Millersville University, Winter 2020
Problem Solving Seminar: MATH 610
Varied: Face-to-Face: 5-8PM: 12/16; 12/18; 1/8; 1/13; 1/15

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NOTE – this class is officially not in session from Dec. 24-Jan. 2. Although you may want to continue to work on the material, posts, etc, there will be no requirement to do so. Likewise, the professor will not be looking for or at anything specifically during that time. Although available by email, response time may be delayed during this time.

Course Description:

This course is designed for teachers and non-teachers to develop problem-solving abilities in mathematics and the teaching of general problem-solving to secondary students. The course will include discussion of solutions to problems and the theories of problem solving.

***Because of the nature of the modality of this course, it is essential that you communicate with the professor and others in the class on a regular basis via D2L. Some structure will be set up initially, and you may want to request that the professor add to this with a new forum/topic.**

Course Objectives: Students will be able to

A. Describe current reform efforts in mathematics education related to problem solving as articulated in the Common Core Math Standards, NCTM Principles and Standards 2000, and in the Focal Points. This will include work that is particularly relevant to the CC Standards for Mathematical Practices:
    1. Make sense of problems and persevere in solving them;
    2. Reason abstractly and quantitatively;
    3. Construct viable arguments and critique the reasoning of others;
    4. Model with mathematics;
    5. Use appropriate tools strategically;
    6. Attend to precision;
    7. Look for and make use of structure; and
    8. Look for and express regularity in repeated reasoning.
B. Apply a wide range of problem solving techniques;
C. Communicate solutions clearly and effectively in multiple ways;
D. Recognize and describe the value of assessment in the learning process;
E. Utilize and teach a variety of problem solving strategies;
F. Build a plan for including more problem-solving instructional strategies into their own teaching, as applicable.
G. Expand current viewpoint of problem solving.

Evaluation Components:

1. **Method "journal"** (Objectives B, C, G) – 10%
   You will need to keep a journal/notebook/packet to record your analysis of the overall method(s) in light of the example(s) or problems, and/or reactions of specific problems on D2L in the Assignment Folder. Consider any submissions to be "in progress" – each submission may be a clearly marked accumulation of prior submissions or you may start a new journal entry each week.
   - Note that this does not require completing the problem; just analysis and reactions. You can group problems together to make more meaningful or organized.
   - Journals will be turned in weekly with specific assigned course topics:
     - Dec. 23, Jan. 3, 10, and 17
   - ***Example*** (extremely brief, yours will be much longer) – The first class we focused on three problem solving methods. I was familiar with all of them, but learned a great deal as well. For instance, "Drawing a Diagram" always seemed like a tool, rather than a method…is there a difference? When I worked on #4, I found that a diagram was essential because…while in #8 I was initially confused. I would not have originally wanted to use a diagram to solve it. After working on it, I can see that others may find this method helpful because…. <keep going along that vein>

2. **Problem Analysis** (Objectives A, B, C, D, E, F, G) – 20%
   You will select at least 'N' Problem Set B problems (not already assigned in HW) to complete and analyze – 1 from each of the covered chapters with a "Problem Set B" in that chapter of the text (as specified), AND utilizing at least 8 different Methods. Your solutions need to be complete and easy to follow. A pool of possible problems will be clearly identified. You may wish to 'work ahead' but it is suggested that you not actually turn anything in until after the specific chapter/method has been discussed in class or online.
   Your analysis should include each of the following, **as appropriate**:
   a. Description of your initial thoughts in solving the problem including any methods considered and abandoned;
   b. Complete solution of the problem including a clear designation and explanation of the problem solving technique being used;
   c. A description of any difficulties that you experienced in solving the problem;
   d. A description of potential uses of the strategy (NOT necessarily including the problem) with your own students, including whether or not you currently teach this strategy and how you might be able to include it to supplement your current teaching. (If applicable, past uses can be substituted for current uses, **if necessary, consider possible uses in a future classroom**);
   e. Extend the problem by connecting it beyond mathematics to another discipline (science, technology, computer science, etc.)
   f. Analysis of the problem itself; anything that you particularly like or dislike about the problem – be specific.
   g. Any "ah-ha" moments when you were solving the problem.
   - When completed, each problem analysis should be uploaded to D2L's Assignment Folder.
   - Every problem should be separately submitted – different folders will be in use.

3. **<u>Writing assignment/Discussion Thread</u>** (Objectives A, B, C, D, E, F, G) – 10%
   The text: Teaching Mathematics through Problem Solving (TMPS) will be used to explore our current use and ideas about problem solving in our teaching. With it, you will need to do the following:
   a. Read the book, there will be assigned days for pacing purposes. You will be randomly assigned a specific chapter to lead an online discussion. You will open your discussion board by briefly summarizing the reading – covering the main points. Then you will need to generate a discussion by doing one or more of the following:
      a. Ask questions that will invoke conversation/reaction.
      b. Provide a prompt to strongly support or contradict what was written in the chapter – feel free to play "devil's advocate" – no need to believe a viewpoint in order to stir people up.
      c. Repost questions from the author that would lead classmates to share their own experiences.
      d. Bring your unique "spin" on things into the conversation by connecting the reading to your own discipline (science, technology, computer science, etc.) in some way.
      e. It is also your job to keep the conversation going and 'wrap it up' after 1 week.
   b. You will then submit a reflection paper (folder provided) in response to the reading and what your classmates discussed. In some cases, face-to-face class discussion or work on specific chapters from the CtRwD text might be included. 1-2 pages, double-spaced is likely sufficient. This may certainly contain some of what you wrote in D2L, but please do not just copy/paste your initial discussion board post.
   c. Each "presenter" must make sure they handle/monitor any questions or points of inquiry on their chapter. In a sense, you are the chapter "expert."

4. **<u>Tests</u>** (Objectives B, C) – 20%
   There will be **<u>2 tests</u>** on which you will be given several "problems" to solve using the content of the course, and strategies of the text. These will be completed on your own, and submitted via D2L – a firm deadline will be given for each. Note – all tests will be completed based on your honor/pledge to work on it by yourself, and to not search the internet for a solution.

5. **<u>Quizzes</u>** (Objectives A, B, C, D, E, F) – 10%
   There will be **3 short quizzes**; each on 2-3 problem solving strategies (Face-to-face classes #2, 3, and 4) at the end of class. Problem Solving strategies for each quiz will be announced during the class prior to it.

6. **Attendance and Participation** (Objectives A, B, C, D, E, F, G) – 10%
    - Your attendance is required during our 5 class meetings. But class doesn't end there. You need to be a frequent and high-quality contributor for our online components. Due to the nature of the class format, your work/contributions are vital to your overall learning and that of your classmates. If an excused absence occurs (life sometimes gets in the way), please be prepared to make this up in a substantial way. Unexcused absences will likely have a significant impact on your course grade.
    - When we meet in person, you will present **frequently** on classwork and homework problems.
    - You will also be expected to lead the class in an appropriate problem at some point during our face-to-face classes. These problems will be selected by the professor, and you will be given advanced notice.
    - Note that all participating and presenting does not require that you have to be "correct" or use "the" right method. Your thinking and process are FAR more important than the answer. Simply showing an answer and not communicating and demonstrating your procedures will affect your grade. However, please note that foundational and frequent mathematics errors cannot be ignored.
    - Regular assignments will be given in order to supplement class work and online discussions and posts. Although not collected, it is expected that you will keep up with these assignments. Presentations in class will occur regularly and randomly; you are expected to be able to contribute.
    - Do not let yourself fall behind in the work; this term will FLY. It will be important for you to spend sufficient time working on your assignments. Ask questions, discuss the mathematics and participate actively in your learning! There will be a specific D2L Discussion Board for discussion of problems among your classmates. This is NOT for sharing solutions, but for sharing strategies, hints, or just dialoging about previous work.
    - This class will require group-work, discussion and REGULAR presentations and sharing. Please be ready each class to discuss assignments and readings.

7. **Student work analysis** (Objectives D, E, F) – 10%
   The hope is that this course encourages you to teach your students (current and future) using some of the strategies in this course. Given our limited time, please select from **one of the following options**. You will prepare a "report" with analyzed student work and describe your findings and/or conclusions. The actual problem(s), classes and types of students used are irrelevant to the study, but will be part of your report. If mathematics is not your primary interest, you are encouraged to find something discipline-specific (science, technology, etc) that either links to the mathematical problem solving techniques or reflects the same philosophies. Note – the results will be presented (see Assessment item #9).
    a. Optimally, if you have two classes of the same subject matter, teach the classes utilizing two different strategies and then compare/contrast your results from a common problem. This does not need to take substantial time from your class – brief usages are encouraged.
    b. Allow several students (they may be in different classes, grades, etc) to complete an item/problem (any from the text are fine). Additional options certainly exist – you just need something that a method can be identified to some degree from student work. Compare/contrast results using our class discussion/topics as a reference or framework.
    c. If you do not have a class (or an appropriate class) that you can use, Use data from a classmate's students as your sample set. You will then analyze them (with or without

input from your classmate). You must cite any external evidence that is provided to you from your classmate.

d. Define your own study that holds to the "spirit" of the assignment. Check with the professor prior to completing it.

8. **Interview Assignment** (Objectives D, E, F) – 10%
   Have at least one middle or high school student solve one of the specified problems with you present. This student does not need to be your own – a friend or family member also works. Encourage them to show any work and to discuss out loud how they are solving it. You may with to videotape your session to review later. You can give them a few minutes to plan ahead if you wish. You will then use the interview questions to probe further and report on your findings (see assessment #9). You will turn in the student's work and your interview summary at the time of the presentation. No specific format is required.

9. **Presentation** (as part of #7/8), 5-10 minutes.
   During the last class, you will share with the class your conclusions, observations, findings, etc. from both Assessments #7, and #8. This has no separate graded component, but in order to get full credit for #7/8, you must complete your presentation.

Final grades will be based strictly on a point system. The minimum percent (no rounding) to attain each letter grade will be as follows:
A (93%); A- (90%); B+ (87%); B (83%); B- (80%); C+ (77%); C (73%); C- (70%)

Required Materials:

- Herr and Johnson: Crossing the River with Dogs, Problem Solving Strategies for College Students, 2nd Edition, Key Curriculum Press, 2012, ISBN: ISBN 978-0-470-46473

- Suggested follow-up reading - Schoen and Charles: Teaching Mathematics through Problem Solving, Grades 6-12, NCTM, Reston VA 2003, ISBN: 0873535413
- Calculator: (graphing, TI-83/84 or equivalent)

Honesty: Academic integrity is expected and will be reinforced. Any cheating will result in a zero for the assignment.