Building Growth Mindset Using Lessons From Sports in Out-of-School Settings

Sanlyn Buxner, Erin Turner, Ricardo Valerdi, Seneca B. Miller, & Christina Baze

In sports, youth are coached to see persistence and hard work as important paths to personal improvement and success. They come to understand through practice that mistakes are tools to help them improve and that collaboration and teamwork are keys to success in team sports (Kovács & Szakál, 2024; Rottensteiner et al., 2015). These ideas about the importance of effort, persistence, mistakes, and collaboration are important components of a growth mindset, the belief that ability is not fixed but can be improved through effort (Dweck & Yeager, 2020). People with a growth mindset view challenges and mistakes as opportunities to learn; they believe that success depends on effort and practice. Further, research shows that a growth mindset is associated with learner persistence and has positive effects on learning in school and beyond, including in sports (Biddle et al., 1996; Blackwell et al., 2007; Dweck 2006).

However, young people who have a growth mindset in sports may not extend it to subjects such as mathematics and science (Chan et al., 2022; Kyler &

SANLYN BUXNER, PhD, is a research professor of science education in the Department of Teaching, Learning, and Sociocultural Studies at the University of Arizona College of Education.

ERIN TURNER, PhD, is a professor in the Department of Teaching, Learning, and Sociocultural Studies at the University of Arizona College of Education.

RICARDO VALERDI, PhD, is a professor in the Department of Systems and Industrial Engineering at the University of Arizona College of Engineering.

SENECA B. MILLER is a PhD student in the Department of Teaching, Learning, and Sociocultural Studies at the University of Arizona College of Education.

CHRISTINA BAZE, PhD, is an assistant professor in the Department of STEM Education at Northern Arizona University.

Photo provided by the Growing Mathletes program of the University of Arizona

Moscicki, 2024). In this paper, we describe a strategy of combining growth mindset principles, mathematics concepts, and sports examples to support students in shifting their mindsets about their own abilities. We share outcomes from implementing these activities at five out-of-school settings.

A Strategy to Extend Growth Mindset in Sports to Mathematics

Through the Growing Mathletes program developed at the University of Arizona, we built on knowledge about young people's growth mindset in sports and the relevance of mathematics in sports to build a set of 19 lessons and two performance-based tasks that integrate growth mindset principles, mathematics concepts, and sports examples. Each lesson centers on sports-related topics and includes activities that integrate at least one core growth mindset principle and several key mathematics concepts. Based on literature about growth mindset and its connections to success in team sports, these principles are:

1. The value of collaboration (Cohen et al., 1999)
2. The power of effort and persistence (Diehl, 2017)
3. The value of mistakes in supporting learning (Ricci, 2021)
4. The malleability of the brain and the role of struggle in learning (Doidge, 2007)

The guides for implementing activities build on an additional educator-focused mindset principle of praising the process, not the person (Mueller & Dweck, 1998).

Growth mindset principles are introduced in multiple ways throughout the program, including inspirational quotes that open each lesson, videos that provide real-life examples, and activities that ask participants to reflect on how the principles apply in aspects of their lives. Activities integrate mathematics concepts related to specific features of sports, such as field layout, scoring practices, and game statistics, or how players and coaches make decisions, such as composing team rosters and comparing player statistics. Other general mathematics concepts include fractions, decimals, and percentages, as well as data representation and analysis.

In this article, we first describe the program context. Next, we offer lesson examples to highlight the five growth mindset principles. After a discussion of results from participant surveys and interviews, we close with implications for practice.

Program Context

We implemented activities at five out-of-school sites that serve children ages 8 to 13 from diverse backgrounds. All sites implemented at least eight hours of activities. Afterschool programs implemented activities for about an hour each day, with either one or four sessions per week, for eight sessions total. Summer programs implemented activities for several hours a day as part of weeklong camps. Afterschool sites had one facilitator, while summer programs had two. Table 1 on the next page shows a summary of participants at each site, with data about the racial and ethnic background of the communities served. In all cases, youth participants mirrored the demographics of the surrounding community.

Growth Mindset Principle 1: The Value of Collaboration

Teamwork is central to success in team sports. Growing Mathletes activities highlight core values of collaboration: that each person has unique strengths to contribute to a team and that many tasks require a variety of skills and abilities. Participants learn that no one person has every needed skill and ability but that, together, a team can draw on the strengths of each member to succeed.

Figure 1. Opening Quote and Reflection Questions for Baseball Positions Lesson

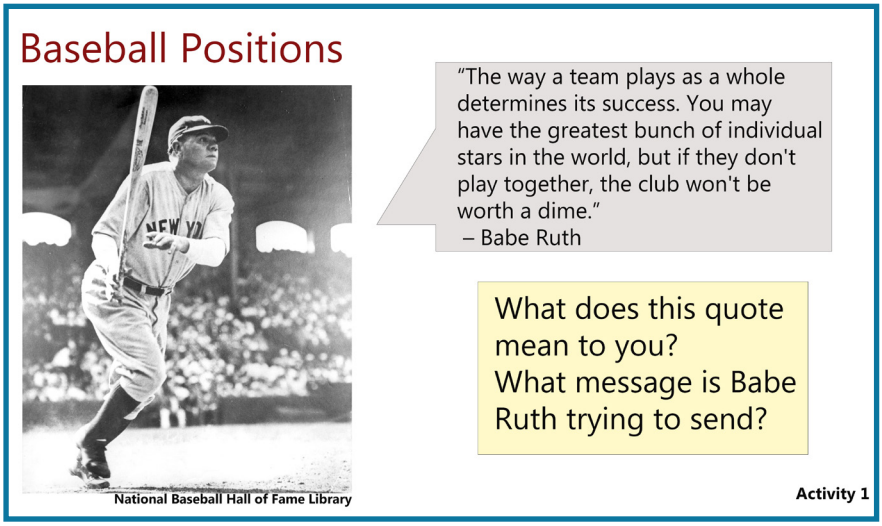


Table 1. Summary of Participants by Site

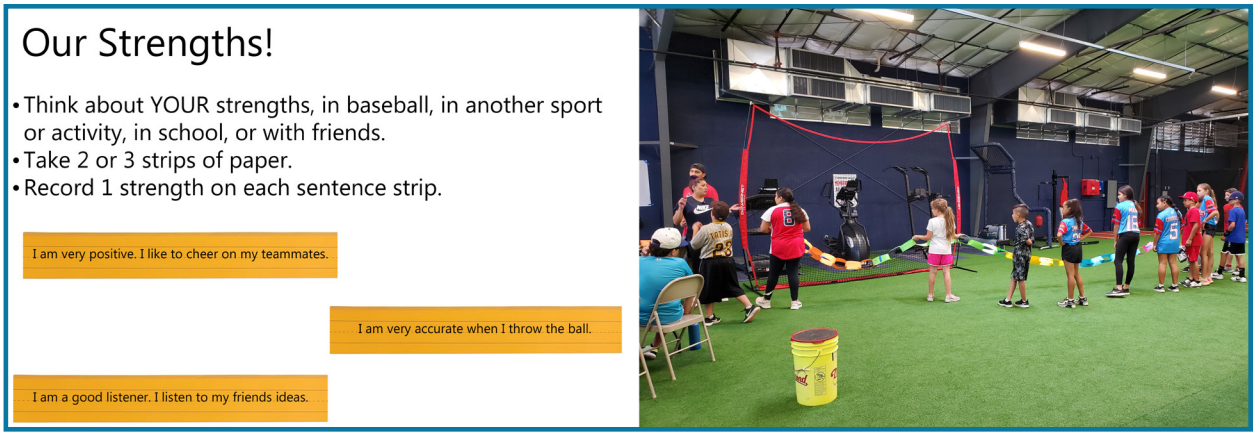
Site Type	Location	Racial Makeup of Community	Number of Participants, Ages, Gender
Afterschool	Southwestern U.S.	Black/African American 17% Latinx 45% White 24% Native American 3% Two or more races 7%	23 youth ages 8–13 10 girls, 10 boys, 3 did not report
Afterschool	Southwestern U.S.	Black/African American 21% Latinx 57% White 14% Native American 4% Two or more races 3%	22 youth ages 9–11 15 girls, 4 boys, 3 did not report
Summer	Southwestern U.S.	Black/African American 3% Latinx 31% White 55% Native American <1% Two or more races 6%	47 youth ages 8–13 18 girls, 27 boys, 2 did not report
Summer	Central U.S.	Black/African American 48% Latinx 43% White 5% Native American <1% Two or more races 2%	16 youth ages 8–13 3 girls, 12 boys, 1 did not report
Summer	Central U.S.	Black/African American 76% Latinx 7% White 11% Native American <1% Two or more races 6%	48 youth ages 8–13 14 girls, 33 boys, 1 did not report

For example, in the Baseball Positions lesson, participants reflect on the quote shown in Figure 1 and discuss how team collaboration applies in their lives at home, with friends, in afterschool activities, and in school. In the first activity, participants collaborate in small groups to calculate and compare the areas of a baseball field that each of nine players is responsible for covering. They reflect on the different skills players need to fulfill their roles and cover their areas of the field. They also consider how similar principles apply in other sports such as soccer.

In the next activity, participants watch videos that explain the roles that different baseball players have on the field and the strengths that each player brings to the team. They then reflect on their own strengths in sports, in school, or with friends and write these strengths on rectangular strips of paper. As a group, they form links with their rectangular strips and then connect the strips to form a "strengths chain." This chain helps participants visualize the importance of each member's strengths and contribution to the success of the entire group (see Figure 2, next page). Youth discuss how this principle applies in various settings. For example, when a group works together on mathematics tasks like calculating and comparing areas, each person's strengths support the group's success.

Facilitators noted that this activity supported participants' understanding of the value of building on one another's strengths. For example, a facilitator at an afterschool club noted that "the strengths chain helped to visualize why it is important to work together with each of our strengths." A facilitator at a summer camp explained that the activity helped campers

Figure 2. Youth Making a Strength Chain in Baseball Positions Lesson



understand "different players' responsibilities and … why it's important for every player to bring their strength."

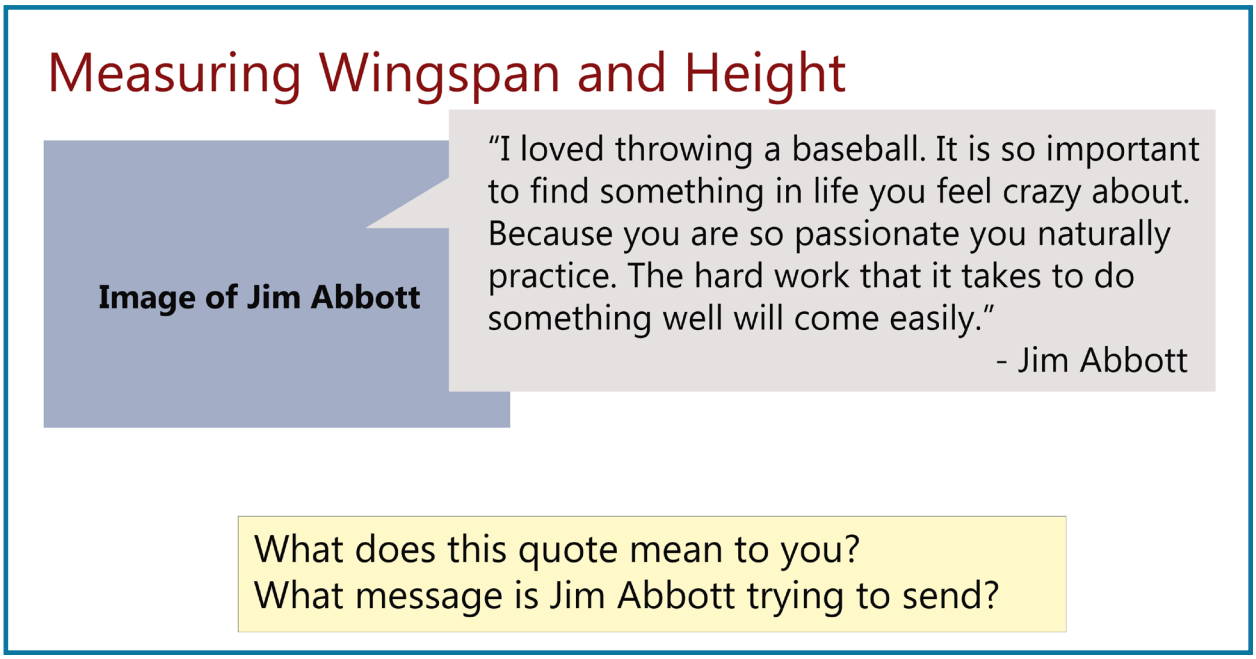
Growth Mindset Principle 2: The Power of Effort and Persistence

Effort and persistence are essential to improvement in sports. Growing Mathletes activities highlight that young people can improve and reach their goals through goal setting, effort, and progress tracking. Participants see tangible examples of the impact of effort as they persevere and work toward goals.

For example, the Wingspan and Height lesson introduces baseball player Jim Abbott, who was a successful pitcher despite having been born with only one hand. Prompted by the opening quote (see Figure 3) and a video about Abbott's life, participants discuss specific examples of overcoming challenges and persisting when meeting their goals in sports and in school subjects like mathematics. They next measure both their height and their wingspan (fingertip to fingertip with arms outstretched) and plot each person's data on a scatterplot. They discuss patterns and trends, including how wingspans change as individuals get taller, and reflect on how different wingspans might be useful in various sports. Facilitators share additional examples of how players with different physical attributes reached success through effort, practice, and persistence.

In the second activity, youth generate inspirational phrases that can help them persist in the face of challenges in sports, with friends, or in school. They

Figure 3. Opening Quote and Reflection Questions for Wingspan and Height Lesson



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create a group inspiration wall, using phrases and images to serve as an ongoing reminder not to give up.

As another example, the Broad Jump lesson begins with a quote from basketball superstar Stephen Curry: "Success is not an accident; success is a choice." Participants discuss the quote and reflect on how effort and persistence can support improvements in various aspects of their lives.

In the first activity, participants review how to do a broad jump by bending their knees and jumping forward. Each one then jumps four times, applying different techniques in each round to improve the distance jumped. They measure the length of each jump and plot the data on a group histogram. They then discuss patterns they notice, including how the length of their jumps changed across multiple trials. Most participants discover that they jumped farther in later rounds, due to both practice and opportunities to apply new jumping techniques. They reflect on how this experience connects to effort and persistence in other activities, specifically, learning mathematics. For example, they may share experiences learning new strategies or models to solve problems and describe how their understanding and performance improved over time.

In the second activity, participants watch a video about how baseball legend Jackie Robinson was successful playing football and track in college but initially struggled in baseball. After discussing the skills Robinson needed to practice to improve in each sport, participants make connections to their own efforts to improve in specific areas of their lives, including sports and school subjects like mathematics.

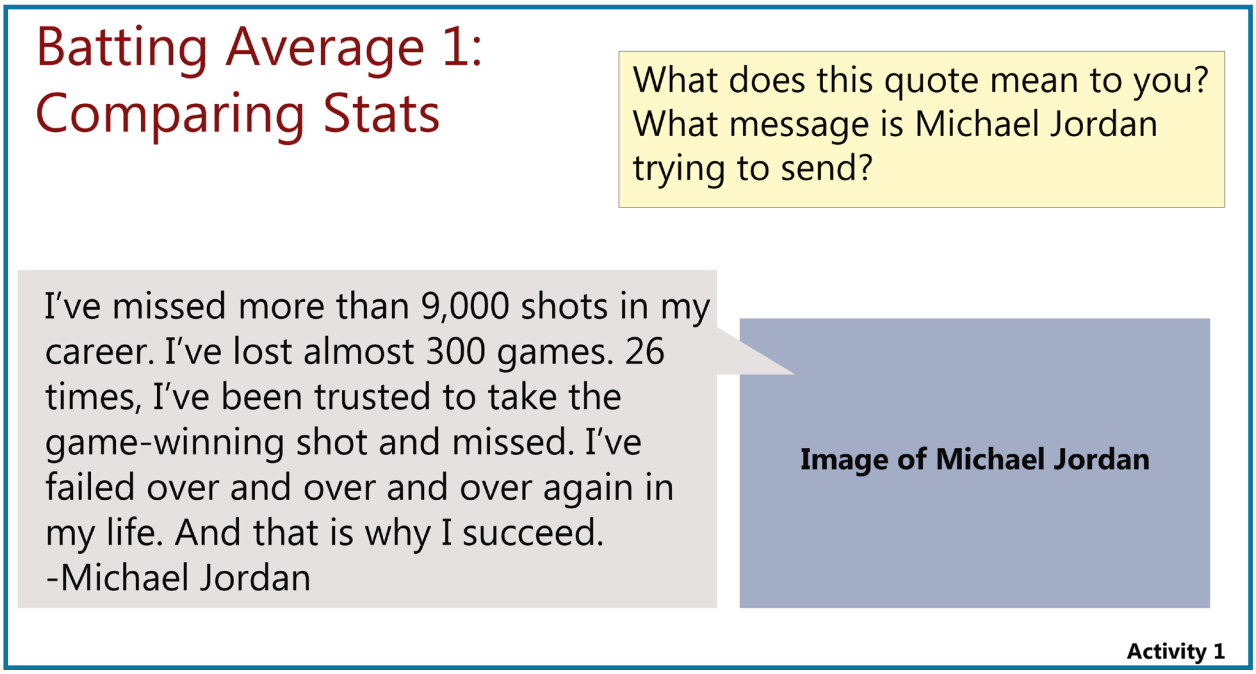
Facilitators frequently commented on the power of these activities to support participants' understanding of the value of effort and persistence. One facilitator at a summer camp noted that "the broad jump trials taught the kids not to think of the activity as a competition, but more so how they can individually improve and what techniques benefit them."

Growth Mindset Principle 3: The Value of Mistakes in Supporting Learning

Making mistakes and reflecting on them is critical to learning in sports, where mistakes are seen as an essential part of skill improvement. As players miss shots and catches, they reflect on how they can both improve their technique through practice and implement new insights for the next game. Growing Mathletes activities highlight that mistakes are an essential part of the learning process across various domains, including in school subjects like mathematics. Participants explore specific examples of learning from mistakes by reflecting on errors and making adjustments.

The Batting Average lesson presents basketball Hall of Fame player Michael Jordan's perspective on the importance of making and reflecting on mistakes to support success (Figure 4). As Jordan shares, failure

Figure 4. Opening Quote and Reflection Questions for Batting Average Lesson



is not to be avoided but rather is an essential part of success and learning.

In the first activity, participants work in small groups to calculate the batting average of several baseball players, representing each value as a fraction and as a decimal. As a group, they compare player batting averages, observing that even highly successful professional players often fail to get hits during games.

In the second activity, participants reflect on mistakes that batters make in baseball, such as swinging too early or too late or swinging at balls that are not on target. They discuss how players learn from those mistakes to improve their performance. Then they generate similar examples of learning from mistakes in their own lives, including in sports, in school subjects like mathematics, and in other activities like playing a musical instrument.

Next, they stand in a circle and listen to scenarios about making mistakes in school or in sports. They discuss each scenario and generate advice and specific suggestions about what the person could do, say, or think to learn from the mistake. As they share ideas, they pass a ball of yarn from one speaker to the next to create a web of connections (see Figure 5). This web provides a visual model of how the process of reflecting on mistakes forms new connections in the brain (Doidge, 2007). Facilitators commented on how well the activity helped young people connect making mistakes with learning. A summer camp facilitator noted that, after campers made the web:

> We explained to them, like, "Oh, this is what your brain looks like when you make a mistake. It learns from it, like sets a spark and that way, you don't make that mistake again or you can try a different route."

Growth Mindset Principle 4: Malleability of the Brain and the Role of Struggle in Learning

The idea that our brains continually grow and adapt in response to new situations and challenges is an essential component of improving in sports. Through Growing Mathletes activities, youth learn that new connections between neurons in the brain change all the time as a result of trying new activities and making new connections between ideas.

For example, in the Elasticity lesson, participants reflect on a quote from football player Ronnie Lott that helps them think about how they can intentionally help their brains grow (Figure 6, next page). Through this discussion, they reflect on how their brains can grow and adapt as they learn new skills and work toward goals.

During the first activity, participants measure how high different kinds of balls (tennis balls, foam balls, baseballs) bounce off a surface, measuring each ball three times. Groups then calculate the average bounce height for each type of ball and discuss its elasticity, that is, how well it bounces back to its original shape after being compressed. Groups collaborate to represent their data on a line plot and discuss patterns in the data.

In the second activity, participants apply the concept of elasticity to understanding the malleability of their brains. They watch a short animated video that explains the brain's neuroplasticity, or its ability to change and adapt in response to challenges and new experiences. The video compares the brain to a muscle that grows as it encounters new ideas and creates new neural pathways. Next, participants brainstorm specific instances when their own brains grew in response to new challenges, experiences, and learning,

Figure 5. Making a Web of Connections in Batting Average Lesson

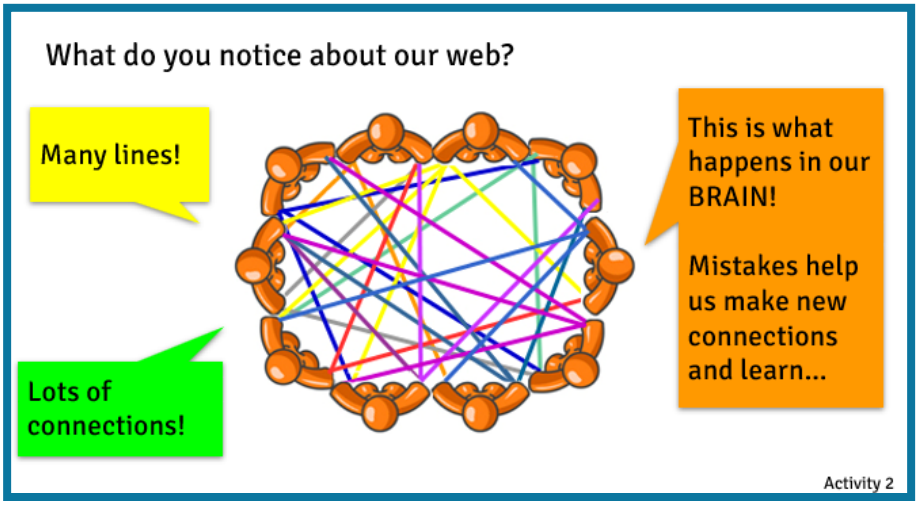
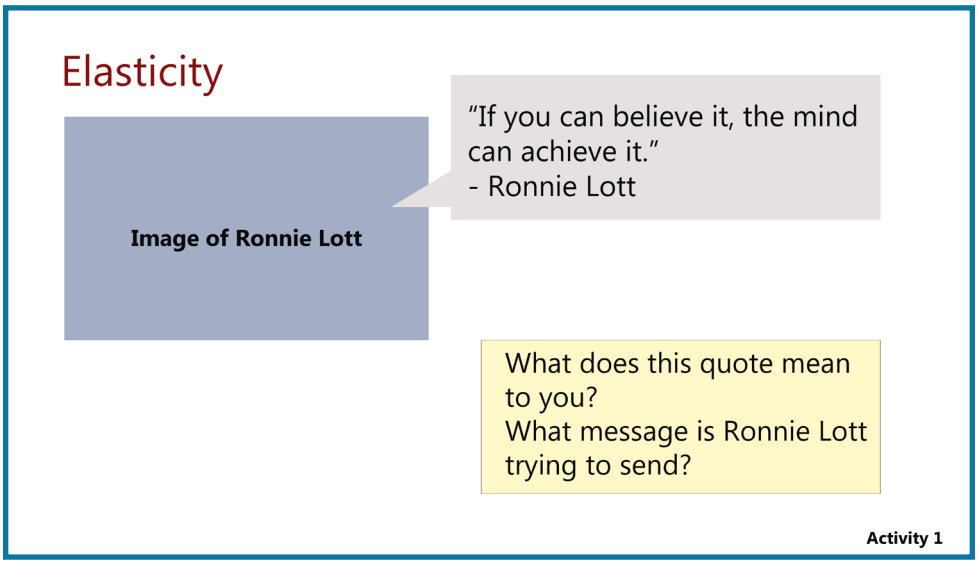


Figure 6. Opening Quote and Reflection Questions for Elasticity Lesson



such as how they learned to bat left-handed or get better at multiplication.

As another example, participants in the Base Running lesson reflect on a quote from the greatest baseball player of all time, Babe Ruth: "Don't be afraid to take advice. There is always something new to learn." This quote emphasizes the importance of taking advantage of opportunities to learn new things.

In the first activity in this lesson, participants use two different techniques to run the bases on a baseball field, a straight-line path and a circular "banana" path, and compare their times. They plot their data on a line plot and discuss which path is more familiar—usually the straight path—and which is faster—the circular path. They watch a video about neuroplasticity and reflect on their experiences developing new skills or habits, including how new learning can feel uncomfortable as their brains make new connections. They conclude by creating pictures that show what helps them to learn new skills in school, sports, and other settings. Facilitators at multiple sites shared the value of teaching youth about this growth mindset principle.

Growth Mindset Principle 5: Praise the Process, not the Person

The language facilitators use as they interact with youth in out-of-school spaces is important. It can reinforce growth mindset principles, specifically the idea that ability is not innate, fixed, and static but can be developed over time with effort and persistence. Facilitators must shift away from language that praises participants' ability or the outcomes of their activity toward language that praises their processes. Drawing on materials adapted from mindsetkit.org (Table 2), facilitators provided multiple examples of how they shifted their language toward praise that emphasizes effort and process. For example, a summer camp facilitator shared, "I can tell them that everybody can

Table 2. Examples of Language to Praise the Process, Not the Person

Instead of This (Person-Praise)	Try This (Process-Praise)
Great job! You must be good at this.	Great job! You must have worked really hard.
See, you are good at math. You got an A on your last test.	You really studied for your math test and your improvement shows it.
You got it! I told you that you were smart.	I like the way you tried all kinds of strategies on that math problem until you finally got it.
You are such a good student!	I love the way you stayed on task, you kept your concentration, and you kept on working. That's great!

Source: Mindset Toolkit (n.d.)

reach them up here if they try. You just can't do it right now. You can't do it yet."

Evidence of Success

From 2021 to 2024, Growing Mathletes activities were implemented in various out-of-school settings including afterschool and summer programs for young people in three U.S. states. Data were collected through pre- and post-implementation surveys with all participants, interviews with selected participants after implementation, and interviews with facilitators.

Youth Surveys

Youth surveys adapted Likert-scale questions from established surveys (Chen et al., 2017; Sarrazin et al., 1996; West et al., 2018) that assessed participants' overall growth mindset (e.g., I can change how smart I am with hard work), their growth mindset toward mathematics (e.g., I am capable of learning anything in math), and their growth mindset toward sports (e.g., I can increase my sports ability by challenging myself). Additionally, youth answered questions about their perceived competence in mathematics (e.g., I am good at math) and more broadly in STEM (e.g., I think that I am very good at coming up with my own investigations). Each survey domain included at least three items and had an internal reliability over 0.7, showing that the items worked well together to assess the domain.

Table 3 shows average pre- and post-participation scores and standard deviations for these five domains on a scale from 1 (strongly disagree) to 5 (strongly agree) for all participants who answered questions on both surveys. The table also includes the results of statistical tests conducted with paired *t*-tests comparing pre- and post-participation scores. Effect sizes for each survey were also calculated using Cohen's *d*, represented in standard deviation units. As can be seen in Table 3, participants both started with relatively high scores on all three growth mindset domains and increased in all three. We found statistically significant increases in both overall growth mindset and mathematics growth mindset, both with a small effect size. Perceived math competency and STEM competency also increased, with STEM competency evidencing a statistically significant increase with a small effect size. Taken together, these results suggest that participating in Growing Mathletes activities enhanced young people's growth mindset and their beliefs about their mathematics and STEM abilities.

Table 3. Pre- and Post-Implementation Youth Survey Responses

Domain	Pretest Mean (standard deviation)	Posttest Mean (standard deviation)
Overall growth mindset (n = 116)	4.26 (.72)	**4.55 (.63)***
Math growth mindset (n = 78)	4.34 (.71)	**4.48 (.64)***
Sports growth mindset (n = 116)	4.42 (.80)	4.47 (.70)
Math competency (n = 116)	3.85 (.76)	3.92 (.78)
STEM competency (n = 115)	3.13 (.52)	**3.28 (.48)***

* Statistically significant change ($p < .05$)

Youth Interviews

Interview data were transcribed and thematically analyzed by members of the research team with a focus on participants' understanding of how key growth mindset principles apply in sports, mathematics, and other activities. Themes included youth learning about the first four growth mindset principles.

The Value of Collaboration

Participants discussed the positive aspects of teamwork and collaboration used during the activities and in their own lives. A 13-year-old at an afterschool program shared positive aspects of working with others:

> Interviewer: What were some of the more exciting parts of building your poster board and your presentation?
>
> Youth: Teamwork was very exciting….
>
> Interviewer: So teamwork, something that you … really liked about it and that they give you a

chance to work on it. How do you think you work when you're in a team, whether in this or just in school?

Youth: I wanted to add that it is kind of a way to bond with each other.… If you really don't like the person, you have to work with them. Maybe the working together, maybe that'll make you friends.

A 12-year-old at an afterschool program shared how working with a group led to success:

Interviewer: What are some things that helped you with those tricky things? Did it help working with a group in a team to make decisions?

Youth: Yeah, because if I were by myself doing it, I probably wouldn't have finished the thing because I'd probably still be thinking about the unique features and all. And if I didn't have my team to help me, like with other things for the features, then I'd still be stuck on my features.

Effort and Persistence

Participants described how practicing and putting in effort would lead to improvements in their skills. A nine-year-old at a summer program shared how practice would help meet a goal of improving in math:

Interviewer: Did you set any goals today?

Youth: So one of them was to figure out how to get better at math, because I'm not the greatest at math.

Interviewer: And what's going to help you get better at math?

Youth: Practice.

Similarly, a 12-year-old at an afterschool program reiterated the importance of effort and practice in improving at running:

Interviewer: What goal did you set for yourself?

Youth: To get faster.… Right now, I don't really run that fast.… I want to get faster.

Interviewer: What are some of the things that you are going to do to meet that goal of getting faster?

Youth: Practice every day. Play more sports.

Learning from Mistakes

Participants articulated the prevalence and importance of failure in sports and how they use failures to get better. A 12-year-old at a summer program showed understanding of how to learn from one's mistakes:

Interviewer: So [today] you were successful three out of 10 times, unsuccessful seven. So what does that tell you about, like, learning from mistakes?

Youth: That it's okay to fail sometimes because even MLB players don't even get three out of 10 sometimes, right? They go maybe one, four, 10 over 10. Right. They're not always perfect, and you're never going to be perfect.

Interviewer: So how do you think MLB players learn from their mistakes?

Youth: They practice, and they have to know what they did wrong and fix it.

Malleability of the Brain

Participants described how the brain is similar to a muscle and can grow with challenges, making connections to learning math. An 11-year-old at a summer program shared his understanding of malleability and the role of struggle:

I kind of think of the brain as a muscle. When you flex and work different parts of your brain, they get stronger, and they get better and more adept at doing those specific tasks. So when it comes to math, when you're stressing it or when you're working your brain on a specific problem on a calculation, something like that on your brain gets stronger.

This idea was also shared by a 13-year-old at an afterschool program:

Interviewer: Is there anything new or exciting or interesting that you learned from today's session?

Youth: Neurons. I learned about neurons.… I didn't even know they existed. I didn't know it was a word, anything.… It's pretty much how your brain grows. They connect with each other after exercising it. The video said to be able to lift more—or, not necessarily lift, to be more intelligent, think faster. At the beginning, say there's three neurons, and they're all separate, doing whatever. And you would think slower, but if you

exercise your brain, if you did math problems, simple ones at first, three times two or two times four, it would grow.

Facilitator Feedback

Our evaluation activities focused on participant outcomes. However, conversations with facilitators indicated that they also saw the value of integrating sports, mathematics, and growth mindset for the young people they served. One facilitator shared:

> Over time, [students] kind of adjusted and started to be more into it…[even] kids that really aren't sports people.… If you're a sports person, the baseball part helped you like the math more.… If you aren't a sports person and you're just here, the school part helped you learn about the growth mindset.

Implications for Practice

Our experiences in the Growing Mathletes program combined with participant responses suggest that integrating growth mindset principles and mathematics concepts in the context of sports is an effective way to engage young people and to expand their perspectives on learning mathematics and the relevance of mathematics in their lives. By starting with lessons from sports—a context that emphasizes the power of effort, persistence, and teamwork and the value of embracing challenges and learning from mistakes—Growing Mathletes activities have the potential to help young people apply growth mindset ideas to other situations in their lives, including at home and at school.

We close with several recommendations for other out-of-school-time programs. First, we found that concrete examples of how and why growth mindset principles support success, including examples from successful individuals who apply the principles to their own stories, was an important part of helping young people change their beliefs about abilities (Yeager et al., 2016; Yeager & Dweck, 2020). Whenever possible, facilitators should consider sharing their own stories, or stories of individuals in participant communities, that highlight the relevance of growth mindset ideas.

… concrete examples of how and why growth mindset principles support success, including examples from successful individuals who apply the principles to their own stories, was an important part of helping young people change their beliefs about abilities.

Second, out-of-school time programs should attend closely to the language used to communicate with youth about ability and effort. Rather than using language that focuses on outcomes, facilitators should use language that emphasizes process and effort. Such language supports young people to recognize their own competence and reinforces the belief that anyone, with effort, can improve their skills. In practice, for example, the popular saying "no pain, no gain" can be updated to "no struggle, no gain," reminding young people that struggle in learning should be celebrated, as their brains are getting stronger.

Third, programs should emphasize that teamwork can be used in multiple domains, not just sports, to support collective success. Collaboration in academic learning as well as in sports allows young people to use the skills they have developed and emphasizes that they all have a role to play in success. Examples may include peer tutoring or peer mentorship.

Fourth, young people should have a safe space to make mistakes. They often have a growth mindset in sports because the expectation there is that they will fail many times while they learn to succeed. Out-of-school spaces should implement similar norms across youth activities. When young people make mistakes, the focus should be on *why* the mistake was made and reframing it as an opportunity to learn. When they are encouraged to fail when learning new things, young people can develop a growth mindset about failure that will support them in other aspects of their lives, including in school.

Future research could include looking at the impact of young people's increased growth mindset on their attitudes and performance in school, especially in mathematics. We invite others to build on what we have learned about integrating growth mindset principles and mathematics in the context of sports with youth in out-of-school settings.

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