evaluate whether example goals are SMART and justify their reasoning.

Lab:

Theme - "Goal Setters" – Working in groups, students complete a structured SMART goals template to set a data-informed learning goal. Using insights from their CODAP and Desmos models, they identify a specific learning behavior to adjust (e.g., study time, review strategies), articulate a measurable outcome, and define how they will track progress over the next week. Students ensure their goals are Specific, Measurable, Achievable, Relevant, and Time-bound, then share and refine them with peer partners for clarity and accountability.

DFA:

Students complete a four-question multiple-choice quiz identifying strong vs. weak goals.

Intervention/Acceleration:

- Intervention (DFA Score < 3): Edpuzzle video: "*Setting SMART Goals for Students*"
- Acceleration (DFA Score 3–4): Students will complete a MyLab activity in Pearson MyLab 7th edition of Statistics: Informed Decisions Using Data by Michael Sullivan III (Chapter 4 sections 4.2 and 4.3) to explore predicting data trends.

DAY 8: HOW DO WE COMMUNICATE WHAT OUR DATA TELLS US? (Unit Capstone Project)

Do Now:

1. What is the most important message you want your Gallery Walk Display to communicate?
2. If your display could only include one insight, what would it be and why?

Mini-Lesson Learning Objective:

In three out of four trials, students will be able to design a personal digital display that communicates their learning data, simulation insights, and SMART goal in a clear, data-driven format.

Guided Practice:

Students will answer gamified checkpoint questions in the mini-lesson regarding the development of a gallery walk digital display of their data visualization, simulations, and SMART GOALS.

Lab:

Theme – "Telling My Data Story" – Students work individually within their groups to design a digital display that showcases their unique learning journey. Each student will create a personal slide or digital board (using tools like Google Slides, Canva, or Adobe Express) that includes their CODAP data visualization, Desmos model, SMART goal, and a brief reflection. Group members collaborate by offering feedback, sharing design ideas, and assisting with layout or tech troubleshooting. Students use a structured checklist to ensure all required components are complete, clear, and visually engaging.

DFA:

Students complete a self-assessment using a rubric, rating their own progress on each required section of the digital display board.

Intervention/Acceleration:

- Intervention (DFA Score < 3): Students receive support completing missing components (e.g., generating a SMART goal or interpreting a model) and may revisit Edpuzzle resources or get peer coaching within their group.

- Acceleration (DFA Score 3–4): Students add a “Next Steps” panel predicting how their SMART goal could impact their future data. They model this change using an updated Desmos graph and write a brief analysis of the predicted trend.