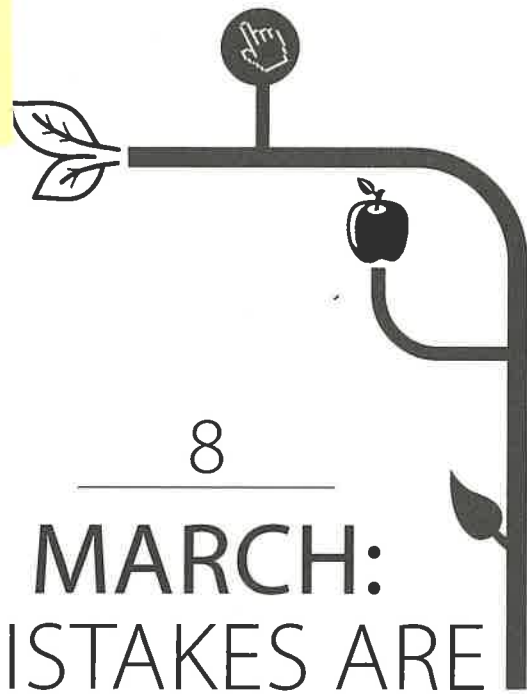


accomplishment has "a beginning, a path of accomplishment with a well- will be encouraged to show qualities to face a challenge isn't the same as t chapter, which addresses coaching th coaching strategies designed to bstacles, failures, and setbacks in the



8

MARCH: MISTAKES ARE OPPORTUNITIES FOR LEARNING

*How often I found where I should be going only by setting out for
somewhere else.*

—R. Buckminster Fuller

OBJECTIVES

- ✓ Learn how to coach students through mistakes.
- ✓ Develop mistake-friendly teaching strategies.

THE GENIUS MYTH

In American culture, Albert Einstein's name has become synonymous with "genius." If you've witnessed someone solve a difficult puzzle or problem, you might have even said, "Way to go, Einstein!" But here's the thing: Albert Einstein was often quick to refute claims of his own superintelligence. He's quoted as saying things like:

"I have no special talent. I am only passionately curious."

"It's not that I'm so smart, it's just that I stay with problems longer."

As a young child, Einstein's parents consulted a doctor because he was so late to begin speaking. He was also a late reader. He was forced to take his college entrance exams a second time after having failed the first.⁷⁰ Certainly, Einstein may have been born with some natural mental acuity where math and problem solving are concerned, but even he would have told you it wasn't his natural intelligence that propelled him to the greatest discoveries in the field of physics, it was his unceasing determination — what we call his growth mindset. When faced with failure, he tried again and again. Here are some snippets of Einstein's thoughts on failure:

"Failure is success in progress."

"Anyone who has never made a mistake has never tried anything new."

"The only sure way to avoid making mistakes is to have no new ideas."

Our cultural value of genius actually stands in stark contrast to the way our most notable genius, Einstein, lived his life, often eschewing his own intelligence and celebrating failure and mistakes as learning opportunities. When Einstein died, his brain was preserved for future research,⁷¹ and while scientists did note some atypical distinctions in Einstein's brain, like dense neurons and a highly developed region linked to musical ability, both nature and nurture likely played a role in his intellectual success. The anthropologist Dean Falk says that while the inherent nature of Einstein's unusual brain may have been partly responsible for his impressive accomplishments, so were environmental factors. Einstein cultivated a reputation for doggedness in his learning and persistence through setbacks and

challenges. He also appeared on the physics scene at a time when the relatively new field was ripe for discovery.

“He had the right brain in the right place at the right time,” said Falk.⁷²

Would Einstein’s parents have taken odds on their son — who was slow to speak and considered “dull-witted” by his teachers — becoming one of the most brilliant, celebrated scientists the world has ever known? Actually, they probably would have. They encouraged his passions in science and math, urged him to develop qualities of self-reliance, and nourished his sense of wonder.

LEARNING IS MESSY

Einstein was a strange boy who had trouble making friends and whose teachers considered him insubordinate and incompetent, and had he been of the fixed mindset he may well have believed them. But Einstein’s growth mindset propelled him beyond failure, setbacks, and obstacles to new heights never before conceived of in science. Einstein defined insanity as “doing the same thing over and over again and expecting different results.” When people of a fixed mindset make mistakes, they’re often unwilling to change the behavior or action from which the mistake resulted or acknowledge a mistake was made at all. They avoid challenge and stay rooted in their comfort zone: never risking looking stupid, but forever missing out on new and different results. Growth mindset, on the other hand, is characterized by a willingness to try new strategies to find a better result.

The learning process is filled with mistakes and setbacks; it can be stifled by preconceived notions and interrupted by environmental challenges. Real learning in your classroom with twenty different kids and twenty different brains and twenty different perspectives is messy, loud, and unpredictable. Perhaps the only constant is that your students will make mistakes, but you can plan how you’ll help students navigate those inevitable mistakes. Here’s a three-step strategy for harnessing the power of mistakes in the classroom:

1. Normalize mistakes.
2. Value mistakes as learning opportunities.
3. Coach students through setbacks.

Normalize mistakes. At the beginning of the year, inform students they'll make mistakes and the mistakes will help them learn. Together create a "mistake language." In one classroom, the teacher and students say "Great mistake!" when they encounter a mistake that shows learning. In another, the teacher asks for a "mistake rationale" to get students to engage in metacognition, or thinking about their thinking. Another teacher calls her students "mistake mechanics." When a breakdown happens, the mechanics have to open the hood (the mind), pinpoint what went wrong, and come up with a strategy to fix it. Having a consistent process for tackling mistakes makes them feel routine and expected, not embarrassing and uncommon. Mistakes are so common in fact, you've planned for them!

There are millions of stories floating around the world of mistakes turned great inventions and failures turned wild successes. Using some of these stories in the form of bell work, journal prompts, or motivators is a great way to plant the seeds of failure being a natural part of hard work. J. K. Rowling, celebrated author of the *Harry Potter* books, was terrified of failure, before it happened to her. She found herself hitting a series of setbacks, including financial hardship, relationship trouble, and professional rejection, before she hit it big with her popular tales of young witches and wizards in training, and discovered that the failure, oddly enough, propelled her in ways that finding success never could have.

"So why do I talk about the benefits of failure? Simply because failure meant a stripping away of the inessential. I stopped pretending to myself that I was anything other than what I was and began to direct all my energy into finishing the only work that mattered to me," said Rowling, who went on to explain that, in hindsight, her personal and professional failures were ultimately a gift, because once she experienced and survived failure she was finally free of fearing it.⁷³

Students need opportunities to experience failure at school so they understand that failing is not something to be covered up or feared, rather it is an important and natural experience from which they can learn.

Value mistakes as learning opportunities. Turning mistakes into valuable learning opportunities is also key to normalizing them. A popular video on [TeachingChannel.org](https://www.teachingchannel.org/), a repository of instructional teaching videos, is "My Favorite No," in which a middle school math teacher, Leah Alcalá, discusses a strategy she uses to demonstrate the value of mistakes.

At the beginning of her classes, Alcalá posts a problem on the board and then hands out note cards on which the students will solve the problem. She collects the answers and quickly sorts them into a yes pile (the students who got it right) and a no pile (the students who got it wrong).

"I look for my favorite wrong answer or my favorite no, and then we analyze it," said Alcalá.⁷⁴

Alcalá's "favorite no" is a wrong answer that demonstrates some solid math. She projects the wrong answer and asks the students to identify good thinking in the problem. At the end of the discussion, she asks the students to find the mistake. In Alcalá's class, mistakes are not penalized; they're used as a jumping-off point for a discussion for improvement. Not all mistakes are created equal, however. Some mistakes, like errors born of rushed work, have no real value except to demonstrate that rushing through work results in errors. Alcalá seizes on the mistakes that have learning value.

Coach students through setbacks. When students hit a snag in their learning they cannot resolve, the teacher has the opportunity to step in and coach them through it. Develop some coaching go-to strategies for students to deploy when they're struggling in learning. It's important that you don't fix the problem for the student; to benefit from the mistake, a student has to work through it. Here are some strategies that work for us:

STRATEGY	DESCRIPTION
ASK THREE THEN ASK ME	In this strategy, when students hit a snag, they must first ask three classmates to help them through it. This promotes collaboration in problem solving, and allows students the opportunity to use metacognitive strategies to think through a mistake or error.
OPEN-ENDED QUESTIONS	Develop a repertoire of open-ended questions you use to provoke problem-solving in struggling students. Questions like "Why do you think this happened?" or "What's another strategy you could use?" or "How might you avoid this mistake next time?" encourage students to think through the cause of the mistake and develop strategies to fix it. Tip: be comfortable with silence! Once you ask an open-ended question, give students time to answer. Too often, we try to jump in and answer the question when the silence has gone on too long. Wait them out!

REFLECTION JOURNAL	Give students time to reflect on their learning. The act of articulating what went well and what didn't through journaling will give students time to stop and process their learning . They may come up with insights in this process they may not have otherwise.
REFLECTION ACTIVITIES	Before learning occurs ask students to think about potential obstacles. If they consider what areas of the concept, skill, or task might pose a problem beforehand, they'll be better prepared to handle any setbacks . This is also a way to normalize mistakes because it lets students know that you expect them to make mistakes in their learning.
USE THE MISTAKE AS PART OF THE LEARNING	If you see a great mistake — the kind that shows good process , but fails to meet its goal — make an example out of it! Like the strategy "My Favorite No," use mistakes as examples of how good process can go awry. Show the students the mistake and ask for input on what went wrong and how it can be repaired. This serves to both normalize mistakes and demonstrate important metacognitive strategies in thinking through problems.

FAMOUS MISTAKES

LESSON PLAN

LEARNING OBJECTIVES

By the end of the lesson, students will:

- conduct research and report on a famous mistake.
- demonstrate understanding of the value of mistakes.

RESOURCES AND MATERIALS

- Computers
- Internet
- Paper
- Writing utensils
- Poster paper
- Markers

METHOD

Say: "What do a microwave, potato chips, and Play-Doh have in common?" (Allow time for students to come up with responses.) Say: "Those are all interesting guesses, but the answer is that the microwave, potato chips, and Play-Doh were accidental inventions. Yes, you heard that right! All three products were created by mistake. In the case of Play-Doh, the doughy material made by Kutol Products was originally used to wipe soot off walls in the days when homes ran on coal stoves. Eventually people stopped using coal as a home heating source, and the company was going out of business until the owner found out that his sister, who was a teacher, was using it as a sort of modeling clay in her classroom. By the next year, Kutol Products turned into Rainbow Crafts, and has been marketing Play-Doh as a children's toy ever since. Sometimes in the course of our schoolwork we get a wrong answer or stumble upon a different strategy, or way of doing something, and these moments can be great learning opportunities! We already know mistakes help our brains grow, but they can also help us see things in a

whole new way. Today, you'll use the Internet to research some familiar items that came about unintentionally or by mistake. You'll be assigned a topic (or choose one of your own!), research it, and fill out the mistake survey. After that, you'll create a poster about your invention to show others the value of mistakes."

Assign or have students/groups choose an item from the list to research. Use your classroom protocols for Internet research or guide students through the Google process. Googling "_____ invented by mistake" or "_____ invented by accident" will likely be enough to generate a good search result. Don't forget to have students evaluate the credibility of their source material!

THE GREAT MISTAKE LIST

Potato Chips	Super Glue	Popsicles
Microwave	Post-Its	Chocolate Chip Cookies
X-ray Images	Silly Putty	Velcro
Plastic	Penicillin	Ice Cream Cones
Teflon	Liquid Paper	Frisbee
Saccharin	Slinky	

Have students answer these questions during/after the research process:

1. How was the product created by mistake?
2. How do we use this product today?
3. How did learning about this mistake make you think differently about mistakes and challenges you face?

Now, have students create posters (or other presentations) depicting how the product was created by mistake and the value the mistake generated for society.

CHECK FOR UNDERSTANDING

Evaluate presentations to ensure that students have properly depicted the mistake and the value of the mistake.

NEXT-LEVEL MISTAKES: GAME NOT OVER

The cultural obsession with video games shows us that kids have the capacity to continually try for a goal even in the face of repeated failures, and yet many of the same children willing to spend hours mastering a level in a video game give up at the first sign of failure in school.

The mindset-researcher Lisa Blackwell writes, "In a video game, students are motivated by earning points, but they don't get discouraged when they fail. [The] video games involve skill, challenge, and incremental progress — without the threat of permanent failure or negative judgment from others."⁷⁵ This "threat of permanent failure" is taken away in video games, where the player is given an unlimited number of chances to improve. Every failed attempt at a level is still an incremental step toward the mastery of it. Teachers can take some clues from the gaming industry — masters at engaging kids — to provoke the same kind of stick-to-it-ness in the classroom that kids employ in video games. Try out some of these gaming-inspired strategies:

- 1. Provide examples.** If you're curious how to conquer any level on any video game, all you need to do is check YouTube. Someone (or multiple people) have undoubtedly uploaded a video walking the player through how to beat a difficult level. Similarly, when teachers ask students to produce a piece of work, they should be able to offer examples of what an end product might look like. Rubrics, examples of past student work, and tutorials are ways to clearly indicate work product expectations.
- 2. Nonthreatening.** In gaming, players often wear the amount of effort devoted to mastering a level or game like a badge of honor — "I played that level for five hours straight!" Similarly, students should be celebrated for how hard they work to master a concept or skill. Parents and teachers often celebrate a student's ability to master something quickly, though it can provoke negative consequences like fixed mindsets, cheating, and superficial learning. There's little consequence for failing a level in a video game: if you die, you just start again. Similarly, students should have room to fail without consequence. If they mess up, allow them to start again

where they are. All the learning shouldn't be chucked out just because at some point the student derailed.

3. **Student input.** In video games there's some element of choice. Players choose the style of game they want to play and can tackle challenges in various ways. Students should also have voice and choice when it comes to their schoolwork. Allow students input on the work they'll be doing and how it'll be assessed. This voice and choice will promote ownership over the task and help students self-motivate to succeed.
4. **Embrace differences.** Just as there are different strategies for mastering a video game, teachers should give students space to strategize ways to master a challenge. Not all students learn the same way, so a strategy that works for one student may not work for another. This is where the "not yet" comes in. Let students try multiple paths and figure out on their own what works and what doesn't. The process of discovery will be a far more meaningful experience than trying once and giving up.
5. **Intrinsic motivation.** Kids are completely self-motivated to play video games. There's no reward at the end; they're in it purely for fun and challenge. Likewise, students must be self-motivated in their schoolwork. Teachers who try to motivate students with external rewards are never as successful as teachers who help students discover what motivates them intrinsically.
6. **Cheats.** We know, we know, cheating is a dirty word in education, but there are all sorts of cheats and codes students can use in video games to give themselves a boost. We're not suggesting that you encourage students to cheat, but giving them tips and tricks to use as strategies in learning should be fair game! Dena, a high school English teacher, openly encourages her students to use SparkNotes, a kind of digital CliffsNotes when they don't get through a reading or need help understanding it. "I don't mind if kids use SparkNotes or access summaries of the readings I've assigned. It's just another way to get the story. If a student is struggling to understand *Macbeth*, I'd rather they Google a summary of it than abandon it all together. I want them to have multiple tools at their disposal, and I'm

not going to discount a student who needed a little help figuring out a storyline. I think it's resourceful."

7. Constant feedback. In a video game, the player is constantly receiving feedback. Dings, bells, and organ tones are consistently informing the player of everything good and bad happening along the way. In the same way, kids need a stream of feedback from teachers and peers offering valuable advice and information that can enhance their learning. A video game that required the player to blindly work his or her way through the level, and then doled out some too-little-too-late feedback at the end, would be an unpopular one. Same goes for student work. Feedback delivered throughout the process is more valuable than some notes on a test handed back a week later, long after the student has moved on.

8. Scaffolding. Video games build on one challenge after the other, increasing in difficulty. This sequencing creates a clear path to mastery: First, you have to get the sword. Then you have to get through the forbidden forest. Then you rescue the enchanted fairy. Many times teachers present concepts in isolation without giving students a roadmap of where they're going or why. Make sure that you provide support to students in the form of scaffolding information and skill acquisition, but not too much: nobody likes to play a game that isn't challenging.

9. Create healthy competition. Not all students are intrinsically motivated by competition, but many are. Using gamification strategies, teachers can use video games or other types of games to create camaraderie, increase engagement, and promote learning through game playing. This is often a popular strategy with students. Be cautious to promote cooperation as an essential component of competition; avoid giving prizes or making too big of a deal about scores. Have students work in groups to practice collaboration and avoid pitting student against student.

Clearly, the gaming industry knows a thing or two about engaging kids. Try some of these strategies to help promote can-do attitudes and resilience in tackling schoolwork that kids often demonstrate in gaming.

PRODUCTIVE FAILURE

When parents and teachers swoop in to protect children from failure, they do them a disservice by depriving them of the opportunity to learn how to fail in a way that's productive and meaningful. Knowing how to fail is a valuable skill, and one that more and more children aren't mastering thanks to overprotective parents and self-esteem culture.

Some call it "failing up." Some call it "failing forward." Whatever you call it, productive failure is the idea that mistakes and setbacks can be transitioned into valuable learning opportunities. Manu Kapur, a professor of psychological studies at the Hong Kong Institute of Education, has dedicated his career to the study of productive failure. His research indicates that when students are given time to struggle with solving a problem, as opposed to receiving explicit instruction on how to solve it, they'll be able to better access and apply the information they learn in the struggle later on.⁷⁶

Kapur conducted a study on the theory of productive failure in Singapore schools. In the study, two groups of students were exposed to two different strategies of mathematical instruction. The first group was given explicit instruction and clear feedback to solve a set of problems. A second group did not receive explicit instruction from a teacher but instead were directed to collaborate with peers to solve the problems, in lieu of asking the teacher for help. The students in the first group, with help from the teacher, were able to correctly answer the problems they had been given. The students in the second group, absent any instructional support from the teacher, were unable to get the problems right. However, Kapur recorded that the second group spent far more time discussing ideas, strategies, and various outcomes of the problem, and when he tested the groups on their learning, the second group did better than the first.

"Hidden efficacy" is how Kapur identifies this idea that struggle can propel students to deeper thinking about the nature of problems, which can be far more valuable than figuring correct sums.⁷⁷ If students have struggled their way through a problem to a solution, Kapur posits, they can better apply the hard-won solution the next time it's needed. This productive struggle, while uncomfortable in the moment, helps students develop better understandings about learning and problem solving. Teachers can incorporate six features in a lesson that will help create an environment ripe for productive struggle.⁷⁸

1. The problems are challenging, but not to the point of frustration.
2. Tasks must have multiple solutions so students can generate many ideas. There cannot be only one way to get the right answer.
3. Productive failure design must activate students' prior knowledge, but students should not be able to solve the problem using only prior knowledge. It should include new challenges.
4. Students have opportunities to explain and elaborate on their thinking and strategies.
5. Students have a chance to examine both good and bad solutions to the problems.
6. The task should be relevant and engaging to students.

"The aim of teaching and learning is to go beyond the basics and engender deeper conceptual understanding and ability to transfer knowledge flexibly to new situations," writes Kapur.⁷⁹ This is why allowing for—and even planning for—failure in your lessons can provide such a powerful learning opportunity for your students; in negotiating the challenges you've created, they'll develop strategic and critical thinking skills useful in life.

Math, in particular, lends itself to incorporating the productive failure learning situations Kapur describes. Consider your own classroom or subject matter, and, keeping in mind the six characteristics of a productive failure task, come up with an idea for your own:
