DESIGN DOCUMENT

EDIT 7520E

A DESIGN BLUEPRINT FOR NO COST, EQUITABLE, ADAPTIVE AND INTERACTIVE LEARNING MODULES IN COLLEGE ALGEBRA

Integrating OER, AI Tools and Desmos Activities in D2L to
Enhance Student Success in Gateway Mathematics Courses

Priya Shilpa Boindala

PART 1: OVERALL INTRUCTIONAL PLAN

PURPOSE OF THE COURSE

INSTRUCTIONAL PROBLEM OR NEED

Lower-level mathematics courses require a cost-effective, adaptive solution that integrates seamlessly with our LMS (D2L). Current low-cost platforms have limitations and do not all fully support individualized practice or equitable access for all students. A D2L-based module/s that combines AI integration with free resources like OpenStax and online videos would provide no-cost adaptive homework and quizzes while giving instructors valuable insights into both individual and class understanding.

OVERALL GOAL OF THE COURSE

The overall goal of my course project is to design and pilot a College Algebra module that integrates adaptive features, AI tools, open educational resources and other features within D2L. This module will serve as a model for developing future chapters or modules, to improve the course experience, with the long-term plan of expanding this approach across multiple courses and multiple modalities.

LEARNING OBJECTIVES

By the end of this module, learners will be able to -

- Recognize and analyze functions by identifying their values, domain, range, and intervals of increase or decrease.
- Apply function concepts to solve problems using algebraic, graphical, and real-world representations.
- Engage with adaptive practice, quizzes and feedback features in D2L to monitor their progress and strengthen understanding of key topics.

SIGNIFICANCE OF THE COURSE

Lower-level mathematics courses are critical gateways for many students, yet access to learning tools remains inconsistent. Some of the tested low-cost platforms often provide only short trial periods before requiring purchase. But with cost disparities between online and bookstore options, students who rely on financial aid frequently face delays that further disrupts their access, leaving them without essential homework resources at the start of the term. These barriers limit opportunities for practice, contribute to inequities, and hinder student success.

A no-cost, adaptive module built into D2L can remove these obstacles by integrating freely available resources such as OpenStax textbooks and online videos with AI-driven personalization. This approach provides students with equitable, real-time, low-stakes practice without the reliance on resources beyond what the institution has already invested in. It would give instructors, clear insights into both individual and class understanding of content. Ultimately, the project would be a sustainable and scalable model to improve learning outcomes in other general education mathematics courses.

LEARNER ANALYSIS

GENERAL CHARACTERISTICS

The learners in this college algebra module are primarily undergraduate students who are enrolled in a STEM or related major at a four-year institution. The age group could be between 18-24 years old with some non-traditional or older students. The learners are placed into this course based on their high school GPA and or Accuplacer test scores. Most students in this course are either full time students or with part-time jobs. The course has a wide representation from students of various cultural backgrounds and ESL students. The students are primarily located in GA. It is expected that accommodations related to screen readers, captions and extended time are in place.

SPECIFIC CHARACTERISTICS

Learners are expected to have the following pre-requisite and competency backgrounds

- **Mathematical pre-requisites:** Able to perform basic algebraic computations, with familiarity with working with exponents, fractions and radicals.
- **General learning:** Reading at the college level, ability to problem solve by considering the various steps in the process, ability to interpret information given graphs.
- **Technical skills:** Learners should be familiar with basic D2L navigation, have previous experience with working in a digital environment (evaluate, create and communicate)
- **Time management:** Must plan weekly study sessions dedicated to this course, able to leverage tools such as reminders to stay organized with course requirements and deadlines, ability to break down larger tasks into smaller ones to avoid last minute cramming.

MOTIVATION, ATTITUDE, AND LEARNING ORIENTATION

This course is part of the degree requirement for STEM majors and satisfies their Area A requirement. It is a pre-requisite for other major courses. Learners in the course are usually anxious, under confident about their mathematical skills, or indifferent as they do not see the

relevance of the course beyond the degree requirement. Most of the students are just looking to pass and not many like to be involved in deep problem-solving approaches. Many students still prefer a traditional approach to the classroom.

GOALS, EXPECTATIONS, AND CAREER RELEVANCE

Many students in the course hope to merely pass the course and satisfy their core-course requirement to prepare for their next math class. The course builds strong algebraic foundations needed by STEM/Business majors. The algebraic concepts learned in this course supports students in upper level mathematics courses. The course builds students' quantitative literacy.

CONTEXTUAL ANALYSIS

LEARNING ENVIRONMENT AND TECHNOLOGY

The course will be delivered through D2L or Brightspace using adaptive release features. Quizzes and videos will be embedded along with feedback tools. Open resources such as e-text from OpenStax, YouTube videos and Khan academy videos along with Desmos graphing activities will be part of the course elements.

The course shell will be ensuring that navigation is simplified with checklists, and maintain consistent structure.

A walk-through video will be provided to introduce the learner on the course features.

DELIVERY CONTEXT AND CONSTRAINTS

There has been a push in the University system of Georgia (USG) with initiatives such as the Affordable learning grants (ALG) for the development and use of affordable course materials. The college is seeing a shift in an increase but a judicious use of AI enhancements to instruction. The college leadership supports initiatives related to development of OER with additional support from IT being available to faculty. The constraints for faculty in developing their own no-cost course has been the limited time in the middle of a semester while also teaching full time. Developing a D2L course that can be used by either full time faculty or part-time faculty as a template for course delivery including adaptive features will be novel within the department of mathematics.

ACCESS PATTERNS AND PACING

This model course will be offered asynchronously over 3 weeks. Most learners will engage in short, frequent study sessions while there might be some who may work on large chunks at a time and possibly close to deadlines. The course will be available with a pacing guide, with the option for students to work ahead.

In the course, the material builds on itself over time. Therefore, though students cannot jump around course material they will have the option to progress at their own pace. Automated reminders based on the pacing guide will be provided to students with low stake checkpoints to ensure that students don't fall far behind.

The course will begin with an activity related to course expectations in an asynchronous modality to ensure students are informed about how to engage with the course elements.

IMPLEMENTATION AND SUSTAINABILITY

If this course were to be implemented in a real-world setting, instructors would be responsible for the course delivery and learner support. IT and LMS coordinators at the college would support any issues arising with LMS integration and related training. Instructors will also be responsible for incorporating revisions in OER used, and other resource links.

MODULES/TOPICS

Course Modules (or Topics)	Description
Module 1: Introduction to Functions	This module introduces the learner to the concept of functions, including function notation, key characteristics such as (domain, range, function values). It will include practice in identifying functions from given relations.
Module 2: Graphical and Algebraic representations.	This module will extend the concept of functions learned in module 1 and focus on analyzing graphs and equations of relations. It will introduce the reader to identifying function behavior (increasing, decreasing, constant) over intervals.
Module 3: Applying Functions to Real-World problems	This module will focus on application of concepts to authentic problems related to examples such as cost, growth and motion. This gives the learner an opportunity to make connections between the concepts in modules 1 and 2 to applications involving algebraic and/or graphical methods.

PART 2: MODULE PLANS

MODULE 1: INTRODUCTION TO FUNCTIONS

PURPOSE OF THE MODULE

This module builds on the foundational knowledge of functions which is at the core of Algebra. Having a working knowledge of functions and recognizing key characteristics for basic functions will allow the student to expand on this knowledge for other function combinations and compositions. This foundational knowledge extends into upper level mathematics courses that students will take as part of their STEM major mathematics courses.

MODULE OBJECTIVES

By the end of this module, learners will be able to

- Determine whether a relation is a function
- Identify the domain and range of a relation
- Interpret the domain and range of a function

LEARNING STRATEGIES

In this module the students will be provided with

- OER textbook links
- Videos going over the specific concepts
- Interactive Desmos activity
- Adaptive D2L quiz

ASSESSMENT

Learners will be assessed using auto graded multiple choice quiz that will focus on the concepts of this module. The quiz will be adaptive in the sense that appropriate resources will be highlighted for the students to review based on their answers. The adaptive feedback will give the learner an opportunity to assess their own learning progress.

FEEDBACK

Immediate quiz feedback will be provided along with either OER text links and video resources the students might refer to before re-attempting an assessment.

Student will be required to complete a reflection prompt based on a desmos activity. They will receive instructor feedback for their reflection as well as be required to review and provide feedback on one other student's reflection.

Resources and Materials

The key resources that will support the learning in this module are

- OER text book links
    - Functions and Function Notation
    - Domain and Range
- YouTube/khan academy videos
    - Function Basics
- Desmos activity
- Supplementary YouTube videos will be provided.
- Supplementary worksheets with solutions for practice will be provided.

Module 2: Graphical and Algebraic representations

Purpose of the Module

This module will focus on extending the concepts of functions learned in module 1 to analyze functions over two representations namely graphs and equations. It will introduce the reader to identifying function behavior, such as intervals on which the function is positive, negative, increasing, decreasing or constant.

This core idea of function behavior extends to logarithmic functions when finding the function's domain and further in calculus when learners must identify similar behavior related to various derivative functions.

Module Objectives

By the end of this module, learners will be able to –

- Identify functions from given graphs
- Identify functions from equations
- Analyze graphs to identify intervals where the function is
    - Positive
    - Negative
    - Increasing
    - Decreasing
    - Constant

LEARNING STRATEGIES

In this module the students will be provided with

- OER textbook links
  - Behavior of Graphs
  - Graphs of Functions
- Videos going over the specific concepts
  - Recognizing Functions
  - Function Behavior
- Guided example worksheet
- Interactive Desmos activity
- Adaptive D2L quiz

ASSESSMENT

Learners will be assessed using auto graded multiple choice quiz that will focus on the concepts of this module. The quiz will be adaptive in the sense that appropriate resources will be highlighted for the students to review based on their answers. The adaptive feedback will give the learner an opportunity to assess their own learning progress.

FEEDBACK

Immediate quiz feedback will be provided along with either OER text links and video resources the students might refer to before re-attempting an assessment.

Student will be required to complete a reflection prompt based on a desmos activity. They will receive instructor feedback for their reflection as well as be required to review and provide feedback on one other student's reflection.

RESOURCES AND MATERIALS

The key resources that will support the learning in this module are

- OER text book links
- YouTube/khan academy videos
- Desmos activity
- Supplementary YouTube videos will be provided.
- Supplementary worksheets with solutions for practice will be provided.

MODULE 3: APPLYING FUNCTIONS TO REAL-WORLD PROBLEMS

PURPOSE OF THE MODULE

The purpose of this module is to expose the learner to authentic problems related to the concepts introduced in modules 1 and 2. Examples of problems demonstrated here are related to cost functions, quadratic growth models and quadratic motion. The exposure to these applications gives the learner an opportunity to make connections between the concepts to applications involving algebraic and/or graphical methods.

MODULE OBJECTIVES

By the end of this module the learner will be able to –

- Apply function concepts to solve authentic problems
- Interpret the solutions in the context of the problem.

LEARNING STRATEGIES

In this module the students will be provided with

- Khan academy videos
    - Modeling with linear functions
    - Interpreting graphs of functions
- Case based activity
- Discussion activity
- Adaptive scenario based D2L quiz

ASSESSMENT

Learners will be assessed using auto graded multiple choice quiz that will focus on the concepts of this module. The quiz will be adaptive in the sense that appropriate resources will be highlighted for the students to review based on their answers. The adaptive feedback will give the learner an opportunity to assess their own learning progress.

FEEDBACK

Immediate quiz feedback will be provided along with either OER text links and video resources the students might refer to before re-attempting an assessment.

Student will be required to complete a reflection prompt based on the case-based activity. They will receive instructor feedback for their reflection as well as be required to review and provide feedback on two other student's reflection.

RESOURCES AND MATERIALS

The key resources that will support the learning in this module are

- YouTube/khan academy videos
- Desmos activity
- Supplementary YouTube videos will be provided.
- Instructor wrap up notes.

PART 3: ENGAGEMENT AND INTERACTION STRATEGIES

LEARNER ENGAGEMENT AND MOTIVATION

Across all three modules, learner engagement is designed to go beyond passive clicking through.

- **Real world relevance:** Each module will begin with relatable contexts, such as mobile phone plans, graphs of real data or cost and motion problems that helps students see mathematics as practical and connected to their lives and or career goals.
- **Interactive experience:** Desmos activities allow learners to play with functions, sketching and applying in dynamic ways. These interactive tools let students test their learnings in real time.
- **Adaptive quizzes:** D2L quizzes will provide immediate and resource linked feedback so students are motivated to learn from their mistakes rather than simply earn points. This adaptive approach will foster a growth mindset.
- **Reflection prompt:** Learners will share specific reflections to prompts related to their desmos activity or case-based activity, encouraging them to delve into the material more deeply.

These strategies will balance extrinsic motivators (points, quiz progression, badges) with intrinsic engagement (tasks and exploration activities)

PEER COLLABORATION AND INTERACTION

Peer collaboration and interaction is woven into each module meaningfully as below.

- **Reflection sharing:** In each module, students are required to review and respond to at least one or two peers' reflections through discussion posts. This prompts students to

collaborate and engage in discussions related to mathematical reasoning. The discussion posts are related to desmos activities or possibly case study applications.

- **Peer feedback:** Structured student feedback on the reflection prompts helps learners to articulate their thinking, compare and learn alternative views and approaches.

This structure will promote a sense of community in an asynchronous modality and encourage learners to value and learn from other perspectives.

INSTRUCTOR PRESENCE

The design of the modules ensures that learners feel guided and supported throughout the asynchronous experience with instructor presence in the following course domains -

- **Personalized feedback:** Each learner gets instructor comments on their reflection activities and progress, offering learners suggestion and recommendations for improvement.
- **Active facilitation :** Instructor monitors discussion related peer feedback and highlights connections among student posts.
- **Weekly announcement:** Instructor will summarize key takeaways from each module and provide a preview for the week ahead, highlighting the connectivity between course modules and consistent communication.
- **Automated support:** Using D2L's intelligent agents, the instructor will ensure that personalized reminders and encouragement is provided to learners to help them stay on track in a supportive tone.
- **Instructor voice in content:** Supplemental wrap up notes, introduction or walk through videos, and any other additional curated videos will feature the instructor's voice, reflecting the instructor's care and reinforce their presence indirectly.

These strategies will provide the learner, with both visible and indirect presence, strengthening learner's engagement and successful completion in an asynchronous setting.