START TO FINISH:
CLASSROOM ENGAGEMENT TECHNIQUES

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Knoxville, Tennessee

American Mathematical Association of Two-Year Colleges
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Our Goals

1. To inform instructors of at least six quick and easy engagement strategies for multiple levels of mathematics

2. To engage session participants in strategies introduced in the presentation

Summary of Techniques

Getting off to a good START

Stations

Snowball Activity

Hint, Hint!

Send-a-Problem

Heading to the FINISH line

Student Engagement Technique:
Getting off to a Good Start with Introductions and Your Syllabus

There are several strategies that can be used on the first day of class to introduce students both to each other and to you, and accomplish the objectives of the day, introducing how the class is to be run.

Introductions

1. Before class, write on the board, or use paper with the document camera, the questions you'd like the students to answer.
2. Greet each student as they come into the classroom and give each an index cards (each class can have a different color). Also, you could have students fold a sheet of notebook paper long ways and write their name and section on the outside.
3. Ask students to answer the questions on the card, or inside the folded paper.
4. Questions:
   a. Name?
   b. Major or area of study?
   c. One thing that might set you apart from others in the group? (ex. children, job, etc.)
5. Midway through the review of your syllabus, at the point where you talk about the importance of homework and how each student needs to find a "study buddy" in class, have students exchange cards or papers and introduce to the class the person whose card they receive.
6. Have students write "Introduced by "their name" and return the card to the original owner.
7. Continue with your discussion of the syllabus.

Variations:

1. Have a list of college clubs on hand or on display from the website, and ask students to choose their favorite one that they'd like to join to answer 4.c. This promotes involvement in the college.
2. A replacement question for 4.c. could be "What is one tip that you would give on how to succeed at Pellissippi State?"

Website-Style Syllabus

Students today read and process information in electronic form every day. The format news is presented on many websites is very visual with multiple small pieces of key information in different formats, fonts, colors, and arrangements. I used a word processor to construct a syllabus with key information such as instructor information, course description, grading scale, class format and expectations, course materials, attendance policies, tutoring information etc… I inserted textboxes, shapes, photos, graphics using multiples text fonts and formats to create the syllabus. Students were more interested in reading the syllabus and were more likely to remember key information in this format.

College Math News

Fall 2012

- Math 1030 – Introduction to College Mathematics -

Meet Your Instructor – Claire Suddeth

Welcome to MATH 1030. My name is Claire Suddeth and I will be your math instructor. I have been teaching math at Pellissippi State for over 10 years. I am married and have a little girl named Piper and a boy named Colin. I enjoy volleyball, soccer, gardening and scrapbooking.

Office Location: AL 209 Phone #: 539-7017
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Grading Scale: A = 93 – 100 B+ = 88 – 92 C+ = 78 – 82

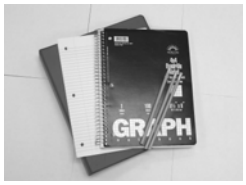
Pellissippi State

What is Intro to College Math?

This course includes the study of quadratics and rational functions and their graphs, exponents, polynomial expressions and factoring, quadratic equations, rational expressions and equations, radical expressions, and related applications. The TI-83 or T1-84 calculator is required and used throughout the course. This course is a prerequisite to MATH 1130, MATH 1710, and MATH 1730 for students with MATH ACT scores

Blitzer Introductory Algebra Custom 5th Edition

Supplies



Supplies

Student Engagement Technique:

Stations*

Description and Purpose:
This Student Engagement Technique (SET) offers an alternative to traditional lecture. It engages students by requiring them to move around the room and interact with learning materials in an active way as they examine, question, exchange ideas with peers, respond to prompts, and formulate their own thoughts and commentary.

Exhibits can be simple or elaborate. Displayed items depend on course content and instructional goals. Examples are written documents, visual documents, objects, media etc.. Learner interactions also vary and can include solving exhibit-posed problems, discussing responses to a prompt, using exhibit information to complete worksheets, or writing group or individual reflective essays.

Step-by-Step directions:

1. Select a topic that seems suitable for display and ask yourself what kinds of objects, images, documents, and other items could be included in an exhibit that would help students learn a deeper, more engaged level than could be achieved from a more traditional method of accessing information such as reading.
2. Plan for exhibit logistics (number, type, and location of stations; items needed at each station; how students will move among stations; how long they will have at each station; and so forth). Although it is possible to make a "progressive" exhibit (with each station building upon the learning acquired in the previous station), stand-alone stations are more practical because students can begin at different stations and start touring the exhibit at the same time.
3. Construct the exhibits and create and copy a group worksheet that gives directions and questions about each station in the exhibit.
4. Use class size, numbers of stations, exhibit layout, and complexity of interaction to decide on the size of the groups that will move through the exhibit together and whether multiple groups can be at the same station at the same time. Groups of 2-3 students are generally the most practical.
5. Divide the class into groups, explain the task, hand out the worksheet, and elicit questions.

*Barkley, Elizabeth F. (2010). Student Engagement Techniques: A Handbook for College Faculty (170-71). San Francisco, CA: Jossey-Bass

EXAMPLES:

Rational Expressions and Equations

I modified the stations activity for my MATH 1030 – Introduction to College Mathematics in several ways using Rational Expressions and Equations as my topic. My classes consisted of between 15 and 25 students. I prepared this activity by selecting one question from each of the following and put them on different color paper. I put multiplying rational expressions on yellow, dividing rational expressions on yellow, adding rational expressions on green, subtracting rational expressions on green, solving rational equations on blue, and an application using rational equations on blue. I also had an answer key only to all problems. During class, the most difficult part for students was arranging desks to make 6 groups with at least 4 desks per group. I told them all they needed was a pencil and a calculator and they could set backpacks at the side of the classroom. I then instructed students to sit at a group of desks and explained the activity. They were to complete the assigned problem at that particular station while discussing the main process in working the problem, then move to 2 more stations with different colors. Before they moved to a different station, they had to come up to me to make sure they had there answer correct. I initialed their paper if it was correct. If incorrect, they had to return to that same station until they completed the problem again. All students completed a minimum of 3 problems, 1 problem either multiplying or dividing rational expressions, 1 problem either adding or subtracting rational expressions, and 1 problem either solving rational equations or an application of a rational equation. Students who completed the minimum 3 problems were then told to complete the missing 3 problems while others worked. Some students completed all 6 problems and they were told to be a "tutor" at a station to help others complete the assignment. It is important to stress to students to help each other with "key" ideas while working problems at each station.

Confidence Intervals and Sample Size

Another Stations activity could be used in a Probability and Statistics course with the topic of Confidence Intervals and Sample Sizes. You could write several confidence interval problems for proportion and mean, and several sample size problems for proportion and mean. You can organize the amount of work students complete in several ways. For example you could make all confidence interval problems on blue paper and sample size problems on yellow paper and have students complete one of each color. Even though they may not get an example of each exact problem, the idea is to help students comprehend key idea difference between confidence interval calculations and sample size calculations.

Student Engagement Technique:
Snowball Activity*

Description and Purpose:
This Student Engagement Technique (SET) promotes physical movement and community. Students in this activity will work on a portion of a designated problem from a teacher constructed worksheet in what are called "rounds". Each student will work on a single portion of a multi-step problem then toss it another student to complete the next step of the same marked problem. Tosses continue until each round or step of the problem is completed.

Students soon realize that their work will affect the next persons work on the problem. This develops a sense of classroom involvement and unity, while promoting self-responsibility and awareness.

Step-by-Step directions:

1. Select a topic that can be broken into the same number of multiple steps.
2. Construct an activity worksheet with approximately 10 questions in the same topic, making sure they all require the same number of steps.
3. Give each step or round a specific name the students can recognize.
4. Finish constructing the activity worksheet by labeling each step or round in a designated work area.
5. Before class, make copies of the activity worksheet for every student and circle a different question on each worksheet. It is ok if some questions are circled more than one time.
6. While handing out the activity worksheet, instruct students to only write their names on the paper and NOT work any problems until prompted.
7. Instruct students to look at their circled question and focus on this question to answer only the area labeled "Round 1".
8. The instructor will wait until all students have completed "Round 1"
9. Now the FUN begins!!! Instruct students to then crinkle their paper into a "snowball" and wait until the count of 3 then throw somewhere else in the room. Count 1, 2, 3 and watch as student throw paper across the class!
10. Instruct students to pick up a "snowball" and notice a possible new circled problem and now complete "Round 2", write their name or initials and wait.
11. Students continue throwing their papers after each round and working problems until each round is completed.
12. When students are finished, they will need to return the paper to the original owner.

*Barkley, Elizabeth F. (2010). Student Engagement Techniques: A Handbook for College Faculty (145). San Francisco, CA: Jossey-Bass

EXAMPLES:

Factoring

I used the Snowball activity for my MATH 1030 – Introduction to College Mathematics with Factoring as my topic. Classes were between fifteen and twenty-five students. I prepared this activity by selecting ten factoring problems, each having the same number of steps, then labeled round one "Name Factoring Techniques", round two, "Factor out Greatest Common Factor," and round three was labeled "Factor again using technique mentioned," Round four was labeled "Check by FOIL
and Distributing." I decided to use boxes for each round to control student work areas. Before class, I circled one problem on all copied activity worksheets. During class I handed out the worksheets and gave instructions as noted in the general directions. I noticed some students felt unprepared, but I encouraged them to do the best they could. I intentionally did not tell them about the crinkling and throwing of the snowball worksheet until the time arrived. As an instructor, I enjoyed watching the students faces light up with excitement when I told them to crinkle up their paper and wait until the count of three to throw their paper. This activity really caught the attention of students who typically are difficult to engage. Students also worked on various problems during this activity noticing the key steps of factoring. After completing all rounds and returning papers to their original owners, they were asked to finish the remaining nine problems on the worksheet on a separate piece of paper to turn in for a grade. Students felt more confident doing the worksheet since they already had experience working on similar problems.

Hypothesis Testing

This Snowball activity could be used in a Probability and Statistics course with the topic of Hypothesis Testing. Several hypothesis test problems for a proportion, mean and standard deviation can be used and the steps named in your rounds. Round one could be writing your null and alternative hypothesis, round two, your rejection criteria, round three could be calculating the test statistic, round 4 could be your decision, and round five could be the concluding statement. The same directions can be used as with the Factoring example, but more class time will be needed.

Quadratic Equations

Another snowball activity could be used in a College Algebra course using the quadratic formula with the topic of Quadratic Equations. Round one could be set the problem to zero, round two, find the discriminant, round three could be describe the solution types, and round four might be solve using the quadratic formula and simplify. The names of the rounds could be changed and/or additional rounds used for decimal approximations, checking of answers etc…

Student Engagement Technique:
Hint, Hint!

One of the most challenging areas to teach well in the mathematics classroom is critical thinking. How we communicate and demonstrate to our students the thought path that we've taken in arriving at a solution is vital in the development of the essential processes of thinking critically, so that our students can replicate a similar path when challenged by new parameters. Here are a couple of the general techniques that I use beginning the second day of class.

Hint, Hint!

This technique can be used with any work that is graded in class.

- As part of my first day handout packet, I include a short pretest/review of skills that they should remember from previous classes as the first homework assignment.
- The second class meeting I have them exchange papers and we correct it in class with the final answer and a hint of how to solve the problem. (They have to exchange with someone who did not introduce them on the first day.) There is much discussion of what's the best hint to use and it also incorporates a review of the correct terms to use when describing a path to the solution.
- The grader returns the paper to its owner and that person then corrects it to turn in at the third class meeting for a daily grade or five points on the first test.

Test Corrections

Here's my variation on this, which is a part of every class that I teach.

- Inform the class of this opportunity <u>after returning</u> the first test of the course.
- For each problem where a student lost 3 or more points (-1 and -2 problems are just little errors), a student can make three part corrections to problems:
  1) an explanation of what went wrong,
  2) the problem worked correctly from the beginning,
  3) a statement to be aware of the error next time.
  Students must use complete sentences and accurately identify where the error occurred.
- With a good correction, a student earns back half (rounded down) the points lost on the problem. For example, if a student has a three-point loss, then he/she gets one point for the correction; for –a four or five-point loss, a student gets two points back.
- The advantages to awarding this type of extra points are:
  1) no student earns a grade above 100 points;
  2) the students with low scores who most need the review get another chance to learn the material;
  3) everyone's tests become a study guide for the final exam.

Student Engagement Technique:
Send – A – Problem*

Description and Purpose:

In "Send – a – Problem," groups of students each receive a problem, solve it, put their solutions into an envelope and then pass the envelope to a nearby group. Without looking at the previous group's solution, the next group works to solve the problem. After as many passes as seem useful, groups analyze, evaluate, and synthesize the responses to the problem they received in the final pass and report the best solution to the class.

"Send – a – Problem" involves two activity stages: solving problems and evaluating solutions. The purpose of the first stage is to provide student to practice together and learn from each other the thinking skills required for effective problem solving. The purpose of the second stage is to help students learn to compare and discriminate among multiple solutions.

Step-by-Step directions:

1. Determine the number of problems you will need in order to have all groups working simultaneously.
2. Decide how you will present the problem. Consider attaching each problem to the outside of a file folder or an envelope into which groups can then insert their solutions.
3. Think about the instructions you will give to the students regarding time limits and the order to pass the problem (such as clockwise). Form 4-6 groups, describe the activity, give instructions, and answer questions.
4. Distribute a different problem to each group, asking each group to discuss the problem, generate possible solutions, choose the best solutions and record and place their response in the folder or envelope.
5. Call "time", and instruct groups to pass to the next group; each group receives a new envelope and problem. Upon receiving new problems, students brainstorm responses and record results until time is called and they again pass the problem to a new group.
6. Repeat the process for as many times as seems useful and appropriate for the problem.
7. Students in the final round will review and evaluate the responses to the problem, adding any additional information if they wish, choosing the most accurate, neat, well organized, multiple represented solutions.
8. The activity concludes as teams report on the responses contained in the envelope or folder they evaluated. As groups report out, add any points that groups missed and reinforce correct processes and solutions.

*Barkley, Elizabeth F. (2010). Student Engagement Techniques: A Handbook for College Faculty (267-68). San Francisco, CA: Jossey-Bass

EXAMPLES:

Trigonometric Identities

I chose to do the Send – a – Problem activity with my Pre-Calculus course, MATH 1730, with the topic "Verifying Trigonometric Identities". For Stage 1, I used six trigonometric identity problems, putting each problem on a different color paper and attaching each to the outside of a manila envelope. With twenty-one students, six groups of three to four students were formed; students chose their own groups. I then gave a description of the activity and the instructions. Students had seven minutes to solve the problem as a group. As each group finished answering their question, each student signed the solutions sheet, the group solution was put into the envelope, and students waited for time to be called. The problem was then passed clockwise to a different group.

During Stage 1, students had the opportunity to work on four or five trigonometric identities. Stage 2 involved passing the envelope one last time; the last group to receive each problem evaluated the other groups' solutions and decided the most accurate, neat, well-organized, multiple represented solutions. Those solutions were presented to the class with comments on why that particular solution was chosen.

Exponential and Logarithmic Equations

Another Send-a-Problem activity could be used in a College Algebra or Precalculus course with the topic of exponential and logarithmic equations. Several exponential equations can be written on separate blue sheets of paper and several logarithmic equations on yellow paper; attach these to manila envelopes. Direct the class into groups of three to four students and give the description of the activity to the groups. As each group completes the activity, envelopes are to be exchanged with another group. Announce that each group will need to complete at least three problems. During the last fifteen minutes of class, each group evaluates for accuracy solutions to a problem they did not work. A representative of each group then goes to the board to write and explain their choice of the "best" solution submitted for the problem they evaluated.

Student Engagement Technique:
Heading to the FINISH Line

Assessment of a teaching strategy is on-going for most faculty members. Each instructor considers the success of something they have tried in the classroom and notes mentally or on paper whether they would consider it to have been successful or not. It is sometimes more difficult to get an impartial assessment from the students. We've developed a couple of ways to get at that for our faculty.

Semantic Differential:
One of the tools we have written at Pellissippi State to evaluate active learning strategies that instructors are using in their classrooms is an evaluation called a Semantic Differential. This technique of assessment is sometimes called a Likert Scale type of evaluation. Students are given a checklist of descriptive words that represent complete agreement or disagreement, and asked to check the level of their agreement with the words describing the activity they are considering. These are then compiled by the instructor and entered into an online form that totals each response behind the scenes for a cumulative look at the success of the activity. We will use them to evaluate the various activities in our classrooms and distribute the information to faculty who might want to try one of the strategies.

Review Ratings:
After the instructor has finished the in-class review questions for a test, have students rate each question.

- Mark a "1" next to the question if they feel confident they can answer the question correctly on a test.
- Mark a "2" next to the question if they could answer some of the questions correctly or may make a common error on this type of test question.
- Mark a "3"next to the question if they would struggle to answer the question correctly on a test.

This technique promotes a student's self – awareness of the studying effectiveness for a test. In other words, it should provide them a "reality check". Some students may mark all "1's", while others have mostly "3's". Stress to students to redo problems they have marked with "2's" and suggest they meet with you or see a tutor to help with the problems marked with "3's".

Quality Enhancement Plan (QEP) In-class Activity Survey

Pellissippi is striving to improve student learning through its Quality Enhancement Plan. We would like your opinion of the activity in which you participated so that we may further design, improve, and test these kinds of activities. We appreciate your responding to the following and offering any comments that you may have.

Instructions: Make your ratings by checking the appropriate space. For example,

engaging __✓_:__:___:___:___:___:___boring

engaging ___:___:___:___:___:___:___ boring

useless ___:___:___:___:___:___:___ beneficial

easy ___:___:___:___:___:___:___ difficult

dull ___:___:___:___:___:___:___ exciting

valuable ___:___:___:___:___:___:___ worthless

complex ___:___:___:___:___:___:___ simple

Comments:

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dull ___:___:___:___:___:___:___ exciting

valuable ___:___:___:___:___:___:___ worthless

complex ___:___:___:___:___:___:___ simple

Comments:

MATH 1030 Chapter 7

SNOWBALL FACTORING

NAME: _____

Listed below are ten questions.
Only complete one round at a time for the given circled problem.

1. $2x^3 - 2x^2 - 12x$
2. $12x^2y + 4xy - 8y$
3. $2x^2y - 18y$
4. $5x^3 - 40x^2 + 80x$
5. $3x^2 - 33x + 84$
6. $2x^2 + 4xy - 30y^2$
7. $10x^2 - 16xy + 6y^2$
8. $3x^2 - 432y^2$
9. $6x^2 - 3x + 12x - 6$
10. $7ac + 7ad + 7bc + 7bd$

ROUND 1: Strategies:

ROUND 2: GCF

ROUND 3: Factor again

ROUND 4: Check