MATH 143: Week 2 - Monday's In-Class Lesson
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Lesson Plan: "Recalling and Practicing Linear Equations"

Overview:
This is the third class period of the semester, and the first period in the lecture room that focuses entirely on the algebra itself (the very first day we did syllabus stuff, and the second day we were in the computer lab setting up Aleks accounts). Much of this will be review for the students from their previous class, and the main objective is to begin to build a strong foundation for linear equations via interactive practice, review, and analysis exercises. This foundation will be essential for the scaffolding process. We'll briefly start by recalling and using basic arithmetic to build expressions, and then we're going to attack linear equations hard with multiple interactive exercises that will offer different perspectives and applications. In each case, the connection between the symbolic representation and graphic representation will be emphasized. During the final phases of the period, the students will submit some of their work on paper for assessment on what they learned.

Important Note:
Although this is a dual class with both Math 108 and Math 143 students, this particular lesson plan focuses primarily on the Math 143 students (but much of the topics are the same). In this particular lesson, much of these topics are review for Math 143 and some new topics for Math 108.

Course Learning Outcomes (CLO):
Through in-class exercises and out-of-class exercises, successful students who pass this course will be able to:
1. **[CLO #1]** Apply and manipulate varied representations (i.e. symbolical, graphical, contextual, and tabular) of algebraic expressions, equations, inequalities, and functions to solve problems and puzzles in diverse contexts.
2. **[CLO #2]** Create algebraic functions with specific, important features such as: axis intercepts, degree, leading coefficient, asymptotes, rates of change, input and output, maximum and minimum, inverse, composition, domain and range.
3. **[CLO #3]** Analyze "real world" data with a regression analysis to estimate relationships among variables and make predictions. Such analyses will include scenario-based problems in disciplines such as business, science, engineering, and/or elementary education.
4. **[CLO #4]** Analyze a specific problem in a scenario and/or context in order to construct a written argument composed of complete English sentences, algebraic statements, and/or logical statements that reasons and explains:
    i.   Why a particular strategy, conclusion, and/or solution is appropriate.
    ii. How the various components or ideas are related, connected, and/or organized.

Lesson Learning Objectives (LLO):
1. **[LLO #1]** To identify operators, variables, coefficients/constants of an expression, and specifically additional key features of a linear equation (including slope and y-intercept). [In alignment with: CLO #1, CLO #2]
2. **[LLO #2]** To apply basic graphing techniques to a linear equation to obtain the graph. [In alignment with: CLO #1, CLO #2]
3. **[LLO #3]** To create a linear equation with a specific slope or y-intercept from scratch. [In alignment with: CLO #2]
4. **[LLO #4]** To analyze the difference between the symbolic representation and the graphic representation of a linear equation and give a 2-3 sentence written explanation. [In alignment with: CLO #4]
5. **[LLO #5]** To analyze "real world" data with a linear regression analysis in a given scenario (i.e. STEM and/or business). [In alignment with: CLO #3]

6. **[LLO #6]** To <u>analyze</u> a specific situation in their current or future career and explain in 2-3 written sentences when and why a linear regression analysis may be applicable and useful. [In alignment with: CLO #4]

Situational Factors:
- There are 20 students in Math 143 along with 18 students in Math 108, so it will be a full class in a lecture classroom (i.e. not a computer lab classroom) designed to fit at most 42 students. The Math 108 students will sit on one side of the room, and the Math 143 will sit on the other side of the room so they can work in groups and so the instructor can target one audience at a time with my mini-lectures, feedback, and assessments.
- The single whiteboard is relatively small for this class size, so the whiteboard material will need to be clean and organized for students to see it.
- The class is from 6pm to 7:15pm, so it is an evening class when many of us are tired and have been working all day. (Note: as always, motivation and interactive exercises will be important to keep people active and working.)
- A relatively large percentage of the class is nontraditional students (in contrast to my previous experience of morning and early afternoon classes).

Prior Knowledge:
- In order to be in this Math 143 class, all students have to pass the prerequisite Math 108 (or equivalent). This means that they've definitely worked with linear equations before (quite extensively), most of these exercises should be a review. This is the "base" of the scaffold and I'm really going to emphasize the importance of this topic and these points, and try to build a strong foundation for what will come in the future (quadratics, cubics, exponentials, etc.).
- Some students who have had the Math 108 (or equivalent) at another university or high school may not have done a regression analysis before.
- For out-of-class homework, students should have already completed their first 6 hours on ALEKS and will have had some limited exposure to the introductory topics, including some on linear equations.
- This is an evening class and there is a relatively large percentage of non-traditional students.
- During previous in-class lecture, we did multiple interactive learning exercises (including notecard introductions, think-pair-share and a group scavenger hunt for the syllabus). The students know that our lectures will be interactive, so they will now be expecting individual-based and team-based exercises. Many of the students have become acquainted with their neighbors and appeared to already be more comfortable with the general interactivity of situation (even after just the first day). They also appeared to be more comfortable with me as an instructor, and many were not afraid to ask questions and even make jokes about the class and the exercises.

Lesson Procedure:
1. **Introduction and Review: Building Numbers Expressions**
   - *Exercise Type*: Individual Interactive Lecture Activity
   - *Learning Objective Alignment*: LLO #1; CLO #1
   - *Estimated Time*: ~5 minutes
   - *Routine*: Instructor will:
     - Ask the students: What other numbers are there besides the counting numbers? What are they called? Students will write answers down on brainstorm paper.
     - Briefly introduce number systems (naturals, integers, rationals, reals). Students will try to come up with examples for each, and then given examples to them.
     - Discuss 4 major arithmetic operators. Explain that these can be used to combine numbers to build expressions and "new numbers".
     - Discuss variables and constants/coefficients. Given some expressions, have students distinguish between them on their brainstorm papers.
     - Mention that expressions can be combined together with arithmetic to build other expressions.
2. **Review: Graphing Linear Equations**
   - *Exercise Type*: Think-Pair-Share Interactive Activity and Assessment (Informal)
   - *Learning Objective Alignment*: LLO #1, LLO #2; CLO #1, CLO #2
   - *Estimated Time*: ~30 minutes

- ○ *Routine*: Students will:
    - ■ Be given multiple interactive exercises to think-pair-share on, including:
        - ● Graphing a line given its equation in standard form.
        - ● Finding the x-intercept and y-intercept of a line given an equation.
        - ● Graphing vertical and horizontal lines.
        - ● Finding the slope given two points on a line.
    - ■ Write strategies and solutions on their brainstorm papers as practice.
    - ■ Have the option to volunteer to write their answers on the whiteboard in front of the class for peer review and instructor feedback.
    - ■ Be briefly assessed by the instructor as he walks around the room and observes, and gives feedback on the whiteboard answers.

3. **"Build" Your Own Linear Equation**
    - ○ *Exercise Type*: Individual Interactive Activity, Assignment, and Assessment (Informal)
    - ○ *Learning Objective Alignment*: LLO #1, LLO #2, LLO #3, LLO #4; CLO #1, CLO #2, CLO #4
    - ○ *Estimated Time*: ~5 minutes
    - ○ *Routine*: Students will:
        - ■ Be prompted to create 2-3 of their own linear equations with specific key features (i.e. slope, x-intercept, and y-intercept) via using their previously gained knowledge.
        - ■ Attempt to connect their creations with symbolic and graphic representations, and explain the pros and cons of graphic vs. symbolic representations.
        - ■ Write their answers down on their brainstorm papers and submit them for assessment.

4. **"Real Life" Scenario and Linear Regression Analysis**
    - ○ *Exercise Type*: Team Interactive Activity, Assignment, and Assessment (Formal, Formative)
    - ○ *Learning Objective Alignment*: LLO #1, LLO #2, LLO #4, LLO #5; CLO #1, CLO #2, CLO #3, CLO #4
    - ○ *Estimated Time*: ~30 minutes
    - ○ *Routine*: Students will:
        - ■ Be given a handout with a "real life" problem scenario along with a corresponding data set.
        - ■ Analyze the scenario and the data, and plot points on paper and in their calculator for linear graphing and regression analysis.
        - ■ Identify key features of the associated linear equations and functions (such as y-intercept, x-intercept, and slope).
        - ■ Give a written explanation in at least 2-3 sentences of what the regression analysis is doing, why it is useful, and what results they found.
        - ■ Submit their work on the handout at the end of class for assessment.

5. **Lesson Self-Reflection**
    - ○ *Exercise Type*: Individual Interactive Activity, Assignment, and Assessment (Formal, Formative)
    - ○ *Learning Objective Alignment*: LLO #5, LLO #6; CLO #3, CLO #4
    - ○ *Estimated Time*: ~5 minutes
    - ○ *Routine*: Students will:
        - ■ Be prompted to:
            - ● Analyze a situation in their current or future career and explain in at least 2-3 written sentences when and why a linear regression analysis may be applicable.
            - ● Recapitulate and summarize the importance, challenges, and/or interests pertaining to the lesson's topics in at least 2-3 written sentences, and additionally write down any question or comments they may have.
        - ■ Submit their work at the end of class for assessment.

6. **Post-Lesson Conclusion**
    - ○ *Estimated Time*: ~1 minute
    - ○ *Routine*: Instructor will mention:
        - ■ The weekly homework due on Sunday at midnight (must achieve time goal and topic goal).
        - ■ The upcoming, short, in-class computerized quiz during Wednesday's class. The quiz is not graded, just a practice and assessment for a participation grade.
        - ■ The topics that may be covered in the next lesson (but can vary depending on the quiz grades and Aleks statistics) and how they're connected with today's lesson.