

Learning Outcome # 1

Action Research Project

- Adequate Preparation
- Appropriate Methods
- Significant Results
- Reflective Critique

LO # 1: Action Research Project

FLO #1: Develop real-life application based collaborative learning activities in College Algebra to improve student comprehension of exponential and logarithmic functions.

Essential Competencies Addressed:

1) Scholarship of Teaching and Learning

- Produce professional work (action research or traditional research) that meets the [Valencia Standards of Scholarship](#)
- Build upon the work of others (consult literature, peers, self, students)
- Be open to constructive critique (by both peers and students)

2) Learning-Centered Teaching Strategies

- Use collaborative/cooperative learning strategies
- Integrate concrete, real-life situations into learning strategies
- Invite student input (choice among assignment topics)

3) Outcomes-based Practice

- Construct measurable learning outcomes
- Help students understand their growth in Student Core Competencies (Think and Communicate) and program learning outcomes
- Design assessments that demonstrate student growth in the student core competencies (Think and Communicate) and program learning outcomes

Clear Goals:

A. Abstract

I have developed group projects involving real-life applications of exponential and logarithmic functions for College Algebra courses. The goal of the project is to determine whether including applications as group activities in College Algebra courses will improve student understanding of the material. The group projects consist of mortgage, bacterial growth and decay, hurricane (data of loss of electricity), and forensics (determining time of death). Groups are determined based on student indicated interests. The projects involve groups of students learning about their chosen application, solving a specific application problem via exponential or logarithmic functions, and presenting their findings in an interactive manner. Qualitative and quantitative analysis of the results of student survey and grades on the chapter test (exponential and logarithmic functions) compared to results from my previous semesters' College Algebra courses demonstrate that the use of group projects involving applications improves student understanding of material.

B. Research Question

Will the use of group projects consisting of applications of exponential and logarithmic functions improve student comprehension and retention of material?

Adequate Preparation:

A. Learning Outcome Statement: Develop real-life application-based collaborative learning activities in College Algebra to improve student comprehension of exponential and logarithmic functions.

B. Background from Multiple Perspectives:

1. Student Perspective: One of the most challenging concepts for students in College Algebra classes tends to be the chapter on exponential and logarithmic functions. These concepts occur for the first time in this course, and students find the new notation and numerous rules involving logarithms overwhelming and confusing. The test given on exponential and log functions tends to have one of the lowest averages in College Algebra classes; students appear to simply give up on the problems because they find the concepts too confusing. One of the

questions that I hear from students often is, “Where would we use exponentials and logarithms in real life?”

2. Colleague Perspective: Learning about applications of mathematics in other fields via collaborative group activities is a popular technique used in the Math Division at West Campus. Many of my colleagues actively employ application-based collaborative activities in their classes and report positive feedback from students. Scott Krise and Boris Nguyen developed honors courses in College Algebra specifically focusing on applications, and they reported that students find applications useful in learning mathematics. Last year I was working on the development of team-based College Algebra courses with my colleagues, and I decided to try small group collaborative activities in my College Algebra classes.

3. Expert Perspective: In order to prepare for this action research project, I decided to consult several resources on active and collaborative learning. The following resources that have been particularly helpful

Siberman, Mel, *Active Learning: 101 Strategies*, MA: Allyn & Bacon, 1996

Bean, John C., *Engaging Ideas: The Professor’s Guide to Integrating Writing, Critical Thinking, and Active Learning in the Classroom*, CA: Jossey-Bass, 2001

Michaelsen, L., Knight, A., Fink, D., *Team-Based Learning: A Transformative Use of Small Groups in College Teaching*, NY: Stylus, 2004

Some of the collaborative activities that piqued my interest in the readings were on peer teaching, such as group-to-group exchange and peer lessons where the students study a topic of their choice, then present it to their peers. I decided to incorporate peer presentations of applications of exponential and log functions into my College Algebra classes.

The seminars that I attended that helped me learn more about active learning and collaborative activities were

Understanding Learning-centered Teaching Strategies, Facilitated by Dr. Susan Ledlow

Understanding Scholarship of Teaching & Learning, Facilitated by Dr. Lisa Armour

Understanding Valencia’s Student Core Competencies: TVCA, Facilitated by Dr. Philip Bishop

4. Self-Perspective: The concepts of exponential and log functions have widespread applications in finance, sciences and statistics. I would like to expose students to the wide range of such applications, so they can relate the concepts of such functions and equations to their lives, which, if relevant, can aid the comprehension and retention of material. Also, I believe that working in small groups on the problem of students' choice can help them "decode" the information about their problem and find the applicable solution, which can further their learning of the material. Furthermore, presenting the solution to their peers in an active learning manner is very beneficial to increasing the understanding of concepts of exponential and log functions.

From expert perspective and my student, colleague and personal observations, I noted that collaborative activities help to facilitate learning in a more active manner. Through many resources I also discovered that active learning and relevance of material to students from use of applications help to promote mastery of material. Through this action research project, I intended to find if collaborative projects used in my classes, which involve students' choice of application, peer review, collaborative solutions to posed problem(s), and group presentations, will increase students' understanding of material.

Appropriate Methods:

A. Methods and Assessment Plan

1. Student Learning Outcomes

1. Student will solve equations involving exponential and log functions.
2. Student will apply knowledge of exponential and log functions to applications.

2. Performance Indicators of Student Learning Outcomes

For SLO 1: Student will solve equations involving exponential and log functions.

- i. Student will apply properties of exponential and log functions in solving exponential and log equations.
- ii. Student will solve the equation by simplifying the expression via algebraic steps and appropriate properties of exponential and log functions.

For SLO 2: Student will apply knowledge of exponential and log functions to applications.

- i. Student will apply the appropriate application model to set-up the initial equation (exponential growth/decay model, Newton's Cooling Law, etc.).
- ii. Student will employ the applicable facts and formulas when reaching the solution to the problem.
- iii. Student will complete the initial solution to problem.
- iv. Student will revise the initial solution, if applicable, to complete the final draft of solution.
- v. Student will communicate the results to peers.

3. Teaching Strategies of Student Learning Outcomes

Step 1: Present students with four applications of exponential functions in calculation of mortgage (finance), population growth/decay (biology), statistical data of loss of power in aftermath of the hurricane (statistics), and finding the time of death (forensics).

Step 2: Let the students pick an application of their choice and form the groups accordingly.

Step 3: Present preliminary information to the groups on the application of their choice, and have the groups answer questions based on the information.

[LO 1 Artifact 1A: Example of Mortgage handout](#)

[LO 1 Artifact 1B: Example of Population Growth handout](#)

[LO 1 Artifact 1C: Example of Hurricane handout](#)

[LO 1 Artifact 1D: Example of Forensics handout](#)

Step 4: Give students a homework problem (a problem that involves solving an exponential equation), so they can attempt the problem individually.

[LO 1 Artifact 2A: Example of Mortgage problem](#)

[LO 1 Artifact 2B: Example of Population Decay problem](#)

[LO 1 Artifact 2C: Example of Hurricane problem](#)

[LO 1 Artifact 2D: Example of Forensics \(time of death\) problem](#)

Step 5: Distribute checkpoints for each problem along with the rubric used to grade the problem. Have students fill-in parts of Checkpoints handouts. Have students compare the results within the group and come to a consensus on the appropriate final solution.

[LO 1 Artifact 3A: Mortgage problem checkpoints](#)

[LO 1 Artifact 3B: Population Decay problem checkpoints](#)

[LO 1 Artifact 3C: Hurricane problem checkpoints](#)

[LO 1 Artifact 3D: Forensics problem checkpoints](#)

[LO 1 Artifact 3E: Rubric used to grade application problems](#)

Step 6: Have groups present their group solution to the class via an active learning exercise such as use of visual aids, analogies, simulations, question/answer activities.

[LO 1 Artifact 4: Presentation Rubric \(checkpoints\)](#)

Step 7: Have each group evaluate each member based on effort and performance

[LO 1 Artifact 5: Team member evaluation](#)

Step 8: Administer student feedback survey.

[LO 1 Artifact 6A: Student feedback survey](#)

[LO 1 Artifact 6B: Student feedback survey results](#)

4. Assessment Strategies

1. Qualitative and quantitative assessment of results of student survey feedback
2. Qualitative and quantitative assessment of student results on Chapter 6 exam (applications part)

5. ARP Design

The project has no control group. The project was implemented in two College Algebra courses during Fall 2009 semester. It will be evaluated qualitatively and quantitatively by looking at student feedback data and by looking at the results of the appropriate chapter tests (Fall 2009) and comparing them with the test results from previous semesters (Fall 2008).

6. Results

I used the results of the Student Survey to gain a quantitative and qualitative measure of this LO. 22 students participated in the survey.

Survey question 1: Did use of projects and presentation help you learn the material in Ch 6 (exponential and log functions) better?

strongly disagree	disagree	neutral	agree	strongly agree	N/A
1	2	3	4	5	

Comments:

Average score: 4.13

The response from the students was overwhelmingly positive from both sections. Most students indicated that the group projects were very helpful because they provided extra

practice for solving problems, seeing application of material, and working with each other and learning from each others' mistakes. One student indicated that the projects were helpful, but there should have been more review of earlier sections. Another student indicated that it would have been more helpful if I went over the material necessary for the projects before the group projects.

My response to above: I was impressed by positive results to this question. The practice of solving problems several times (including rough and final drafts of solution), and then presenting the problem to the class was indeed helpful to raise students' confidence in their ability to solve the problems. However, implementing this project was time-consuming and it took up 2 weeks for student group work and presentations, so I did not have a chance to review earlier chapter sections adequately. So, in the future implementations of this project, I am dedicating the last 15 minutes of class of the three presentation days to reviewing earlier sections. In response to one of the student's comments that I should have gone over the material before the group projects, I feel that it would defeat some of purpose of solving the problems in groups and collaborating on the solution instead of me presenting the solution to a similar problem ahead of time. There will always be students who would rather I go over the material on the board, but I feel that students are capable of solving the problems in groups with minor guidance from me.

Survey Question 2: Did making a presentation involving the problem in the project help you understand your problem better?

strongly disagree	disagree	neutral	agree	strongly agree	N/A
1	2	3	4	5	

Comments:

Average score: 4.04

All of the students agreed or strongly agreed in response to the question. Their comments stated that solving the problems multiple times and presenting them to class was indeed helpful.

My response to above:

During the course of this project my students realized that teaching the material to peers is really helpful in learning the material and requires understanding of the problem prior to presentation. It was interesting to see that the students realized that writing out the problems multiple times starting with a rough draft as a first attempt at solution where it is acceptable to be messy and trying things then proceeding to final draft, which is a clean step-by-step solution to problem. I hope to incorporate such a method (rough and final drafts of solutions) more often into my classes.

Survey Question 3: Were you satisfied with your group's performance?

very unsatisfied	unsatisfied	neutral	satisfied	very satisfied	N/A
1	2	3	4	5	

Comments:

Average score: 4.32

I was rather surprised that the answer to the question was rated very highly by students, but from reading the comments, some students indicated that there could have been more involvement or excitement from their group members, or one or more of their group members could have contributed more.

My response to above: I have limited control over how the group members perform. I do have each group assign individual member grades based on their participation and effort in the project. This provides students with a chance to let me know if some members are over or underperforming. Most of the grades on the team evaluation form had been high, and there were no reported complaints. However, I did have trouble with attendance in one of my sections. Individual attendance is important and I emphasized this to students. Last semester I determined groups according to student indicated interests. During my second implementation of this LO, I formed groups according to students' indicated interests and similar academic levels in the course, which resulted in better student contribution to their group project.

Student Survey 4: Were the directions for the project easy to understand?

The majority of students answered yes, that the directions to the project were clear and easy to understand. Some students indicated that while there was some initial confusion, I was able to clarify any misunderstandings. One of the students suggested my giving detailed, written guidelines prior to the project.

My response to above: I usually walk around the room while the students work on the project, so I am able to answer any questions from students as they arise. However, I really liked the suggestion of written guidelines of expectations and instructions given at the beginning of assignment. During my second implementation of the projects, I wrote out the schedule and grade breakdown of the projects ahead of time and also provided students with the applicable rubrics. I still walked around and answered questions, which were minimal. I find that most of confusion with students arises from having rough and final drafts to solutions, the process, which they are not used to. I may emphasize that portion of the project a bit more in the future.

Survey Question 5: Do you have a suggestion for improvement for project or presentation?

There were many different suggestions from students. A couple of students preferred more directions about the project. A few students recommended more practice. One suggested having a practice presentation in front of instructor. Some indicated that there should more involvement or enthusiasm from other group members. Another student suggested spending less time on the project. Another student suggested different problems for groups with the same application to present on to make it more interesting.

My response to above: Although it was interesting to read students' comments and responses to this question, aside from having more directions to the project I did not find many of student suggestions feasible. We do spend couple of weeks on the project, where one week consists of solving a few problems, including the one with the rough and final drafts, and one session is dedicated to preparation for presentation, so I think students have adequate practice time in class. At the same time, I can't spend less time on the project without eliminating one or more important components of the project. Aside from assigning individual as well as group grades, I have limited control over student enthusiasm or involvement in the project. I believe this is up to the groups to cultivate. And, the groups do have an option to present on a different problem

than the one they were assigned if they choose to do so; some groups did write their own problems and solutions to make their presentation unique.

Survey Question 6: Would you recommend using projects involving presentations in the future College Algebra courses?

Everyone who participated in the survey answered yes to this question. Some commented that they definitely recommend group projects because they are fun and exciting. Others implied that the projects are more hands-on activities that are helpful to learn and are beneficial for other courses as well, and that the projects add a more personal experience in the subject matter.

My response to above: I was very pleased to see such overwhelming support from the students about the group projects. Although they are time-consuming and take careful planning and preparation throughout the semester, I definitely intend to utilize such projects again in my College Algebra courses.

Comparison of Chapter test averages:

In addition to student survey results, I decided to test the effectiveness of group projects in students' comprehension and retention of the material by comparing test averages on the chapter test on exponential and logarithmic functions (Ch 6 Test) from both of my College Algebra courses during Fall 2009 to the average on the same exam in College Algebra course I taught during Fall 2008 semester since I taught College Algebra course without utilizing group projects in that chapter during Fall 2008.

Average score in College Algebra: Fall 2009 Ch 6 Test	Average score in College Algebra: Fall 2008 Ch 6 Test
Section I: 76.9%	Section I: 52.5%
Section II: 68.5%	

The averages in both sections of College Algebra during Fall 2009 semester were considerably higher than the average score in College Algebra in Fall 2008. The average score in the second section of College Algebra in Fall 2009 was lower than the average in the first section, which I

think may be due to the factor of many absences during presentations week when the applications had been discussed in detail. Overall, I notice that not only the averages on the test were higher in the sections where I implemented the project, which can be due to many compounding factors such as student backgrounds and motivation, time and days of class, etc., but I also recall that a clear majority of the students in College Algebra in Fall 2008 semester left the application questions on the exam blank and reported major misunderstanding of the material despite examples being done in class. This fact actually prompted me to think about group projects involving applications of the material. Whereas, almost everyone in both courses during the last semester attempted application problems, and more students than in Fall 2008 performed correct calculations on those questions. I was also able to observe student confidence rise over the course of group projects, so the students felt they were more prepared to tackle the chapter exam. I think that along with the review of earlier sections of the chapters, implementing group projects along with presentations are very beneficial for students.

7. Reflection

A. General Reflection

During the implementation of this action research project, I was impressed with student enthusiasm for group projects involving a presentation, which prompted me to repeat the implementation with some minor adjustments. I once again observed general excitement and enthusiasm of the students for the projects. I saw the level of enthusiasm rise even with students, who do not consider mathematics their strong point, and who are not as involved during lecture classes. I can see that utilizing applications of the material to the real world situations, giving students a choice among applications, and having them work in groups to gain a deeper understanding of the material and present the application in an interactive manner are definitely helping students engage in more active learning in my classes.

I plan to continue utilizing these group projects in my future College Algebra courses. Some of the improvements that I am currently utilizing and am planning to implement are

- 1) Write out clear guidelines, schedule and grade breakdown of the project and presentation.
- 2) Implement Myers-Briggs test or equivalent early in the semester to help me form groups more effectively.

3) Introduce smaller, less time-intensive group projects earlier in the semester to get students used to presenting in front of the class.

I think these changes will improve these projects even more in the future semesters.

B. Critical Evaluation of each Essential Competency addressed in this LO

Scholarship of Teaching and Learning (SOFTL) Reflection

In order to construct the appropriate applications for my projects, I consulted internet resources, where I was able to find the appropriate problems for mortgage, population growth/decay, and hurricane (loss of electricity) problems. During Year 1 meeting with my committee members, I took up the suggestion from Jody DeVoe, one of my panelists, to seek the application involving time of death in Forensics. During Summer 2009 semester, I posed a question in one of the online discussions regarding applications of exponential and logarithmic functions and finding appropriate resources in my online PreCalculus course. One of the students pointed out a resource of forensics application of Newton's Cooling Law in a humorous scenario, which I found perfect for the use in group projects in College Algebra. Also, I consulted the appropriate literature in designing this action research project. I have produced the work that meets Valencia Standards of Scholarship. I am also open to constructive feedback from students and colleagues on how to improve future implementations of this project.

Learning-Centered Teaching Strategies Reflection

I have learned and borrowed some ideas on learning-centered teaching strategies and effective group work from Susan's Ledlow's seminar on this competency and her website. I found a rubric for grading presentations and team member evaluation forms on Susan Ledlow's website and was able to adapt both to my action research. I also learned about the importance of assigning both individual and group grades throughout the project to ensure personal responsibility from students.

I have utilized real-world applications for the purposes of this project to ensure that the assignments are learning-centered. Since the students had to rank the applications according to their interests, a majority of students were able to focus on either the first or second choice of their application. I have students rank the applications (not simply choose one) in order to

ensure adequate participation in all areas (four applications) and to minimize students picking an application in hopes of working with their friends. I also give careful consideration to the construction of groups to encourage active participation from within each group. I currently do this by grouping students with similar academic levels.

In order to improve on future implementations, I would like to go over the rubrics used to grade the problem and presentation in addition to posting both in WebCT with the class during the group activities to ensure clarity and understanding of expectations. Also, I would like to develop more handouts on giving an effective presentation to students in addition to the rubric, so they learn to develop effective presentations for their future courses.

Outcomes-based Practice

In developing the Faculty Learning Outcome and the student learning outcomes for this project, I followed the design principles established in the Outcomes-based Practice seminar. I paid specific attention to establishing the collection methods that produced sufficient data to measure whether the learning outcomes were achieved.

During the course of this action research project, the students implemented Valencia Student Core Competencies (Think, Communicate, Value and Act). The application problems involved students in active construction of knowledge. Before the project, I gave a minimal introduction to students regarding the applications of exponential and logarithmic functions, then students would actively discover for themselves how to solve a problem involving the application of their choice (TVCA Indicators: **Think, Act**). The students had to communicate effectively the results first among their group members and myself, then later through presentation of their application (TVCA Indicator: **Communicate**). I also liked the idea of implementing first and final draft solutions, so students receive a better experience of solving real-world problems, where the process can be messy at first and quite involved, but through the process of working with the peers and myself, they can arrive at a complete and cleaned-up final version of the solution to the problem (TVCA Indicator: **Value**). In moving through these stages, students also recognize the incremental development in their thinking. During this problem, students not only realize the importance of practice with different problems, but they also learn how to make the solution to a single problem better, and that solutions can be a work in progress similar to other disciplines, instead of a single attempt at a solution to the problem.

In order to improve on students' ideas of first and final drafts of application problems and to emphasize building more effective group work and presentations, I would like to include smaller group projects in applications of linear and quadratic functions as well, so the students get more exposure to applications of mathematics and working effectively in groups.

7. Dissemination

I plan to present the results of this action research project to the members of my panel during my Year-2 meeting. I would also post this project in Action Research builder, so all interested faculty members will be able to view this project.