Improv Practices in Mathematics Active Teaching

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**ABSTRACT**

This article explores the parallels between improvisational theater, commonly known as improv, and active teaching. Specifically, it focuses on the impact of improv techniques on instructor and teaching assistant professional development. The implementation of an active teaching seminar is analyzed, where improv techniques were used in developing the teaching quality of teaching assistants in the mathematics department at the University of California, Santa Cruz.

**KEYWORDS**

Improv; mathematics; active teaching; active learning; professional development

1. INTRODUCTION

In this article, we describe a framework for a graduate student active teaching training utilizing techniques from improvisational theater. It is worth noting that we make a difference between *active learning* and *active teaching*.

Generally speaking, the term active learning means that the student becomes an active component of class [7, 31]. Specifically, it can be defined as “anything that involves students in doing things and thinking about the things they are doing” [2].

Traditionally, the term active teaching has been used in reference to active learning, often appearing as “active teaching and learning” [19, 31]. Many authors use it to describe methods and techniques to promote active learning on their students [7, 31]. However, it is possible for an instructor to play a passive role even in an active learning environment. By this we mean to follow a highly scripted lesson plan, leaving little room to reacting to student actions.

We believe that there must be a differentiation between the terms *active learning* and *active teaching*. In this article, we use the term active teaching in reference to the quality of responding to, and using the actions and reflections of students. This becomes a complement to active learning, providing a closed feedback loop in the learning process [7, 31, 33].

The active teacher must handle the unexpected, or improvise, under many situations [29, 33]. Sometimes the term *improvisation* has a negative connotation, denoting something of bad quality or a temporal fix without preparation [20]. However, improvisation in music, theater, and dance has become an art form in and
of itself. Despite not being previously scripted, improvisation requires extensive training and preparation [25, 29, 34].

Improvisation in the arts can be taught and mastered in a systematic way. Similar principles can be used to develop and promote active teaching [29, 33]. Several efforts in utilizing improv as a way to promote academic and non-academic skills inside the classroom have been explored in the literature [1, 3, 35]. In this article, we propose a complementary approach: using improv techniques to develop skills on the instructor. We aim to provide a framework for teaching assistant training and instructor professional development.

Section 2 introduces improvisation in the arts and focuses on theater improvisation, or improv for short. Then explores the connections between improv and active teaching. The article describes the so-called rules of improv, which are strategies developed to handle the unexpected. These ideas can also be applied in the context of active learning and active teaching. Section 3 describes the implementation of an active teaching seminar in the mathematics department at the University of California, Santa Cruz. This seminar sought to apply the rules of improv in an active teaching context. The seminar was held once a week during 8 weeks, primarily with teaching assistants and tutors from the mathematics department. The approach to this seminar was using improv games that explored the rules of improv together with guided discussions about their pedagogical implications. Section 4 discusses the findings of implementing the seminar. It analyzes the effect on the participants and their teaching. Finally, Section 5 presents conclusion and closing remarks.

2. IMPROV AND ACTIVE TEACHING

Improvisation appears in several art forms. The most common ones are music, dance, and theater. Music jams or improvised sessions are common in a more informal setting. Improvised dancing is very common in social events. Improvised theater, or improv, is very popular in comedy. Also, it is often used as a way to warm up for performances. Artists use improvisation to practice performing techniques, team-building, and other skills [25, 34].

Improvisation also has powerful educational value in the performing arts. It is used for stimulating creativity, developing flexibility, building teamwork skills, and improving self-awareness. The value of fostering these skills is not only restricted to the arts but extends to almost any field.

Conceptually, improv could be perceived as unexpected and not organized. However, guided or disciplined improvisation allows the performer to take advantage of the unforeseen. The apparent lack of prescribed structure at the performance level is compensated by a set of guidelines on a higher level of abstraction. These are often called rules of improv, which are strategies to let performers weave a unified and consequential story line despite not having a script [25, 34].

The parallels between teaching and artistic performance have been extensively explored [1, 13, 28, 30]. There are two main classifications within these parallels. The first is to think about teaching as a scripted play. The instructor designs their
course and lesson plans. As a scripted play, the instructor carefully thinks about the right definitions, examples, and activities to include in the lecture. The second way is to think about teaching as improvisation [13, 33]. This is a more flexible approach, where the instructor is more attentive to the particular needs and reactions of students [29].

Using improv as a metaphor for teaching offers a way to pursue a more creative teaching that aligns with the emotional state of students [3, 13, 18, 28, 30]. This becomes a very natural approach for addressing discussions and interactions in class [29]. It is often said that life is improvised. In the context of teaching, we face discussions at different levels. From Socratic seminars with a group of students to small interactions generated by students’ questions in the classroom. These interactions become very common when following a teaching approach using active learning, constructivism, or problem-based learning [28, 29, 33].

Active teaching requires the instructor to be receptive to the students’ emotional and intellectual state [7, 33]. By deviating from the script and reacting to students, the instructor can be more effective, taking advantage of the teaching moments that naturally arise within the student interactions [7, 33].

Improvised is often associated with comedy and often the comic parts of an improvised scene are not forced [25, 34]. Rather, these appear naturally as a consequence of the emotional and intellectual connection among the performers on stage. Similarly, we can say that learning cannot be forced, but promoted. Teaching moments naturally arise when there is a deeper emotional and intellectual connection between students and instructor. Then, the key role of the instructor is to promote, identify, and use these teaching moments in an active way [33]. The main idea is to complement active learning with active teaching in order to produce teaching moments.

2.1. Rules of Improv

The rules of improv are guidelines for giving meta-structure to improvised scenes [25, 34]. Performers use rules to approach the creative process in a more systematic way [29]. Improvisation is a very free and open art form. Hence, it does not need to satisfy rules [25, 34]. The usage of the word rule is somehow loose in this context. Perhaps a better expression would be improv techniques [25].

In the context of education, these rules are also referred to as disciplined improvisation [28, 30]. This means that instructors are controlling the flow of ideas while still leaving room for little deviations [29].

Five of the most common improv rules are: Yes-and, Active Listening, Embracing Failure, Being Present, and Teamwork [25, 34]. We describe these rules in the improv setting as well as their connection with active teaching. We also include case studies during real lectures throughout the author’s teaching career.

2.1.1. Yes, And

This implies acknowledging the other and being present. By yes-anding, performers are able to create a common reality and keep the flow in a scene. A tricky part of this
rule is to distinguish between yes-and and becoming a yes-person [25, 29]. To yes-
and means to acknowledge with the reality of others. It does not necessarily mean
to share a feeling, point of view, or goal [25, 34].

In the teaching setting, especially during a lesson, this rule becomes key [29]. Yes-
and ing generates many teaching moments that can otherwise be lost. Many times,
as instructors, we simply dismiss answers that seem out of place and simply provide
the correct answers to questions. This strategy fails to take advantage of a valuable
teaching moments. A student that replies with an apparent out of context answer is
telling the instructor that there is a misconception or misunderstanding that needs
to be addressed.

2.1.1.1. Case Study. During a Precalculus lecture, we were discussing about
domain of functions. I gave students the square root function and asked them to
give examples of possible domains for it. One student suggested that a possible
domain was “cosine.” I was tempted to dismiss this answer, but I went ahead and
yes-and ed their idea by following the student’s train of thought. First, I asked the
class if they agreed with the answer. Some students replied that this answer didn’t
work. I asked why and some said “because it is not a number.” Here, we were making
the connection that domains involve numbers. So I wrote on the board, cos(0), and
asked again if that would be a sufficient answer. Some students said that it was not
enough because “we needed a set of numbers.” Someone suggested to use intervals.
Then someone else suggested, cos(0), cos(1). Finally, I directed them to writing this
using interval notation and following the increasing order of endpoints, for example
[cos(1), cos(0)].

Even with a lesson plan prepared, it was not evident for the author to foresee
the situation in Case study 2.1.1.1. Many times, as instructors, we simply dismiss
answers that seem out of place and provide the correct answer to questions. This
strategy fails to take advantage of valuable teaching moments. The student that
replied with the apparent out of context answer is telling the instructor that there is
a misconception or misunderstanding that needs to be addressed.

2.1.2. Active Listening
Listening is more than just paying attention [26]. In improv, listening plays a funda-
mental role since there is no script and the players have no notion of what to expect
in a scene. Listening involves full and undivided attention [26]. By giving the other
performers full attention, improvisers are able to fully grasp their understanding of
a certain event, which in turns allows them to react and adjust accordingly [25, 34].

A similar phenomenon happens during a lesson. Communication can be under-
stood as occurring when the behavior of one person affects the behavior of others
[17]. As instructors, we seek to impact the behavior – learning – of our students.
This includes verbal and non-verbal communication. Active listening includes both
of these aspects [11, 29].
2.1.2.1. Case Study. In a lecture for an Integral Calculus course, we were working on an example involving the net change of the position of a particle with a given velocity. While setting up this example, I asked the students for ideas on how to solve the problem. One student said to “find the equation between the initial and final points.” This answer, taken out of context, might not reflect a good insight from the student. However, during the lesson, we had solved a couple of similar problems earlier where we *found the integral between the initial and final points*. Also, this student was secure with his tone, and accompanied it with a hand motion describing an initial point and a final point with reference to the area under a curve. In this case, the verbal plus the non-verbal cues, together with the lesson context, gave me a good indication that the student had the right idea but *said* the wrong answer. I addressed their idea and pointed out that a more accurate way to phrase it could be to “find the integral between the initial and final points.”

By purposely focusing on all the communication components we have more tools to better understand the mental and emotional context of the other person [10, 14]. By actively listening in Case study 2.1.2.1, the student could identify that his understanding was good, but his terminology still needed to be refined.

2.1.3. Embracing Failure

Being too afraid of mistakes and failure can dramatically affect a performer’s creativity [25, 34]. Mistakes are one of the best ways to produce comedy. A good amount of comedy is unintentional. The way to achieve comedic effect is by allowing for mistakes to happen [25, 34].

Similarly, in a classroom context, most teaching moments are unintentional. These often arise by mistakes. Mistakes are a sign that learning is occurring [12]. In particular in mathematics, mistakes are often regarded as a big failure. The common belief is that in mathematics *there is only one answer*, but instructors often forget to reinforce that there could be multiple ways to arrive at a particular answer. Not everyone thinks in the same way, and when a student pursues their own way of thinking, mistakes can happen. Making mistakes is also a sign that there is creative thinking involved [12, 18].

2.1.3.1. Case Study. In a lesson about the Net Change Theorem for my Integral Calculus course, I was working on an example about a tank being filled up with water. The tank had capacity 10 gal; it was already filled up to 2 gal, and there was a source pouring water into the tank at a rate of \( r(t) = e^{-t} \) gal/min. The question then was to find out how long we had to wait for the tank to fill up. Solving this problem requires solving the equation, \( \int_{0}^{T} r(t) \, dt = 10 - 2 = 8 \), which leads to, \( -e^{-T} \bigg|_{0}^{T} = 8 \), \( T = -\ln(-7) \). This leads to complex valued solutions! While solving this example, I realized that I had made a mistake in the definition of the rate function. It originally was \( r(t) = e^{t} \). I had made a typo when starting the example. When we reached the last line of the example, I noted that this result would not make physical sense. Immediately after, a student asked if that meant that the tank would never be filled up, and this led to a fruitful discussion. After this, I asked the
students what changes we could make to the rate function so we would actually be able to fill up the tank in finite time. Finally, I also noted that I had made a mistake in copying down the problem.

Even in scripted lessons, mistakes can happen. Embracing failure as an instructor can make students see mistakes as something normal in learning. Failure is a big stigma in our culture, but it is a fundamental part of learning. This can take away the burden from students to strive for perfection, which can hinder their learning experience.

2.1.4. Being Present
When on stage, the audience can better connect with performers that develop a story happening in the present time [25, 34]. Watching characters talk about the past or planning the future can lead the audience to become bored and disengaged from the show [25]. Both, performers and the audience are in the same physical location; therefore, to achieve a better connection, they also should be in the same mental and emotional place [25, 34].

Being present encompasses many aspects which translate into the classroom. In addition to being physically present, instructors need to be mentally present. Mindfulness [20] is “the practice of maintaining a nonjudgmental state of heightened or complete awareness of one’s thoughts, emotions, or experiences on a moment-to-moment basis.” Mindfulness has to do with the awareness of thoughts, emotions, and experiences on the present moment. This involves the awareness of the physical surroundings, as well as the other people present [19].

2.1.4.1. Case Study. At the beginning of a lecture of my Calculus for Science course, I noticed that students were more quiet than normal. Before starting class, I asked them how their other courses were going and if there was anything troubling their minds. Some of them expressed that they were stressed because in that particular week they had multiple midterms and major assignments in other courses. I then decided to give them 5 minutes to share in groups about what was stressing them out and how they were coping with that. After doing this, they became more talkative and their engagement with the class increased. I then proceeded to start lecture.

Situations like Case study 2.1.4.1 are not atypical for instructors. In certain situations, it is easy to drift away from class. This is the complete opposite of mindfulness in the classroom. Students are not immune to this lack of mindfulness either. Sometimes life has its own issues and as humans, it is difficult to put those issues aside and to completely focus on class. As instructors, we cannot fully prevent students’ minds from drifting, but we can be strategic about first being present ourselves and then promoting students being present as well.

2.1.5. Teamwork
A scene is the result of everyone’s work on stage. This entails two factors: the responsibility of supporting scene partners and the certainty that performers will look out
for each other. It is common to hear performers say to each other “I got you back” before going on stage [25, 34].

Something similar happens in the classroom. It is important to promote an atmosphere of teamwork [31]. The instructor should strive to have their students’ backs. This can help diminish the fear of failure some students can have. It is important for the instructor to convey the message that their role is to help students. Sometimes class might feel like a battle between two teams, students and instructors, instead of both being part of the same team.

2.1.5.1. Case Study. During office hours for my Vector Calculus class, a student told me that they felt that some of the concepts in class were not completely clear for them and that the homework had been very demanding. Nonetheless, they told me they didn’t feel bad about it since the environment in class made them feel safe and confident that later they would understand the material, even if at that moment certain concepts were not completely clear. This student had taken the prerequisite for this class with me the previous quarter and their prior experience with our class culture and their final performance helped them to feel confident regarding the approach to the current course.

With a spirit of teamwork, we can foster a better class climate. This can help to improve the sense of belonging of students and their own confidence in the learning process.

3. IMPROV SEMINAR

Instructors and teaching assistants are not often exposed to the skills necessary for active teaching. Our approach is to facilitate these skills for graduate student instructors, teaching assistants, and tutors through an Improv seminar. In this sense, improv can provide a professional development framework for instructors [33]. Using improv in developing instructional and academic skills is a common practice in other fields [5, 6, 8, 9, 15, 16, 27, 33].

Improv has been used in mathematics education as a way to promote active learning and student engagement inside the classroom. This usually involves playing games with the students in class to develop skills that complement the traditional academic experience [1, 3, 35]. Another use of improv in mathematics has been to use it as a professional development tool in order to develop skills needed to become a better mathematician [4, 32]. However, most of these approaches focus on using improv as a framework to work with the students during lecture. Our approach is different from the traditional use of improv in mathematics education. We focus on utilizing the improv framework in fostering teaching skills, rather than providing active learning strategies in the classroom.

3.1. Set UP

The Improv seminar was held every week for one hour and it was open to anyone interested in teaching. It ran as an independent seminar in the mathematics
department at the University of California, Santa Cruz. Attendance was not mandatory nor part of any other course. It was aimed at graduate students in the mathematics department that were interested in teaching, specially in becoming teaching assistants or graduate student instructors.

It consisted of independent sessions covering different improv/active teaching skills each week. The main goal was to cover the topics described in Section 2 and to provide a way to practice the corresponding skills as an instructor. It was led by the author of this article, who has experience in improv and currently serves as teaching faculty in the mathematics department.

During the sessions, participants discussed improv concepts and their connection to active teaching, and explored improv games that incorporated these ideas. The seminar was structured in an interactive way, where the session leader would introduce the concepts, facilitate discussion, and lead the improv games.

### 3.2. Participants

Participants mainly consistent of teaching assistants in the mathematics department. However, some graduate students from other departments, undergraduates, and tutors from other divisions attended the sessions. Most participants didn’t have any improv or theater experience prior to this seminar.

Attendance was fairly regular throughout the seminar despite participation and attendance not being mandatory. Usually there would be approximately 8–10 participants in each session.

Teaching assistants that participated in the seminar covered a range of courses including precalculus, calculus, and some upper division courses. They were under the supervision different faculty members.

### 3.3. Sessions

Sessions were composed of discussions centered around improv/active teaching skills and improv games. Games in improv involve the key elements of improv and usually focus on developing these as opposed to applying them in order to create a story [25, 34]. These are usually three or four-minute long games and are highly interactive [23].

The seminar consisted of a total of eight meetings during the Fall quarter of 2018. We focused on different skills during each meeting and explored games that incorporated them. The sessions were designed to be independent of each other. A distribution of the topics can be found in Table 1.

| Session 1  | Yes-and  | Session 5  | Association |
|------------|----------|------------|-------------|
| Session 2  | Being present | Session 6  | Being obvious |
| Session 3  | Teamwork | Session 7  | Listening   |
| Session 4  | Failure  | Session 8  | Details     |

*Table 1. Sessions for the active teaching seminar.*
Improv games are not standard and often vary from theater to theater. Each school might have different versions of a particular game. However, there are many repositories on the internet with game descriptions. The games used for the improv seminar were an adaptation from the games found in some internet repositories. The following are some of the repositories used for the seminar: [22–24].

We will describe some of the games used to promote the active teaching skills during the seminar and part of the discussion generated during the sessions. These descriptions come from the personal notes of the author of this article.

3.3.1. Session 1: Yes-And
Discussion during the session revolved around the idea that it is important to accept what students give and add to that. In this way, they are not rejected but rather, redirected. By doing this, learning is approached from a building-up perspective. The student can better internalize their learning since it originated from their own idea [21].

Games used: Yes-and, I'm a tree, Storytelling, Gift giving, Words of wisdom [22–24].

These games share the idea of agreement with previous information and building on top of it.

3.3.1.1. Example Game: Yes-And. This game consists on each player saying a statement one after the other. The main goal for the game is to take the previous players' ideas, agree with them, and add to them in order to create a coherent story.

In this game, the main idea is to listen what other players have said from a non-judgmental point of view. The game promotes building a shared reality incorporating the statements and points of view from all the players. Even when players say something that defies logic or is apparently wrong, the idea is to accept it and use it to enrich the story. By doing this, players focus on the story and not on judging the way the other players say things.

This is key in instructor–student interactions. By yes-landing students’ perspectives, we can recognize and accept their reality, which enables learning in a cooperative way. Interactions in the classroom can be more meaningful and engaging when pursuing this approach.

3.3.2. Session 2: Being Present
The main idea discussed in the session was that by being present, we are able to connect better with students. It is important to pay attention to what is currently happening in class and not focusing only on delivering the content [21].

Games used: Zombie name, Questions, Sound circle, Whoosh-bang-pow, Enemy-defender, Last word [22–24].

With these games, players need to be very attentive to their environment and to other players. Some of these games tend to be fast, so players must focus and be ready to react.
3.3.2.1. **Example Game: Last Word.** This game consists on each player saying a statement in sequence. The condition is that every player needs to start their statement with the last word of that the previous player used.

In this example, being present is practiced by paying attention to what is being said. Players need to listen to what the other players are saying, but cannot prepare beforehand what their responses could be. This is a common issue in improv, where players don’t pay attention to the present because they focus on preparing clever responses or elaborated stories in their minds. With this game, players need to wait until the previous player ends so they can formulate their response.

This is an important skill for instructors to develop. Many times we listen only to reply, but not to understand. When interacting with students, paying close attention to what is being said rather than how is being said becomes crucial for becoming an effective teacher. In this way, the instructor can separate the student’s understanding from the terminology used to described such understanding and address each of them accordingly.

3.3.3. **Session 3: Teamwork**

The notes discussed for this session where that the concept of team work is very important in the learning experience. Many times, the classroom environment is presented as competitive and highly individualistic. If we rather make this a group experience, it is then possible to learn from others and from their particular appreciation and experiences regarding the topic. Also, this takes away the heavy burden of competition and showing off, making it more free and more engaging [21].

Games used: Group mirror, The tribe, Mind meld, Count to 20, Da Do Da Do, The expert, Machine [22–24].

These games circle around the idea of collaboration and connection. The main focus is for the group to become a single unit, where the entire group works towards a common goal in a non-competitive way.

3.3.3.1. **Example Game: Count to 20.** The goal of this game is to count from 1 to 20 as a group. All players are in a circle and any player can say the next number out loud. When two players talk over each other, the count must be restarted. The game end when reaching 20.

The idea of this game is to behave as a group. The main feature of this game is that the goal is communal and not individual. It fosters cooperation and sense of unity. When the goal is reached, all of the players feel accomplished.

Often, this is left out from a classroom environment. It is common that students perceive them to be in a different -opposing- team than the instructor. Conveying the message that learning is a group effort and a collective accomplishment helps students gain trust in the instructor and the teaching methodology.

3.3.4. **Session 4: Failure**

The main idea discussed during this session was that failure is part of the learning process. Learning means to make the impossible, possible. We need to embrace failure
as something normal and natural while learning. It is fundamental to know how to use failure in order to find the weak concepts that students might have [21].

Games used: Naming things, Five things, Failure bow, 3–7, Word dissociation, Ah So Koh [22–24].

Due to the speed and complexity of these games, it is very easy to fail. This provides an opportunity to experience failure and to normalize it.

3.3.4.1. Example Game: Naming Things. In this game, players wander around the room. Initially, they point at things in the room and say the object’s name out loud. Next, players need to say the name of the last object they pointed at, while pointing at a new object. Then, players need to name the second to last object, and so on.

This is a very demanding game. It starts in a very simple way, however it becomes challenging very quickly. Since it requires to temporary store an increasing amount of information in the brain, it suddenly becomes harder. This makes players to constantly fail. However, the goal of the game is to accept such failures and to see them as something normal that everyone experiences.

In the classroom, normalizing failure is key to embrace learning. Providing guided and controlled failure exercises can help students use and recognize failure as a natural process of learning.

3.3.5. Session 5: Association

The notes for this session were that associating apparently unrelated concepts is key in directing students to a better understanding. Initially, students might have an erroneous idea about a concept that needs to be redirected. By building a bridge between their initial misconception to the actual notion is important so that the student is able to construct their own understanding and not only to adopt one that is given to them [21].

Games used: Math mashup, I’m a tree, Mind meld, Word association, Association chain, Translator [22–24].

These games involve the idea of active listening together with looking for relations between -apparently- unrelated notions.

3.3.5.1. Example Game: Math Mash-Up. Here the players are given a random mathematical field, a random theorem, and a random open problem. With this, they need to create a fictitious story that relates the three mathematical components.¹

This game focuses on making connections between different mathematical concepts. A good way to engage students is to take their inputs and to connect them to the concepts in class. However, sometimes these inputs can seem to be unrelated to the contents from class. The main goal for this game is for the players to purposely look for connections and build bridges from the student’s standpoint to the concepts planned for the class.

¹ Original game created by the author.
3.3.6. Session 6: Being Obvious
The main idea discussed was that being obvious and simple is very important when teaching new concepts. Many times we tend to jump right away to the complex cases or explanations, and this can lead us to be blind to the interpretation of students [21].

Games used: Family portrait, Ding, Mental flush, 3 lines, Barney, Gift giving [22–24].

These games use the idea of yes-anding, active listening, and being present. These games also rely on getting inspiration from obvious facts or situations that might happen while playing.

3.3.6.1. Example Game: Family Portrait. In this game, a set of players are given 10 s to create a pose resembling a family picture. The players are not allowed to discuss anything, just to adjust their pose based on one another. After the pose is being set, an extra player has to come up with an explanation for this family portrait incorporating all the poses from the players.

This game fosters paying attention to obvious details in a more intentional way. The player whose task is to explain the family portrait needs to look and identify all the relevant details that are present in the family portrait.

Likewise, the instructor needs to pay attention to the obvious details in class and content. Paying close attention to students is important in order to make connections relevant to them and to make use of the resources and situations that naturally arise in the classroom. Also, from the content point of view, being obvious means to not underestimate trivial or straightforward examples and applications of the topics. In this way, being obvious helps in clarifying concepts and strengthening connections with the real world.

3.3.7. Session 7: Listening
The notes for this session were that learning how to listen is fundamental when interacting with students. Listening to understand and not to reply is one of the most important things to keep in mind for improving as an instructor. More effective listening means to move away from preconceived ideas and from jumping into conclusions too quickly about what a student might mean or might have troubles with [21].

Games used: 3 lines, Last word, Last letter, Silent scenes, Interrogation, Make up a story, Small/big [22–24].

These games require the players to pay close attention to what is being said, either by another player or by themselves.

3.3.7.1. Example Game: Last Letter. In a circle, players sequentially say words. Each word must start with the last letter of the previous word.

In this game, players really need to pay attention to what the other players are saying. Since some words can have cumbersome spelling, this game forces players to practice active listening, where they don’t only hear what the other players are saying, but also need to analyze the words.
Active listening is key in the classroom. It is an important skill to analyze and meditate on what students say during class. In this way, the instructor can get feedback more effectively and adjust to the students’ needs.

### 3.3.8. Session 8: Details

The main idea discussed here was that finding and describing details is very important when catching students attention and motivation. One apparent irrelevant comment can be used as segue for driving the explanation of a complex topic. Also, when reading students work, sometimes the detective task is to decipher what they actually meant. Recognizing details is key to understanding their work better [21].

Games used: Small/big, Ding, Family portrait, Five things, Adjectives, What do you see?, Explain the math [22–24].

These games use the ideas of active listening and being present. They promote players to pay close attention to details. They also demand from players to actively look for as many details as possible.

#### 3.3.8.1. Example Game: Small/Big

For this game, a player tells a story and a moderator can say “small” or “big” at any moment. When the moderator says small, the player needs to go into more details of the specific part of the story. When the moderator says big, the player needs to give a big picture and not focus on details.

With this game focuses on developing the ability to adjust explanations to the listener. This is a very important skill when explaining concepts. By adjusting to the listener a speaker can improve audience engagement and be more effective in facilitating a concept. In the classroom, it is important to balance explanations to the needs of the audience. This can make lessons more effective and engaging.

### 4. FINDINGS

The use of improv skills embedded in instruction, such as the examples explored in Section 2, improved the engagement of students and made lessons more natural. In this sense, improv skills resulted as an effective tool for managing naturally occurring situations in the classroom.

Similarly, explicit improv games used during the seminar fostered a deeper engagement into instruction by the participants. In this case, the use of improv games improved the sense of belonging and community of the graduate student instructors. The games also supplied with practical examples of the active teaching techniques discussed. In this sense, improv become the perfect framework for experiencing the pedagogical concepts in active teaching.

The games helped participants become more open and interactive with their environment. They informally expressed how they were able to recognize the different skills covered in the seminar on their own interaction with students. They also became more relaxed in their interactions throughout the quarter. These games helped them to become more active and comfortable with uncertainty.

Participants were highly engaged during the seminar. In each session, they actively participated in discussions, expressing their ideas and perspectives with
respect to the topics treated. They were also very engaged during the improv games. At the beginning of the seminar, participants were a little shy, but they quickly became more engaged and comfortable with the games.

Their attendance was fairly consistent throughout 8 weeks that the seminar lasted. This was not mandatory nor part of any other class or requirement, however, there was a core group of eight to ten participants that regularly attended. This suggests that participants found the seminar to be valuable.

An unexpected result from the seminar was that it provided an opportunity for community-building among the graduate students in the mathematics department. Participants expressed the value of the seminar not only in improving their own teaching skills but also in providing an opportunity to bond with others in a non-competitive way. They communicated that the format enabled them to actively participate and practice the concepts exposed. They also felt that the environment was more open and welcoming than more traditional seminars in pedagogy and mathematics seminars in general.

Assessing the direct effects of the active teaching seminar on the participants’ teaching and student learning would require detailed data collection and a long-term analysis. Participants of this seminar spanned different courses, instructors, and sets of students. This provided a challenge on evaluating the short impact on student learning. However, informally, every week participants discussed the applications of the concepts considered and the situations in which they used the practices explored in the seminar.

5. CONCLUSION

Improv techniques can be used during instruction in order to promote and manage teaching moments. The situations explored in Section 2 demonstrate how typical classroom interactions can be framed using improv skills in order to foster engagement and connection with students. In this sense, improv cannot only be used for classroom activities, but it also provides a powerful framework for instructors to deal with the unexpected.

Even more when working within an active learning environment, active teaching becomes essential in order to manage spontaneous teaching moments that naturally arise. Therefore improv becomes a natural framework to foster active teaching skills that complement active learning.

Unexpected situations are to be expected in an active learning environment. Even the most experienced instructors will face unforeseen situations in their classroom. It is important to embrace these situations and to prepare for them. These unexpected circumstances will generally arise from student–student or student–instructor interactions, generating natural teaching moments. During these, students are highly connected with the learning environment, providing a good avenue for teaching.

Improv provides a structured approach in managing these unexpected moments. Despite not being scripted, improv supplies instructors with a higher level of abstraction for managing the unforeseen. Just as any other art form, improv requires
training and practice. Improv principles can be applied to the teaching context, in which the instructor can be trained to manage and to use these unexpected situations to generate teaching moments.

Active teaching skills can be developed through improv practice. It is possible to explore and practice active teaching skills by utilizing improv techniques as part of professional development. Improv games showed to be effective in proving a natural playground for active teaching skills. Professional development activities such as the active teaching seminar in the mathematics department at the University of California, Santa Cruz manifest the power of improv techniques in influencing active teaching, as well as community-building.

**Disclosure Statement**

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**BIOGRAFICAL SKETCH**

Pedro Morales-Almazan has been interested in mathematics outreach and education since participating in high school competitions. After receiving his Ph.D. in mathematical physics, he joined the Mathematics Department at The University of Texas at Austin, where he led the Math Teachers’ Circle. He moved to the University of California, Santa Cruz where he is a teaching professor in the Mathematics Department.