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How to Address Pandemic-Learning Loss and Close Learning Gaps

STEM Intervention Resources and Tutoring Practices for Elementary Schools

Several reports confirm that student achievement and growth rates declined during the pandemic school closings compared with previous years. K-12 officials must take steps to address this "pandemic-learning slide," and a February 2021 EdWeek Market Brief article reported on the programs and strategies that schools and districts plan to use over the next year. Almost half (43%) of K-12 officials surveyed intend to provide tutoring via paraprofessionals, teachers' aides, and volunteers. Those three groups will be much-needed support for teachers as students return to school, but those support groups will need help in terms of resources and guidance on best practices.

A good starting place to gather best practices is in the research of Professor John Hattie, the author of *Visible Learning and Visible Learning for Teachers*. Professor Hattie is famous for amassing an enormous collection of evidence-based research on what improves students' learning. His website contains a graph that compares the efficacy of different factors and instructional practices in student learning. But, as previously stated, that's just a starting point.

Educators are viewing this summer as an opportunity to get a head start on addressing learning loss—or closing academic gaps from previous grade levels—before the new academic year. It's imperative to make the most of that time for the school year to run smoothly.

This guide will share ideas, practices, and tools that can support the efforts of volunteers, aides, and paraprofessionals providing tutoring in elementary schools.

Make STEM Fun and Meaningful

After more than a year of distance learning and mostly unstructured time, many students will have difficulties readjusting to in-person instruction and classroom routines. Those difficulties will make it harder for them to focus on learning.

If students are motivated to learn, it will make their readjustment into the classroom easier and help keep them on task. One way to help foster motivation and engagement is by making science instruction exciting and relevant (rather than relying on rote learning). When students perform their investigative labs or experiments and can be a part of the processes, procedures, and concluding results of these activities, the content learned and the memories made are unbeatable compared to using only a textbook or worksheet.

One way to motivate learning is through an intriguing introduction, such as an exciting demonstration or an engaging activity, for each concept or skill. For example, a tutor could prepare students for a lesson about fossils by pressing various objects into a ball of modeling clay and then observing the imprints left behind. Students can relate to the everyday event and find more meaning in discussing guided questions on how fossils formed.

Example guided questions:

- Predict the type of organism represented by your fossil?
- Describe the types of environments that these plants or animals would need to survive?
- Why do scientists study fossils?
- How long do you think it took for fossils to form in real life compared to the formation of our examples today?

Connect Science to Real-World Activities and Jobs

As stated above, using real-world examples is an effective way to capture students' interests. Children may view some science concepts as irrelevant or confusing if they can't understand how it relates to the real world. This reaction is a normal human response: if you perceive something as meaningless, it becomes harder to remember and understand.

Showing how science has connections to their lives or potential careers will make the subject meaningful to students. Students in kindergarten through second grade will respond to references to things they frequently observe or experience, such as games, eating, etc. Children in later elementary grades pay more attention to possible careers. For this reason, they will be interested in how science relates to different jobs they might choose in adulthood.

Therefore, tutors can have students in Grades 3 and up read a brief biography of a famous person in a STEM career (e.g., a climatologist). Then, the tutors can have students investigate precisely how science correlates to that job.

Use Hands-On Exploration

Hands-on science activities are also convenient for engaging elementary school learners. For example, tutors could play a small game of Tug-of-War with students to demonstrate different patterns of motion. Students can then use their observations to answer questions about balanced forces, acceleration, and unbalanced forces relating to the game. These types of activities enable students to engage directly with the content and deepen their understanding of science concepts.

Further Differentiation

It is also essential that tutors offer various avenues for their students to explore science concepts. Tutors can differentiate their instruction by providing picture vocabulary for visual learners, literacy connections, videos, interactive games, virtual science labs, or group discussion activities. By giving various modalities, students are more likely to find an avenue that works best to learn new content or reinforce previously known content.

Access our K-5 Activity Pack with three hands-on explorations that students can complete from home or in the classroom.

Debate and Discourse

As the San Diego County Office of Education explains, discourse is "integral to human learning and provides a window into student thinking, revealing understanding and misunderstanding" in science class. The National Academies Press (NAP) also supports this notion, stating that scientific discourse is "a critical component of science learning, particularly for students from populations that are typically underrepresented in science."

Discussing scientific concepts with each other allows students to figure out if they have any misconceptions. It also gives them the chance to explore alternate ways to view different ideas and realize that they can apply science to real-world scenarios. Also, participating in science conversations causes students to reflect on what they've learned, which helps them retain more of the new knowledge introduced.

Tutors can use guided questioning and encourage peer-to-peer discourse to facilitate class discussions. For instance, they can have students conduct a "Turn-and-Talk." This activity involves the following steps:

1. Divide a class into pairs.
2. Pose a question or prompt for discussion, and tell students how much time they will have (one or two minutes is best).
3. Set a timer and have discussions begin.
4. When the time is up, ask the pairs to share thoughts and ideas from their discussion.

This activity gives all class members a chance to be part of the discourse rather than having only a few individuals speak up during a class-wide discussion.

Embrace Productive Struggle

Productive struggle is learning that Edutopia describes as having "desirable difficulty," where students learn more after facing a challenge than they would with an easier topic. Productive struggle requires students to work through increasingly challenging and unfamiliar concepts. This approach causes them to make connections between different science concepts to look at the "bigger picture" connections instead of just memorizing content.

Tutors can provide independent or collaborative tasks that allow students to explore challenging, meaningful concepts in a real-world context. Students should have the flexibility to use different processes and strategies to determine their responses. That way, they will develop fluency and confidence as they become more efficient and accurate in exploring science concepts.

Identifying Students That Need Help and Pinpointing Areas of Struggle

In addition to the engagement strategies mentioned above, tutors will need to figure out which students have fallen behind their peers and what caused each one's decline in learning.

Diagnostic Testing

Using diagnostic testing to establish Beginning of Year (BOY), Middle of Year (MOY), and End of Year (EOY) benchmarks helps determine how much students have grown from the instruction they received over an academic year. An added benefit is that tutors can use data from diagnostic testing to target areas of need, such as knowledge gaps and misunderstandings that occurred in previous grades.

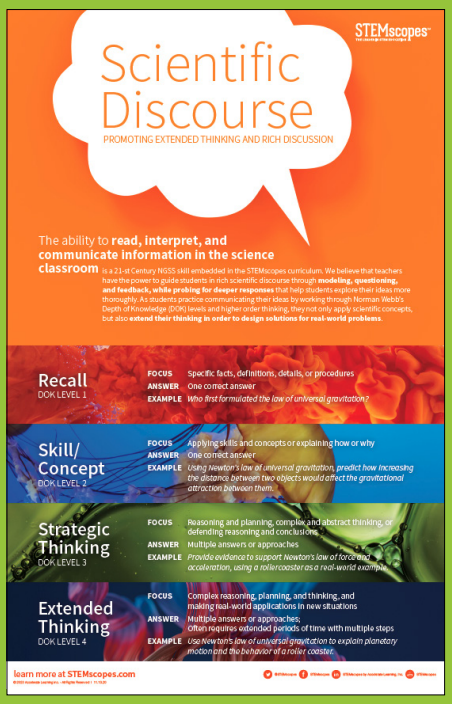
Digital curriculum solutions with diagnostic testing resources provide educators and tutors with actionable data for focusing instruction. For example, STEMscopes Science includes BOY and EOY benchmark assessments and integrated formative and summative assessments that track student progress and help educators address struggling areas.

Determining Why Progress Was Blocked

Students' COVID-19 experiences may have impacted their science learning in any number of ways. Understanding what caused the issue can provide a better understanding of what made them unable to perform as they would under normal circumstances, and that understanding can help guide remediation. For this reason, educators and tutors should ask themselves the following questions about students' lockdown experiences:

- Did students have equitable access to learning materials?
- Did they have parents at home to support them in virtual learning?
- What impact of social-emotional learning (SEL) has been taken into account?
- How could the presence or absence of SEL have influenced students' emotional wellbeing and motivation to learn?

Using open-ended questioning in instruction requires a specific set of skills and strategies. The Scientific Discourse Poster shares the four levels of communication through Norman Webb's Depth of Knowledge (DOK).



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Using Open-ended Questioning to Detect Areas for Growth

Closed-ended questions (e.g., "What do plants need to survive ?") focus on the correct answer. Open-ended questions (e.g., "How do plant and animal needs differ?") give insights into misconceptions and provide a good overview of what students know. Open-ended questioning serves several purposes:

- It helps teachers and tutors assess students formatively throughout an assignment and over the course of many lessons.
- It enables teachers and tutors to monitor individual and class-wide progress and adjust subsequent lessons accordingly.
- It enables teachers and tutors to differentiate instruction by student ability and learning style, asking questions that meet students where they are and encourage them to move forward.
- It teaches students metacognition—the ability to observe their own thinking and learning process. This ability gives students a better sense of their strengths and weaknesses, competencies, and areas of growth so that they can maintain insights about their abilities within a wide range of domains.

Getting to Know Each Student Personally

Knowing every student on a personal level means understanding what motivates a specific child and drives their interest. One student may pay more attention to instruction that incorporates social issues such as pollution. Another may perk up at references to a popular fictional character or television series.

Two ways to figure out what sparks students' interests are using an Interest Survey and having one-on-one chats with students. Instructors can use free online tools like Poll Everywhere and Survey Monkey to create interest surveys quickly. The surveys can contain questions and statements accompanied with a Likert scale, which provides options for "Strongly Disagree" all the way to "Strongly Agree." Since students may be more honest if they can take the survey anonymously, it's advisable to include names as optional.

Using Frequent Checks for Understanding

Checks for Understanding (CFUs) or comprehension checks like "Thumbs-up/ Thumbs-down" are quick, visual, formative assessments that gauge students' understanding throughout a lesson. The practice allows on-the-spot reteaching or adjustments in instruction. It also ensures no student simply stays silent and ignored. CFUs are easy to implement, and instructors can find 15 examples at the website WeAreTeachers.com.

Helping Non-Experts Deliver Effective Science Interventions and Instruction

An instructional intervention is a program or set of steps designed to boost learners' performance in areas that they have found challenging. Interventions can be delivered one-on-one or in small groups. What an intervention class might look like will vary according to the state and district. The Wayne Regional Educational Service Agencies emphasize that intervention groups should be as homogeneous as possible regarding their learning needs.

Ratios of Students to Tutor

Institutions differ in their recommendations of how many students that one adult should work with within an intervention group. According to the IRIS Center, supported by the U.S. Department of Education's Office of Special Education Programs, Tier 2 groups in response to the Intervention (RTI) model should have three to five students. It also states that Tier 3 groups should have no more than a 1:3 teacher-to-student ratio.

On the other hand, the RTI Action Network, created by the National Center for Learning Disabilities, recommends that Tier 2 groups in a multi-tier support system (MTSS) be between five and eight students. However, it agrees with the IRIS Center about the size of Tier 3 groups being three at the very most.

Here are some outlined guidelines on grouping students when returning to the classroom.

Incorporating SEL and Community Activities

Curriculum and instruction that give students the chance to develop core social and emotional competencies have been shown to produce increased academic achievement and improved attitudes and behaviors. In addition, discipline problems and emotional distress decrease among students that take part in SEL.

The five areas of social and emotional competencies defined by the Collaborative for Academic, Social, and Emotional Learning (CASEL) are self-awareness, self-management, social awareness, relationship skills, and responsible decision-making. Below are suggestions for incorporating these competencies into science instruction.

1. **Self-Awareness:** As stated earlier, science instruction should provide an opportunity for students to debate, present their reasoning, and share their thinking. Tutors have learners work alone, in pairs, or in teams to explain why they reached the conclusions they did. Students demonstrate self-awareness by monitoring what they say and how they say it during this activity.

2. **Self-Management:** Students should have the opportunity to analyze their thinking through three unique lenses: content, process, and emotional. By sharing their perspective in a small group or with a partner after working independently, students can practice self-management as they experience different points of view. For example, students need to manage their stress when developing and presenting ideas to their peers. Additionally, students have to control their impulses to interrupt classmates with whom they disagree.

   Tutors can also present questions and have students reflect on their emotions during an activity. For example, they could examine how doing the work made them feel and how they felt if their partner used a different process to come up with the same answer.

3. **Social Awareness:** When science instruction is relevant to students' lives, it's easier to incorporate current event issues, for example, humans' use of natural resources in our everyday lives. Create or look for lessons that come with media and questions that spark dialog on social topics so that students become more socially aware while developing science and engineering skills.

   A type of interpersonal social awareness can be developed by pairing students with behavioral challenges with more mature peers. The behavior-challenged student is encouraged to observe and imitate the mature classmate's behavior. Through that imitation, the struggling student will have an opportunity to experience the world from their classmate's perspective.

Additionally, students can be instructed to face each other and maintain eye contact during one-on-one dialogues. This practice encourages them to observe and react to emotional markers and indicators.

4. **Relationship Skills:** Activities such as "Think-Pair-Share" and "Turn-and-Talk" enable students to hone relationship skills and be openly vulnerable as they tackle new and challenging content together. Tutors should encourage learners to listen and respect their peers as they ask questions and wonder aloud. In addition, they should help learners to feel comfortable asking for and offering help.

   Students can participate in role-playing activities that allow them to practice appropriate manners and body language. They should also coach them on how to communicate questions clearly and succinctly. In addition, students can practice resisting social pressure that creates a hostile environment where they fear asking "stupid questions."

5. **Responsible Decision-Making:** From setting goals to figuring out how to communicate about science, students have multiple opportunities to learn responsible decision-making while strengthening classroom norms. Tutors can foster this competency as they establish classroom rules that promote safety and social norms, for example, respecting others' personal space and saying "excuse me" and "thank you." Students uphold high ethical standards as they demonstrate respect for peers through behaviors such as active listening and teamwork.

Additionally, tutors can help students manage learning anxiety by providing them with steps or metacognitive questions to use whenever they face a challenge. For example, if students struggle with understanding a scientific problem, they can use the problem-solving model found on the next page.

Fifth-Grade Science Investigation Example

Everyday Phenomena: How do shadows change throughout the day?

Activity: Students construct a sundial using a paper plate, pencil, and small ball of modeling clay.

As students work through the activity, look for teachable moments to introduce students to vocabulary terms relevant to understanding the activity. Try to point out examples of the terms as students are working so that they can connect the meaning of the word with their experiences.

Encourage students to use the following words as they create and discuss their sundial.

Earth	the planet that all known life exists on
The Moon	a natural satellite that orbits a planet; some planets have no moons; others have over 60 moons
Orbit	the path an object takes as it revolves around another object in space
Axis	an imaginary line that a sphere rotates around
Rotation	a complete spin on an axis
The Sun	the star at the center of the solar system that supplies heat and light to Earth; its enormous gravity keeps the solar system in orbit
North Pole	the northernmost point on Earth, as determined by the planet's rotation
South Pole	the southernmost point on Earth, as determined by the planet's rotation

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Students will use the following steps to investigate the phenomena:

- Represent the situation when designing the activity (sundial)
- Give each student a copy of the Student Journal and read the driving question: How do shadows change throughout the day?
- Have students record the measurements and observations of the activity in their Student Journal.

Ask students the following questions to reinforce learning from the activity and address any misconceptions.

- Explain what caused the shadows?
- Why did the Sun *appear* to move across the sky?
- What time of day were the shadows the longest?
- Did the shadows point in the same direction all day?
- What time of day were the shadows the shortest?
- Describe the pattern of the shadow as it relates to the Sun's movement across the sky.
- Based on this pattern, what do you predict the shadows will be like tomorrow?
- What helps you make this prediction?

Students may not understand that shadows are a pattern and happen every day. To help with this concept, have students repeat the investigation for at least two (2) days in a row. These steps will allow students to gather data, compare their results, and draw conclusions that the shadow patterns happen the same way they did the day before.

Independent vs. Group Work

When to schedule independent work versus group work is ultimately a matter of instructor preference. Some tutors prefer to introduce a concept or skill to the entire class and then have students hone their understanding by working in groups or pairs. Finally, they ensure students have achieved mastery by assigning them solo work.

Alternatively, other instructors prefer to introduce a challenging task by having students work on an assignment independently. Then, students move on to collaborative work; and finally, they wrap up with a whole-group activity.

In each case, it's vital to bear in mind that the aim is to develop students' ability to use science reasoning independently.

Time Blocks for Interventions

Many schools provide time for students to receive extra help on their studies during the school day or week. Students are put into groups strategically to receive support for targeted skills.

Schools may already be using diagnostic data from digital curriculum platforms, software, and other formative assessment sources to identify students needing intervention. If there's still a lack of progress during those blocks, tutors will need to consult the data once more to determine if a student needs a greater level of support or simply needs more time in terms of session length or frequency.

Additional Ways of Providing Academic Support

One way to support students' academic progress is by helping the people who will be tutoring them. One of the difficulties likely to arise is that many of them, especially volunteers from the community, may not be familiar with pedagogical strategies currently being used. In this case, they will need content support describing the background information on how and what the student is supposed to learn.

Otherwise, if left to their own devices, those volunteers will deliver instruction in the ways they received it as children. In many cases, that means jumping straight to the problem or activity, which is not what the standards require. There cannot be an assumption that volunteers understand or are even aware of what the state standards want students to accomplish.

One solution is to provide introductory letters, such as the letters sent to parents to help students learn at home. These can explain each unit and include the models, vocabulary, and menus of activities and tasks. The teacher-facing materials in digital curriculum platforms are also likely to contain an introduction that explains what to do and what to expect as students work through lessons. For example, STEMscopes Science provides a Teacher Background within every scope (chapter) that explains the scientific concepts behind that scope's lesson activities. This resource is helpful to give tutors or even students who need a more in-depth introduction to a lesson's content.

Supporting students academically also means equipping them with the knowledge and skills that will enable them to succeed with multiple-testing modalities. In addition to high-stakes testing, students should be able to handle the following:

- Argumentation-based assessments that they must reason through and defend
- Multiple choice
- Fill in the blank (computation)
- Drawing representations
- Explaining concepts to a peer

The objective should be to make learners well-rounded enough for all those evaluations. Students need to understand science in multiple dimensions. Otherwise, they'll just think about getting the correct answer without truly understanding why a scientific concept discovery is essential and why its real-world application is necessary for students to create more profound meanings and connections.

Supporting Students Socio-Emotionally

Some of the people who will be providing tutoring may not have seen children for a year or more. But suddenly, children will be physically present with them in June or July. Those individuals need to prepare for several issues:

- Students who have no behavioral norms because their parents have been too busy or distracted to give them attention.
- Students who have not read anything beyond sentence fragments online, so their skills for deeper understanding need reactivating.
- Some students have breakdowns in the classroom because they no longer know how to interact with peers after a year of being isolated from friends.

Below are some ideas for activities to incorporate into class time to help students de-stress and readjust to the classroom.

- **Daily Emotional Check-Ins:** Check-ins can be done at the start of class or for individual students. Students will identify their current feelings and figure out aloud how to regulate their emotions if it's needed. Procedures will need to be in place for students who indicate that they are depressed. Also, tutors will require some training on identifying and supporting students who may seek attention by exaggerating negative emotions.
- **Mindfulness Practices:** Mindfulness is a valuable skill that can help learners calm down before a test or when they are upset. Mindfulness practices include deep breathing (taking slow, deep breaths) or observing the emotions they're currently feeling.
- **Releasing Body Tension:** Tension within the body often produces or intensifies negative emotions. Tutors can use directed movement exercises, such as jumping jacks, to change students' physical states, thus changing their emotional states.

Recovering from the Pandemic's Damage is a Process

Everyone has been looking forward to getting "back to normal," but returning to normalcy will be a process. As students return to physical classrooms, we need to assess and remediate the damage done.

COVID-19 dealt a blow to some children's educational progress, especially those who could not transition to online learning and those who suffered economic insecurity. Likewise, the uncertainty and social isolation that these students endured will have hindered or even damaged their emotional health and social development.

In the same way that educators, parents, and communities rallied to make it through the pandemic, they can also heal its blows. This guide is designed as a resource for educators and volunteers to begin that critical and uncharted task. Together, we can ensure that they have the most remarkable comeback possible.

About STEMscopes

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