MATH 0010 - PROBLEM SOLVING

Catalog Description

Prerequisite: Completion of Intermediate Algebra or appropriate placement
Hours: 72 lecture
Description: Individual and small-group problem solving geared toward real life situations and nontraditional problems. Problem solving strategies include: draw a diagram, eliminate possibilities, make a systematic list, look for a pattern, guess and check, solve an easier related problem, subproblems, use manipulatives, work backward, act it out, unit analysis, use algebra, finite differences, and many others. Divergent thinking and technical communication skills of writing and oral presentation are enhanced. Designed to teach students to think more effectively and vastly increase their problem solving ability. (CSU)

Course Student Learning Outcomes

- CSLO #1: Apply divergent thinking to mathematical problems and solutions.
- CSLO #2: Design and implement solution strategies to mathematical problems.
- CSLO #3: Present logical, accurate, and detailed steps to communicate mathematical reasoning in the strategy and approach to solving problems.
- CSLO #4: Evaluate, improve, and correct the appropriateness and reasonableness of a solution to a problem.

Effective Term

Fall 2021

Course Type

Credit - Degree-applicable

Contact Hours

72

Outside of Class Hours

144

Total Student Learning Hours

216

Course Objectives

Using homework assignments, reports/projects, classroom discussions, weekly problem sets, exams and quizzes, the student will:
1. Solve problems at a post-intermediate algebra level from a variety of different mathematical subject areas, especially topics not usually covered in a traditional mathematics course;
2. Analyze given information and develop strategies for solving problems involving mathematical and logical reasoning;
3. Recognize and apply the concepts of mathematics as a problem-solving tool in other disciplines and contexts;
4. Utilize linear, quadratic, exponential, and logarithmic equations, systems of equations, and their graphs to analyze mathematical applications from various disciplines;
5. Solve problems involving probability;
6. By generating lists and investigating patterns, formulate rules for permutations, combinations, and the basic counting principle;
7. Develop linear, quadratic, cubic, and/or exponential functions that model real world data. Use the function to predict future behavior of the model;
8. Select and correctly apply appropriate strategies to solve a new problem, and evaluate the appropriateness and effectiveness of their strategies;
9. Evaluate the appropriateness and reasonableness of a solution;
10. Work cooperatively in groups to solve problems, choosing an appropriate strategy, formulating a solution and comparing and contrasting their solution with the solutions of their classmates;
11. Compose detailed explanations of the thought processes used to solve problems;
12. Prepare and demonstrate problem solutions to the whole class;
13. Appraise the validity of an oral presentation of the solution to a problem;
14. Read a math text and evaluate written solutions to problems critically and with understanding;
15. Practice metacognition;
16. Use appropriate mathematical vocabulary in discussing problems with group members, presenting solutions to the class, and writing solutions to problems;
17. Think divergently, designing and evaluating a variety of approaches while brainstorming possible solutions to new problems;
18. Upon receiving a problem that is unusual and different from any previous problem, students will compare and contrast the problem to problems solved previously, assess previous methods of solution and determine their validity in this case, choose an appropriate strategy for the new problem, and construct a solution;
19. Solve problems of increasingly greater difficulty;
20. Work toward alleviating the fear caused by problems with words, and experience success in solving difficult problems while developing greater confidence in problem solving ability;
21. Apply problem solving skills to life by relating problem solving skills to real-life issues.

General Education Information

- Approved College Associate Degree GE Applicability
  - AA/AS - Comm & Analyt Thinking
  - AA/AS - Mathematical Skills
- CSU GE Applicability (Recommended-requires CSU approval)
  - CSUGE - B4 Math/Quantitative Reasoning
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)

Articulation Information

- CSU Transferable

Methods of Evaluation

- Objective Examinations
  - Example: 1. Students will be graded on their weekly problem sets, which include a thorough written explanation of their work. Example: Dionne can run around a circular track in 120 seconds. Basha, running in the opposite direction as Dionne, meets Dionne every 48 seconds. Sandra, running in the same direction as

Basha, passes Basha every 240 seconds. How often does Sandra meet Dionne? 2. Students will complete a group final and be evaluated on their communication, presentation, and accuracy of their work. Example: 3. Students will take individual quizzes on one or two strategies per quiz. 4. Students will take a midterm where they have to set problems up using a predetermined strategy. Performance will be based on demonstrating mastery of each strategy.

Repeatable

No

Methods of Instruction

- Lecture/Discussion
- Distance Learning

Lecture:

1. Every week the students will learn a new problem solving strategy. They will learn the strategy by solving a series of problems in small groups, with the teacher roving between the groups offering assistance as needed. Occasionally the teacher will demonstrate the new strategy by doing one example on the board. Here is an example of the above from the chapter on finite differences:
2. Students will be given functions charts from functions that are either: linear, quadratic or cubic. With the instructors assistance, the students will work in small groups to determine which type of function is represented by the data, and then use the strategy of finite differences to determine the equation of the function. (Objective 4)
3. Working in small groups with the instructor's assistance, the students will analyze a set of five problems to determine the most effective strategy to solve each problem. They will work through the solutions to each problem in class in small groups and outside of class working on their own. They will write up detailed solutions to each problem which include the name of their strategy, all of their computations, and a written explanation of their thought process. The instructor will grade these write ups using a rubric which awards points for different parts of the solution process. These parts include: did the student understand the problem, did the student choose an appropriate strategy, did the student execute the strategy in an effective way, did the student get the right answer and state it clearly using appropriate units, and did the student explain the solution in a clear coherent complete manner? (Objectives 1 & 2)

Distance Learning

1. Every week the students will learn a new problem solving strategy. They will learn the strategy by solving a series of problems in small virtual groups, with the teacher moderating, offering assistance as needed. Occasionally the teacher will demonstrate the new strategy by doing one example. Here is an example of the above from the chapter on finite differences:
2. Students will be given functions charts from functions that are either: linear, quadratic or cubic. With the instructors assistance, the students will work in small virtual groups to determine which type of function is represented by the data, and then use the strategy of finite differences to determine the equation of the function. (Objective 4)
3. Working in small virtual groups with the instructor's assistance, the students will analyze a set of five problems to determine the most effective strategy to solve each problem. They will work through the solutions to each problem in small virtual groups and on their own. They will write up detailed solutions to each problem which include the name of their strategy, all of their computations, and a written explanation of their thought process. The instructor will grade these write ups using a rubric which awards points for different parts of the solution process. These parts include: did the student understand the problem, did the student choose an appropriate strategy, did the student execute the strategy in an effective way, did the student get the right answer and state it clearly using appropriate units, and did the student explain the solution in a clear coherent complete manner? (Objectives 1 & 2)

Typical Out of Class Assignments

Reading Assignments

1. Read a word problem and understand what is being asked. For example: A grocer was stacking oranges one day. She decided to stack them in a triangular pyramid. She put one orange in the top layer, three oranges in the second layer, six oranges in the third layer, and so on. Each layer except the top formed an equilateral triangle. How many oranges would it take to build such a pyramid 50 layers high? 2. Given the textbook problem, "In how many ways can you give change for 25 cents?" Students will describe and use the four different systematic lists presented in the textbook for this problem. They will then compare and contrast the advantages and disadvantages of each system. 3. Read a fellow classmate's explanation of a problem's solution and understand and critique it.

Writing, Problem Solving or Performance

1. Solve problems in small groups. 2. Present the solution to a problem on the board to the entire class. 3. Solve a word problem and write a thorough explanation of the solution process. The following are a small sample of problems solved in the class. These particular problems were selected for inclusion here mainly for brevity. Most of the problems solved in the class are much longer than these. The problems listed are a mixture of difficulties and strategies. 1. Find three numbers between 11 and 30 such that the squares of the three numbers contain all the digits 1 to 9 exactly once. 2. A group of students went to the pub after the football game on Saturday, and all ordered from the menu. The bill totaled $162. They decided to split the bill evenly, but then three people said they had no money. The rest of the people each had to chip in $2.70 extra to cover the tab. How many people were in the group? 3. You have 12 identical looking coins, one of which is counterfeit. The counterfeit coin is either heavier or lighter than the rest. The only scale available is a simple balance. Using the scale only three times, find the counterfeit coin. 4. The volunteer firefighters decided to teach fire safety techniques to the citizens. They set up a plan where the 8 firefighters would each teach two people. Then the teacher would retire, but each of the pupils would teach two people. Those people, in turn, would teach two others. The teaching lasted for one month. How many people would know the fire safety basics after 10 months? 5. There are nine points on a piece of paper. No three of the points are in the same straight line. How many different triangles can be formed by using three of the nine points as vertices? 6. What is the sum of all ten-digit numbers? 7. Dionne can run around a circular track in 120 seconds. Basha, running in the opposite direction as Dionne, meets Dionne every 48 seconds. Sandra, running in the same direction as Basha, passes Basha every 240 seconds. How often does Sandra meet Dionne? 8. A number is called a decreasing number if it has two or more digits and each digit is less than the digit to its left. For example: 73; 421; 964,310; and 52 are decreasing numbers but 3,421; 6,642; 89; and 963,861 are not. How many decreasing numbers are there? 9. At one family reunion, every niece was a cousin. Half of all

aunts were cousins. Half of all cousins were nieces. There were 50 aunts and 30 nieces. No aunt was a niece. How many cousins were neither nieces nor aunts. 10. The expression n! is read "n factorial" and means n(n-1)(n-2)(n-3)(n-4)...(3)(2)(1). Thus 6! means (6)(5)(4)(3)(2)(1) which equals 720. And 10! means (10)(9)(8)(7)(6)(5)(4)(3)(2)(1) = 3,628,800. Notice that 6! ends with one digit of zero and 10! ends with two digits of zero. How many digits of zero does 5000! end with? 11. A grocer was stacking oranges one day. She decided to stack them in a triangular pyramid. She put one orange in the top layer, three oranges in the second layer, six oranges in the third layer, and so on. Each layer except the top formed an equilateral triangle. How many oranges would it take to build such a pyramid 50 layers high?

Other (Term projects, research papers, portfolios, etc.)

Every week, after week 4, the students are required to complete a problem set of 5 problems requiring a mixture of strategies. Their assignment is to solve each of the problems, and then write up an explanation of their solution. Write-ups include their thought process, a written explanation of their work in paragraph form, the name of the strategy used to solve the problem, and a clearly stated answer, including any appropriate units. Each problem set requires 6-8 hours of work, and is approximately 3-5 pages long.

Required Materials

- Crossing the River with Dogs: Problem Solving for College Students
  - Author: Johnson, Herr, Kysh
  - Publisher: John Wiley and Sons
  - Publication Date: 2018
  - Text Edition: 3rd
  - Classic Textbook?: No
  - OER Link:
  - OER:

Other materials and-or supplies required of students that contribute to the cost of the course.