

Final Project for SED 567: Curriculum Unit

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Unit Title: Green Algebra: A Problem-based Unit for Elementary Algebra

Course Overview

1. **Unit:** A problem-based learning overlay for MTH70-Elementary Algebra at Southwestern Oregon Community College.
2. **Educational situation:** MTH70 Elementary Algebra is a developmental mathematics course offered to students who do not have basic algebra knowledge and skills. It is an 11 week class intended for students who do not have significant mathematics knowledge and skills beyond basic arithmetic.
3. **Rationale for the unit:** The MTH70 students are underprepared students. Many are intimidated by mathematics, disinterested, or lack study skills. The majority are also relatively new to the college environment and its expectations. Currently, the success rate of students enrolling in this class is less than 40 percent. We have targeted our developmental mathematics courses in our Title III grant activities as a means to improve overall student retention and learning. Research indicates that students who require remediation when entering college have a much lesser chance of college success than those who can enter without remediation. In fact, 62 percent of well prepared high school graduates go on to earn a four-year college degree whereas only 3 percent of the underprepared high school graduate do the same (Tinto, 2002). Increasing student success in MTH70 will help students overcome the odds that are against them.

Traditional instruction and assessment currently prevails in the mathematics department of Southwestern. As my Title III initiative, I propose to employ performance assessments to benefit from the validity of the assessment, the value of authentic learning, and the enhanced learning though traditional assessment will still be used for assessment of foundation knowledge and skills. To do this, I will overlay the MTH70 content delivery

with a contextual focus relating to sustainable living – that is, “Green Algebra”. Additionally, the contextual focus will integrate a problem-based learning experience to develop an action plan to recommend sustainable initiatives here on campus. Research has indicated successful student retention in the community college setting generally hinges on constructing educational communities that promote student engagement (Chaves, 2003) and this project will allow students to contribute to the campus community in a constructive manner.

Contextual teaching and learning offers a constructivist model and supports the attainment of higher-order thinking skills. By connecting the subject area content to real world contexts, students begin to appreciate the applicability and value of the content. Bern states that with contextual teaching strategies students “are better prepared for postsecondary education, careers, and bright futures in the 21st century.” (Bern et al, 2001) Integrating higher level learning and critical thinking into remedial classes has proven successful in improving the performance of underprepared students and be retained longer (Boylan et al, 1999). Through this project, they will hopefully learn that they can work independently or as a team, to produce useful and worthwhile mathematically-based decisions and recommendations.

4. **Unit Organization:** On the first day of class, the college Vice President of Student Services will ask them, as student members of the college campus, to propose first steps for a student-driven initiative to encourage our campus community to “live green”. Students will adopt the role of a student consultant to the college administration. From that point, daily algebra lessons will introduce various aspects of climate change and sustainable living as well as related resources. A concept map of the PBL is included as [a PDF file](#).

Due to the remedial nature of this course, most students will not have developed effective problem solving strategies before taking this class. Therefore, during weeks 2 through 6 of the term, students will develop a portfolio of open-ended problem solutions. Self and peer evaluation will be a major aspect in the development of this portfolio to encourage students recognize and demonstrate quality problem solving and be familiar with expectations. The peer review process will also offer the opportunity for students to begin to develop working relationships with their team members.

Beginning in week 6, once introduced to open-ended problem strategies, Individual students will be asked to research and analyze feasibility of an action alternative they have selected to evaluate the cost and effectiveness. They will document their research as well as conduct their analysis. They will bring their independent findings to the team meeting

where the team will determine the “best” option that they want to refine and present to the college administration for consideration.

During week 10 of the class, students will present their recommendations through two modes: A brief presentation will be made to the college Vice President and members of the administration, accompanied by a written project action plan.

Through this overlay unit, students will conduct research, analysis, and critiques, work independently and as a member of a team, deliver a persuasive presentation, and produce a professional report.

See attached [Green Algebra Materials](#) for lesson plan materials.

5. **Goals:** This overlay unit focuses on three goals:
 - I. Engage students in the campus community
 - II. Facilitate the development of effective problem solving strategies in an authentic setting
 - III. Encourage self-directed learning

6. **Objectives:** This overlay project is intended to contribute to achieving the college-wide competencies as well as the MTH70 learning outcomes. Therefore, the project is designed so that upon completion of this project, the student will ...
 - a) Understand climate change issues such as global warming and the factors that can contribute to it.
 - b) Have an appreciation of the health impacts of climate change.
 - c) Conduct research, evaluate sources, and summarize findings.
 - d) Propose options, conduct feasibility analyses and make recommendations from the point of view of various stakeholders.
 - e) Develop effective problem-solving strategies.
 - f) Develop and deliver a team presentation with data and visuals.
 - g) Write a team action plan document.
 - h) Work effectively in teams to accomplish a common goal.
 - i) Become a self-directed learner.
 - j) Develop positive attitudes toward using mathematical and scientific knowledge to address environmental issues and problems.
 - k) Develop a positive attitude toward environmentally responsible citizenship.

Assessment plan for Green Algebra

1. **Pre-assessment of students:** Two pre-assessment strategies will be implemented in this course – one formal and one informal. The formal strategy will be employed to assure students have the necessary skills and background for the new topic while the informal strategy will be used to provide a baseline from which to judge student growth as a result of learning in the unit.

Students entering this course need prerequisite knowledge and skills in basic mathematics, arithmetic. Though students must have successfully completed a prerequisite MTH20 course or have scored at the prescribed level on the college placement exam, many students are not comfortable with the prerequisite skills and should strengthen those skills prior to this course to ensure success. As part of Title III, the mathematics department chair is currently developing a MTH70 pretest that will be used for all sections of MTH70, including this one. The formal pre-assessment test will include selected-response items covering the basic math concepts needed for this course plus questions that survey their dispositions. Workshops will be available to students to assist in strengthening their prerequisite weaknesses.

A less formal preassessment will be implemented to survey their incoming awareness of climate change and sustainable living and their problem-solving dispositions. On the first day of class, students will be asked to write a minute paper, well actually, three minute paper, to answer the following questions:

- Climate change – What is it and can you personally impact it?
- How do you use math to solve problems in your daily life?
- How many students take classes here on campus today?

This survey will set the baseline for the project. The final personal reflection at the end of the project will demonstrate the degree of growth from this baseline to the achievement of the project goals.

2. **Unit assessments:** A variety of assessments are included in this overlay unit, both formative and summative.
 - **The formative assessments:**
 - The formal pre-assessment* will evaluate readiness for the underlying MTH70 coursework and need for reinforcement. This assessment will be administered in the Math Lab to introduce students to the resources and assistance available.
 - The informal pre-assessment survey* minute paper will clarify the starting point for growth towards meeting the project goals of the overlay project.
 - Self and peer evaluations* of the open-ended problem solutions and alternative analysis will offer insight on the students' development in problem solving and identify areas that may need to be reinforced. At the

same time, the evaluations will be a learning experience for students in learning to recognize effective strategies.

The problem statement will allow me to evaluate their premise for investigation and enable coaching to refine and focus as needed.

An annotated bibliography will help students summarize and synthesize their research and to identify quality sources and identify need for coaching to refine and focus as needed.

The Writing Lab Review will introduce students to an available campus resource to assist with writing assignments as well as offer a constructive critique of the project proposal.

Team meeting minutes will keep me abreast of team progress and identify problems so that I can offer guidance and assistance as needed for each team to be effective.

○ **The summative assessments:**

Problem Solution Portfolios will give me the opportunity for me to evaluate their development of problem-solving strategies and their organizational skills.

The annotated bibliography will allow me to evaluate their research.

The presentation will allow evaluation of their content and related mathematic knowledge and skills, their ability to effectively communicate the same, and their ability to collaborate to produce a team product.

The written report, Green Action Plan, will also allow evaluation of their content and related mathematic knowledge and skills, their ability to effectively communicate the same, and their ability to collaborate to produce a team product. Included within the report, the **alternative analysis** will be assessed as their final demonstration of the mathematical problem solving strategy developed; the **Project Proposal** will delineate their problem analysis, and the **report document** will demonstrate the product of team collaboration to produce a professional quality product.

The reflection paper will be used to evaluate attainment of the project goals.

○ **Table of Assessments:**

Project Goal	Lesson Objective	Assessment	Form	Criteria	Evaluation Tools
II	Pre-requisites	Formal pre-assessment	Selected-response test	MTH20 basic math knowledge and skills	Formative: Introduction to math lab resources Summative: Results used for determining needed reinforcement

ALL	a, b, e, k	Informal pre-assessment survey	Modified minute paper	Identify incoming dispositions to project goals	Formative: Clarifies project goals baseline
	e, i	Self and peer evaluations	Evaluation rubric for problem solving strategies	Conformance to Problem Solving Template Guidelines	Formative: Constructive feedback to student plus development of self assessment skill
II	c, d, e	Problem Solution Portfolios	Student selected collection of open-ended problem solutions	Conformance to Problem Solving Template Guidelines and Portfolio Requirements	Formative: Identifies need for adaptation of Alternative Analysis guidance Summative: Rubric to determine conformance to requirements; subjective evaluation of growth
ALL	a, b, c, e	Problem statement	A brief outlining the task assigned to them	Identifies: - the administration's vision for the campus - the population involved - the scientific basis of the need	Formative – rubric to determine clarity of assigned problem task and students perception
III	a, b, c, k	Annotated bibliography	Summary of research conducted	Considers quality of sources, synthesis of content, applicability to project, and citation	Formative: Coach as needed Summative: Rubric to evaluate conformance to requirements
III	i	Writing Lab Review	Draft proposal reviewed by Writing Lab personnel	College level writing standards	Formative: Provides writing assistance plus introduces student to available resources
ALL	h	Team meeting minutes	Peer evaluation of team progress	Considers: - Individual contributions to product and assigned tasks - effectiveness as a	Formative: Results used for team coaching

				team member - perceived disposition to team activity	
ALL	ALL	Presentation	Brief presentation supported by detailed written action proposals	Considers: - communication of key issues - Summary of process - clarity of mathematical process explanations - summary of proposed action alternative - professionalism - persuasiveness	Summative: Rubric team project
ALL	ALL f, h, j, k	Written report	Action plan including summaries, alternatives proposal and accompanied analysis, and recommendations	Considers: - applicable facts and principles - mathematical analysis applied - assumptions made - impacts on involved population, including costs and conveniences - overall impacts - documentation - analysis - overall completeness - documentation -	Summative: Rubric used for final evaluation of team product and individual contributions
ALL	ALL g, h, j, k	Reflection paper	Brief paper presenting students' lessons learned	Aligned to Project Goals	Summative: used to evaluate project and student growth

3. **Plan for analyzing the quality of the assessments:** With the exception of the formal pre-assessment (for which item analysis will be conducted based on all sections of MTH70 fall term), this project will employ rubrics as evaluation tools. The assessment table above describes the uses and analysis of the formative assessments. The evaluation of their quality will be determined by the overall products produced and the final student reflection. Evaluation of summative assessment will be conducted using rubrics.

The reflection papers will be used to evaluate attainment of project goals. These evaluations, along with control comparisons, will reflect the impact the project had on student attitude and learning. The control comparison will be conducted using the final grades of students in Green MTH70 as compared to those in a conventional classroom environment to determine comparable student success rates.

The portfolio, annotated bibliography, presentation, and action plan all will be evaluated using rubrics designed to assess content, format, and synthesis. I have selected an analytical style rubric rather than a

holistic for the individual problem solutions and alternative analyses to enable the solution to be evaluated with multiple descriptive criteria for distinct aspects of the problem solving performance. Providing the rubric to students helps them better understand expectations and learn what differentiates high-level responses from low-level responses and offers constructive feedback, consistently. (Cooney et al) Results of the evaluation will be reviewed to identify areas of lower achievement that may indicate areas of improvement for instruction and/or project materials.

I selected a holistic rubric for the portfolio, presentation and action plan, scoring each as a single performance category (Caso et al, 2002) since each is a compilation of work individually evaluated. Review of these evaluations should reveal overall success in attaining the project goals as well as learning objective. The rubrics were designed to evaluate all aspects of the overall projects.

Grading Scale for Green Algebra.

Formative assignments and the portfolio constitute 50% of the project grade and the items contributing to the final project constitute the other 50%. This is a developmental course, and the development of the background problem solving strategies is equally as beneficial as the production of the authentic product. Therefore, I have balanced the grading between the two. The Green Algebra Unit will account for 20% of the total MTH70 grade.

Goals/Objectives	Assessment Sour	Points	Percentage of Unit Grade
various	Formative assignments	20	10
II: c, d, e	Problem Solution Portfolios	80	40
All: a, b, c, e	Problem statement	10	5
II, III: a, b, c, k	Annotated bibliography	10	5
ALL	Presentation	25	12.5
ALL	Written report	45	22.5
ALL	Reflection paper	10	5

Web Resources

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- 1) Climate Change
 - a) Brochure: http://dels.nas.edu/dels/rpt_briefs/climate_change_2008_final.pdf
 - b) Movie: Episode 12 – Earth’s Changing Climate and Looking Forward
<http://www.annenbergmedia.org/resources/series209.html>
 Online textbook and Interactive lab activities:
<http://www.learner.org/channel/courses/envsci/index.html>
 - c) NY Times Articles:

- i) The Green Issue:
<http://www.nytimes.com/indexes/2008/04/19/magazine/index.html?scp=1&sq=green%20issue&st=cse>
- d) CO2 Concentration General
 - i) Lesson: Algebra with functions
http://earthmath.kennesaw.edu/main_site/algebra_functions/awf_co2_conc.htm
 - ii) See Annenberg Carbon lab:
<http://www.annenbergmedia.org/channel/courses/envsci/interactives/carbon/>
 - iii) NY Times article: The Carbon Calculus <http://www.nytimes.com>
- e) US Energy Flows Project <http://www.enviromath.com/projects/Ch03Project.pdf>
- f) NY Times Article: Putting Energy Hogs in the Home on a Strict Low-Power Diet
- g) http://earthobservatory.nasa.gov/Library/GlobalWarmingUpdate/global_warming_update2.html
- h) Global Warming Art <http://www.globalwarmingart.com/>
- i) The Big Picture Facts
<http://www.metoffice.gov.uk/corporate/pressoffice/myths/bigpicture.pdf>
- 2) Fuel Economy
 - a) Lesson: Algebra with equations (fuel economy)
http://earthmath.kennesaw.edu/main_site/algebra_equations/fuel_economy.htm
 - b) Lesson: Algebra with functions (auto fuel economy and CO2 emissions)
http://earthmath.kennesaw.edu/main_site/algebra_functions/awf_emmissions.htm
 - c) NY Times: Travel Habits must Change
<http://www.nytimes.com/2006/12/30/business/30diet.html>
- 3) Bottled Water
 - a) Sierra Club Brochure:
http://www.sierraclub.org/committees/cac/water/bottled_water/bottled_water.pdf
 - b) Article: 5 reasons not to drink bottled water
<http://lighterfootstep.com/2008/05/five-reasons-not-to-drink-bottled-water/>
 - c) No Bottled Water Pledge
http://www.democracyinaction.org/dia/organizationsORG/fwwatch/petition.jsp?petition_KEY=569
- 4) Light bulbs
 - a) Project: http://www.enviromath.com/projects/Ch11Project_TI.pdf
 - b) Movie: Understanding Energy Efficient Light Bulbs
http://nytimes.feedroom.com/?fr_story=a3df3747120024fb18183b1f11fe4d538f91c299
 - c) NY Times articles: <http://www.nytimes.com/>
 - i) Making the Switch (or not)
 - ii) Must Flatter, Work Nights and Last Forever
 - iii) No Joke, Bulb Change is Challenging
 - iv) Wal-Mart Puts Some Muscle Behind Power-Sipping Bulbs
 - d) Article, strategy to switch <http://lighterfootstep.com/2008/05/how-to-live-with-cfls/>
- 5) Household Energy
 - a) Energy Star: <http://www.energystar.gov/>
 - b) NY Times Article: Putting Energy Hogs in the Home on a Strict Low-Power Diet
http://earthobservatory.nasa.gov/Library/GlobalWarmingUpdate/global_warming_update2.html
- 6) Miscellaneous Sites
 - a) <http://lighterfootstep.com/>
 - b) Environmental Responsibility Lesson
<http://www.yale.edu/ynhti/curriculum/units/1993/5/93.05.09.x.html>
 - c) NY Times DOT EARTH Whose Climate is it, Anyway?: <http://www.nytimes.com/>
 - d) NY Times Energy Challenge: <http://www.nytimes.com/ref/science/earth/energy.html>
 - e) UBUYACAR
 - i) User Manual <http://www.mcli.dist.maricopa.edu/pbl/ubuytutor/index.html>

- f) Recycling computers lesson with movie http://www.thefutureschannel.com/dockets/hands-on_math/recycling_computers/

Works Cited

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