

# STEVEN CLONTZ

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## Teaching and Outreach Statement

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Learning should be fun. That wasn't always my experience as a student, but as an educator it's something I strive for in my classroom. My first teaching "job" was for a Boy Scout leadership training camp in Florence, AL, beginning when I was fifteen years old. All instructors at these camps are young men and women between the ages of fourteen and twenty, and the students range from thirteen to seventeen years old. During each week-long course, we'd train these youths to become leaders in their home scouting units through a sequence of lectures, challenges, and games.

I am proud of the holistic approach to leadership education our small group developed over the decade I was involved in the program. It wouldn't be for many years that I would learn jargon such as "active learning", "gamification", and "inquiry-based learning", but we essentially used variations on all these techniques to teach our students how to be teachers and leaders, both in scouting and in the rest of their lives. While mathematics education is distinct from leadership training in many ways, I've been thankful that I have had the opportunity to spend this large portion of my life developing my philosophy of education and putting it into practice.

### APPLICATIONS OF GAME AND PUZZLE DESIGN TO EDUCATION

I've always had an interest in games. I spent many hours in my younger years playing Nintendo and board games, and my parents inform me that my first answer to "What do you want to be when you grow up?" was "A game show host." The core of *The Price is Right* is mainly made up of rather boring trivia questions about blenders and laundry detergent intertwined with simple puzzles and games, but thanks to the Bob Barker and his production staff, the highlight of any sick day was on CBS between 10am and 11am. Of course, I eventually realized my true calling was in mathematics and teaching (and Drew Carey has quite a few years ahead of him on the show, I'm sure), but as a mathematics educator I use the same skills that are needed for good game and puzzle design.

A common pitfall that beginner puzzle designers encounter is the desire to show off their own cleverness by making purposely obfuscated codes or riddles with several dead ends. Alternately, the designer may neglect to take time to playtest the puzzle for mistakes and unintended difficulty. These same shortcomings are found in the assessment design (or lack thereof) in too many mathematics classrooms. When I create challenges for my students (e.g. homework, exams, projects), I avoid designing them simply for the purpose of adversity or grade differentiation. Instead, my assessments are designed to complement the lessons and skills established within the course for the purpose of providing students feedback on their own learning.

Any game designer can tell you that polishing individual game mechanics is not sufficient to create a great game. Similarly, it's not just assessments which require thoughtful design for a

successful classroom. After all, many students wouldn't take a large final project seriously if it's only worth 5% of their overall grade, regardless of its design. Designing the course syllabus is treated as an afterthought by too many instructors, when it's possibly the most important aspect of garnering engagement from students who are not self-motivated to take part in the class. I take care to balance my grading system for each course so that the class won't lose morale or focus from a fear of failing. At the same time I won't allow a course to be too easy, as even responsible students may then be tempted to ignore the material in order to concentrate on other classes or extracurriculars. Combined with assessments which are designed to promote learning rather than as a chore, each syllabus I write provides the structure for a class which students want to and can succeed in.

Returning to the *Price is Right* analogy, the Plinko minigame would not be as exciting to watch without the flashing lights and catchy music. Since your students won't take your course any more seriously than you do, a little production value can go a long way. I use many tools in my classroom to provide a professional and well-designed experience for my students. I typeset all printed documents in L<sup>A</sup>T<sub>E</sub>X and post them online in PDF format when appropriate. I enhance my classes by writing computer programs or using tools like Geogebra to create visual aids for understanding material, and I use Learning Management Systems like Canvas to keep my students plugged in to the class from wherever they can log in. In addition to showing my students that I'm willing to make an extra effort, I believe that using multimedia in this way brings mathematics to life much better than can be done with just chalk on a blackboard.

#### ACTIVE AND INQUIRY-BASED LEARNING

As they say, "Mathematics is not a spectator sport." Only a rare student would be inspired to pursue mathematics just because they listened to someone lecture about it. Rather, the beauty and fun of mathematics is trying to solve these puzzles on your own. As a high school student, I was grateful to be given freedom by my math teachers to ignore slow-paced lessons to work ahead or on my own mathematical puzzles. While I craved more engaging lessons at the high school level, I know now that it's impossible to reach students of all levels with a single lecture. Even worse, students who fall behind in mathematics find themselves bored and frustrated with lectures which assume knowledge they have yet to master. So, how can we broaden our reach within the mathematics classroom?

In the language of Bloom's taxonomy, one may characterize learning at six levels: from lowest to highest these are Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating. A shortcoming of passive lecturing is the inability to teach or assess higher order levels of learning: we are only requiring our students to Remember. However, students in all fields can benefit from real mathematical thinking, using math to Analyze the world around us, Evaluate situations, and Create mathematical models or even new mathematical knowledge. One solution to this problem is to shift the responsibility of learning to the students themselves by way of active learning. Such a shift allows us to have our classrooms better emulate the real world of industry and research, where our students will not always have an expert to rely on for all the answers.

I've had much success with inquiry-based active learning as both a student and instructor. The curriculum of an inquiry-based learning class is carefully organized into a "theorem sequence" of definitions, theorems, and questions, often given as a whole to the students on the first day of class. The instructor serves as a coach and moderator, while the students discover and present proofs and solutions to the theorems and questions asked of them. Since different proofs and solutions

will have different difficulties, this technique allows students of all abilities to stay active in the course and work on problems at their own skill level. This method is not limited to upper-level mathematics courses, and my calculus students have also expressed appreciation to have an active hand in the time we spend in class and to gain a deeper understanding of the material.

#### ONLINE MATHEMATICS EDUCATION

While face-to-face instruction is usually preferable, online instruction has a place as an economical solution for covering service courses where resources are otherwise insufficient. I have experience with the ALEKS learning management system for teaching hybrid online/lecture courses for the developmental mathematics curriculum at the community college level.

One advantage to such online systems is the automatic customization of course material to the ability of each student. In ALEKS, students are assessed at the beginning of the course and periodically afterwards so that each student is presented with course topics fitting his or her level of mastery. Thus students are allowed to move at their own pace, provided the course is completed by the end of the semester. As an instructor, I am able to use valuable class time to work one-on-one with individual students as needed, rather than give a lecture which may not fit the needs of every student.

#### MATHEMATICS OUTREACH

The work I've done to promote mathematics extends beyond the classroom. My gateway to mathematics outreach actually began outside the university as a part of Auburn, Alabama's puzzle competition community. Through organizing and participating in a series of puzzle hunts and alternate reality games, I developed many of the game mechanics that would go on to inspire the "Challenge" style of mathematical puzzle competitions.

The original such event was the A.M.P.'d (Auburn Mathematical Puzzle) Challenge, co-created by myself and a fellow AU graduate student with the support of the AU College of Science and Mathematics Office of Outreach. Breaking away from traditional ciphering and examination-based competitions, the A.M.P.'d Challenge focuses on inquiry-based active learning in a team setting. The problems we present are often pulled from the undergraduate curriculum, such as graph theory or number theory puzzles. Focusing on problems outside the typical middle school curriculum allows us to challenge the students on their mathematical problem-solving ability rather than their recollection of mathematical knowledge from their classrooms. In addition, the students are given the opportunity to expand their leadership ability, as they must delegate different puzzles to different players and put their heads together to overcome new problems. Due to its success, I was hired by Lamar University to bring this sort of experience to a high school audience in 2015, and I have since teamed with colleagues at multiple campuses across the country to create Mathematical Puzzle Programs and its inaugural MaPP High School Challenge in 2016.

Beyond being fun for both the participants and myself, these mathematical outreach programs have given me the opportunity to connect with my community and others. Too often I've found that the post-secondary mathematics classroom is divorced from the current experience of high school mathematics. Organizing such events gives me a unique perspective on secondary education, which better enables me as an educator of undergraduate mathematics students.