



THIRD SPACE
LEARNING

The Ultimate Guide to Metacognition

Examples, tips and strategies to successfully embed
metacognition across your school to
accelerate math growth

School and District Leader Guides

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Introduction

What is metacognition?

Metacognition is an awareness and understanding of one's own thought processes.

It is one of three essential components of self-regulation; supporting students to think about their own learning more explicitly:

Cognition – the mental process involved in learning

Metacognition – Often described as 'learning to learn' or 'thinking about thinking'

Motivation – willingness to engage our metacognitive and cognitive skills.



Metacognition and self-regulation approaches to teaching support students to think about their own learning more explicitly, often by teaching them specific strategies for planning, monitoring, and evaluating their learning.

Education Endowment Foundation¹

Teachers seamlessly weave metacognition and self-regulation into their daily practices, often without conscious recognition. The challenge lies in translating this inherent skill into tangible examples and strategies. In other words, teaching metacognitive strategies is easier said than done.

This guide aims to bridge the gap between research and practice in the classroom.

Metacognition and self-regulation learning are key to helping students develop independence and taking ownership of their own learning. We've dug into the research to summarize the key information teachers need to know about metacognition - specifically in regards to math teaching and learning - and provide practical strategies and advice for today's math classrooms.

Why we've made this resource

Despite the positive impact metacognition has on learning, it's not always easy to explicitly weave into classroom instruction. Because it comes naturally to us as adults, it's sometimes hard to teach to young people.

We've made this guide to provide practical tips and ideas you can use with your students to encourage them to think about their own learning more explicitly.

Throughout the guide we've drawn on our experience as online one to one maths tutoring providers since 2013, helping 150,000+ pupils develop their metacognitive skills.

Why is metacognition important?

Research has looked at learners in both elementary and high schools – and even those who have not yet started school – and found benefits in all cases.



“There is a strong body of research from psychology and education demonstrating the importance of metacognition and self-regulation to effective student learning. The Sutton Trust-EEF Teaching and Learning Toolkit—which summarizes international evidence—rates ‘metacognition and self-regulation’ as a high impact, low cost approach to improving the attainment of disadvantaged learners.”

Metacognition and self-regulated learning guidance report, EEF²

3 Children as young as three have been able to engage in a wide range of metacognitive behaviors.

Studies found disadvantaged students are less likely to use metacognitive strategies, having been more likely to be exposed to negative environments which can have lasting effects on brain development. Disadvantaged children might also lack family investing in their cognitive development, so it can be a great way to support your students who need it most.

When students use metacognitive activities effectively, they:

- ✓ Set goals;
- ✓ Select specific strategies to enhance their learning experiences;
- ✓ Use self-assessment or self-questioning to monitor their own learning.

Metacognitive processes have become increasingly researched in recent years, with findings being applied to students' problem-solving skills, study strategies, reading comprehension interventions, and learning strategies.



Cognitive processes are the range of learning skills that students possess. In contrast, metacognitive processes enable students to self-evaluate the effectiveness of their cognitive processes.

Schraw, 1998.³

The benefits of metacognition in the classroom

+ Accelerates growth

7+ Research suggests that the potential impact of metacognition and self-regulation approaches is high (+7 months additional progress).

+ Closes the achievement gap

The report states that there is some indication that students who come from disadvantaged backgrounds are less inclined to utilize such tactics and, as a result, could potentially gain the most from them.

The research indicates that using metacognitive teaching strategies is beneficial for learners who are at a disadvantage compared to their peers.

+ Develops more independent learners

When young people are capable of monitoring their progress, it enables them to manage their own thinking and independent learning, both in and out of the classroom.

+ Easy-to-implement

In effect, a metacognitive approach to teaching does not require specialist equipment, nor any other large purchases. It only requires teachers to be trained effectively in metacognitive practices.

Therefore, professional development and training opportunities are the main expenses for integrating metacognition in education.

+ Transferable

Metacognition helps learners transmit their knowledge and understanding across tasks and contexts, including reading comprehension, writing, math, memorizing, reasoning, and problem-solving.

+ Improves resilience

By identifying their successes and failures, and which specific strategies work best for them, learners have a toolkit for perseverance with their work.

+ Supports emotional and social growth

Gaining awareness of their own thinking, learning processes and cognition allows learners to think about how to be happy and confident in themselves. Metacognitive thinking also allows learners to consider things from others' perspectives. It nurtures self-awareness and a growth mindset.



Read: [What Is A Growth Mindset And What Does It Mean For Kids And Parents?⁴](#)

3 min read

+ Boosts motivation

Research shows metacognition increases learner motivation because learners feel more in control of their own learning. Learners who make use of metacognitive strategies are more aware of their own thinking and more likely to be active learners who learn more deeply.

“There are students who feel far more confident speaking with Skye than they do in a classroom setting. I've noticed a real difference in the willingness to try things and make mistakes. I can see it in the confidence reports on the platform too - scores going up, and the little comments students leave for Skye tell their own story.”



Madeline Loeb, Director of Curriculum and Instruction,
Primary Hall Charter School



Maths & metacognition

Although the skills of planning, monitoring, and evaluating are common to all subjects, the way in which these skills are applied can vary depending on the specific subject. For instance, planning an essay requires a different skill set than planning how to find the tangent to a curve.

When coupled with strategies that emphasize oracy and classroom discussions, metacognitive approaches prove especially effective in cultivating both mathematical skills and confidence. Fostering reflective thinking alongside verbal expression creates a dynamic learning environment that significantly improves students' proficiency and self-assurance in mathematical concepts.



One-on-one teaching provides a unique opportunity for focused math talk. All teachers wish they could sit side by side with their students and discuss math and problem solving in depth – but in a busy class of 30, this isn't always possible.

Third Space Learning provides online one to one maths tutoring for elementary, middle and high school students. With Skye, the AI math tutor, students work through topics at a pace that suits them.

Skye models different strategies and narrates its approaches to math problems. When students move on to more independent practice, Skye asks questions to support students to do the same to develop their metacognitive skills.

Research suggests that metacognitive strategies are most effective when embedded in the curriculum and a specific subject lesson. This means that to foster metacognitive awareness in mathematics, learners must acquire it in the mathematics classroom.



Research has shown that intervention programs targeted metacognition:

- ✓ Are more successful at making math progress
- ✓ Have a higher impact than curriculum reform and computer-assisted instruction
- ✓ Reduce math anxiety



At Third Space Learning we embed the teaching of metacognitive skills within our math lessons.

Our team of pedagogical experts carefully design curriculum-aligned lessons that actively develop metacognitive strategies and Skye, the AI tutor, is trained to promote the development of metacognitive skills in students through effective questioning

The one-to-one AI math tutoring with Skye is highly effective for metacognitive development because the conversational, one to one, spoken nature of the AI tutoring allows students to feel more comfortable and confident in verbalizing their thoughts and articulating the steps they're taking to solve a problem, which may not be possible in a whole-class environment.

Effective Questioning Techniques for tutors

Questioning does **not** mean just asking your students any questions. Questions should be thought out when you are planning your lessons such that you are able to **use questioning as an assessment for learning (AfL) tool** whilst you are teaching.



Effective questioning techniques

- Asking a range of questions, from basic fact recall to more open-ended and exploratory questions (e.g. "What do we need to do when adding two fractions together?")
- Using "why" and "what if" questions often, which focuses on depth of learning and clarifying understanding (e.g. "Why can't our answer be an even number?")
- Using effective follow up questions, that facilitate meaningful discussion (e.g. "How do you know your answer is correct?")



Ineffective questioning techniques

- Repeatedly asking ineffective or complicated questions (e.g. "Is it 6? Are you sure it's 6? Is it 6 or is it 5?")
- Questions that obviously guide the student to just choose the opposite answer (e.g. "Are you sure?"). You could instead say to the student: "Can you explain how you got that answer?"
- Telling the student the answers and/or what methods/calculations should be used, which impedes learning during the session (e.g. "To find the difference you have to subtract")

A resource used to inform Skye's training
to develop questioning techniques

Step by step: how to teach metacognition



Research has shown that students' use of metacognitive strategies significantly improves when their teachers explicitly state the cognitive processes required to complete a task.

To help teachers with this, one research body has made an evidence-based 7-step framework for teaching metacognitive skills. It can be applied to all subjects and to any age group.

We've summarized the report below and provided practical examples from from our own online one-on-one elementary math tutoring so you can see each step in action.

1 Activating prior knowledge

When delivering a new unit, teachers should find opportunities to activate prior knowledge that is relevant to the new unit at the start of the lesson. This technique supports students to assimilate the new information with previously learned material and also reduces the demands placed on their working memory during the lesson.

Using a low-stakes quiz is one of the most effective ways of activating prior knowledge and can take as little as 5 minutes at the start of a lesson. This could be a quick recap quiz as a class or could take the form of homework set in advance of a new lesson.



Practical examples to activate prior knowledge

In Third Space Learning's AI math tutoring with Skye, the lessons begin with a diagnostic assessment - the Skill Check In - to activate prior knowledge. The AI tutor uses this pre-assessment diagnostically to get an understanding of what the student knows or does not know.

The conversational, spoken nature of the AI tutoring allows Skye to ask carefully considered questions. By engaging the student in dialogue, Skye models various planning and reasoning techniques for them, which helps to develop the student's metacognitive skills.

For the elementary lesson, examples include:

- What do you think the first step is?
- What happens to the value of a digit when it moves from the ones place to the tens place?

Understanding place value relationships in multi-digit whole numbers

Skill Check In

Fill in the blank to make the statement true.

The value of the 7 in 327 is times less than the value of the 7 in 5,716.

TTh	Th	H	T	O
		3	2	7
	5	7	1	6

Third Space Learning's online one to one math tutoring begins with a Skills Check In to activate prior knowledge.

2 Explicit strategy instruction

Explicit instruction is an important stage in developing metacognitive skills. It ensures that students are secure in their knowledge of the different cognitive strategies available to them for problem-solving. Explicit instruction is teacher-led and the quality of the instruction is likely to depend on the pedagogical knowledge of the teacher.

Providing clear worked solutions with notes that detail each step is an effective method for explicitly teaching new units.

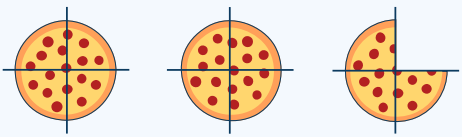
Practical ideas for explicit instruction of metacognitive skills


Let's learn

An improper fraction is a fraction where the **numerator** is greater than the **denominator**. We can convert improper fractions into **mixed numbers**.

$\frac{11}{4}$ This is the same as saying 11 quarters.

1 Imagine 11 quarters of a pizza are eaten. We can write this as a mixed number.



2 Bar models are another way we can think about improper fractions.

a Write as an improper fraction.

--

b Write as a mixed number.

--

5

Hint 1 Before trying to solve this exercise, what is the question asking you to do?

Hint 2 Instead of thinking about the whole problem at once, focus on just the first thing you could do.

If you had to teach your method to someone else, what would you say?



Skye engages students in their Third Space Learning one-on-one math tutoring by asking questions.

In this Third Space Learning lesson, the explicit instruction stage teaches students how to use visual representations and bar models to help them understand conceptually how to convert between mixed and improper fractions.

Students could also be asked to evaluate the success of various cognitive strategies so that they are actively engaged in this stage. For example:

- How could you check if the mixed number you found is actually correct?
- How do you think a student may get stuck here?

3 Modeling of learned strategy

This stage is also teacher-led but the students will need to engage at a higher-level compared to the previous stage.

Modeling a new strategy offers two important benefits for students:

- ✓ First, they learn how to apply the new strategy to solve problems.
- ✓ Second, it is an opportunity for the teacher to model metacognitive strategies if they think-aloud and verbalize their decision-making processes.

Modeling a strategy using worked solutions has been shown to be an effective form of explicit instruction in mathematics, especially for novice learners (Manson and Ayres, 2019).

However, expert learners benefit more from partial worked solutions due to the expertise-reversal effect. The amount of detail included in demonstrating a new technique should depend on the students' proficiency and the difficulty of the technique.

Example-Problem Pairs is a very effective approach for modeling in mathematics.

The teacher presents two very similar problems to the class (one on each side of the board). On one side, the teacher models a complete solution and students then attempt the question on the other side of the board, using the worked solution as a guide.

Practical ideas for modelling of learned strategy

Follow me

Let's convert mixed numbers to improper fractions.

$3\frac{4}{7}$

a There are 3 wholes.
One whole is equivalent to 7 sevenths.

b $3 \times 7 = 21$

c Altogether there are $\frac{21}{7} + \frac{4}{7}$

d $3\frac{4}{7} = \frac{25}{7}$

Your turn

Convert the mixed number below to an improper fraction.

$2\frac{3}{5}$

a There are wholes.
One whole is equivalent to fifths.

b $2 \times \dots = \dots$

c Altogether there are $\frac{\dots}{5} + \frac{3}{5}$

d $2\frac{3}{5} = \frac{\dots}{5}$

What common mistakes might people make when converting to an improper fraction?



Skye verbalises and models metacognition to students,

In our online one-on-one tutoring, Skye demonstrates math concepts to students and also explicitly explains and demonstrates the metacognitive skills that students need to improve their math performance.

Students can discuss ideas with Skye through their audio connection and Skye can reveal the planning, monitoring and evaluating thought processes of an expert.

For example:

- “The first thing I would always try to do with questions like this is to...”
- “I might check at this point that I am on the right track by...”
- “To check if the answer is correct, I would...”

4 Memorization of learned strategy

Students will eventually need to memorize new strategies if they are to use them successfully under exam conditions and beyond. However, a teacher may choose to let their students refer to their notes in the early stages of the learning process.

This benefits the students by reducing their cognitive load, allowing them to focus more on applying the new process rather than remembering it.

Memorizing a new strategy requires students taking responsibility for their own learning, with the teacher taking a supportive role.



Practical ideas for the memorization of learned strategy

Within each Third Space Learning one-on-one AI tutoring session, students are encouraged to memorise metacognitive strategies through the independent practice they complete at the end of each session.

During the sessions themselves, Skye asks questions to make sure the student is practising using the metacognitive strategies the AI tutor just demonstrated.

For example:

- What did you notice first?
- How could you check that the answer is correct?
- How do you know what strategies to use here?
- What could you start by working out?

5 Guided practice

Scaffolding is an effective form of guided practice; the process of supporting students to answer a question through a series of hints or prompts. In mathematics, scaffolding has been found to be positively correlated with the development of metacognitive strategies.

Guided practice is likely to involve adapted activities, allowing students to work at different levels or at a different pace to each other.

Verification feedback (identifying if an answer is right or wrong without further explanation) is an effective way to support guided practice (Guo and Wei, 2019) [9]. Teachers act as facilitators at this stage with the majority of the work being completed by the students.

In mathematics, when students are given a copy of the answers, they can provide themselves with verification feedback which is an effective way to prepare them for independent practice.

Practical ideas for guided practice

Every Third Space Learning tutoring lesson uses our structured curriculum of intervention lessons, in which paired examples give the student an opportunity to practice completing a question with a perfect model answer (as well as all the support they might need from Skye). This scaffolding allows the student to approach the question in easy digestible steps.



Follow me

Let's convert mixed numbers to improper fractions.

$3\frac{4}{7}$

a There are 3 wholes.
One whole is equivalent to 7 sevenths.

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c Altogether there are $\frac{21}{7} + \frac{4}{7}$

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Your turn

Convert the mixed number below to an improper fraction.

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One whole is equivalent to fifths.

b $2 \times \dots = \dots$

c Altogether there are $\frac{\dots}{5} + \frac{3}{5}$

d $2\frac{3}{5} = \frac{\dots}{5}$

Navigation bar: Select, Point, Symbols, Text, Shapes, Draw, Erase, Clear all, Undo, Redo

Students complete the 'your turn' section, using Skye's example and guidance to help them

6 Independent practice

The five preceding stages are essential stepping stones towards students being able to complete independent learning and practice.

Independent practice involves intelligent practice where students get a chance to make active choices in how to manage, organize, deploy, monitor and evaluate metacognitive skills.



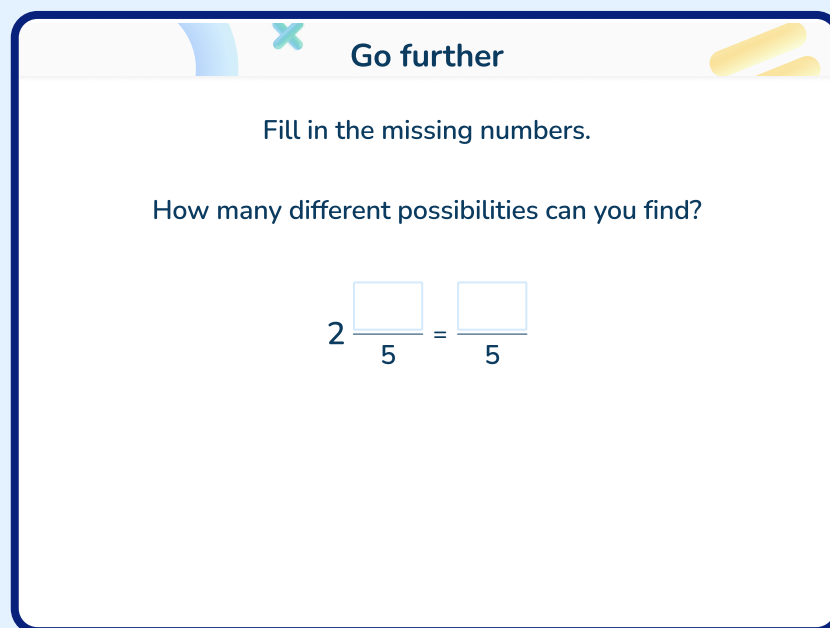
Practical ideas for independent practice

With Third Space Learning, students have AI tutor Skye on hand to give effective and timely feedback whilst supporting motivation with specific praise that develops a growth mindset.

For example:

- “Excellent demonstration of converting to an improper fraction correctly, I saw that you drew a bar model and that helped you remember what to do!”
- “I see you picked up on the mistake in the last question correctly, can you explain why so many students make this mistake?”

During independent practice, challenge is also crucial to allow students to develop and progress their knowledge of tasks and themselves. All Third Space Learning lessons provide an enrichment slide to extends students’ thinking.



Go further

Fill in the missing numbers.

How many different possibilities can you find?

$$2 \frac{\boxed{}}{5} = \frac{\boxed{}}{5}$$

The design of Third Space Learning lessons allows for fully personalized tutoring, including a challenge at the end of the lesson.

7 Structured reflection

When students are encouraged to share reflections of the learning process with their teachers, it significantly improves students' ability to use metacognitive strategies.

Part of its success is because it provides opportunities for teachers to intervene or adapt their strategies to further enhance students' learning.

For example, a study found that secondary students' attainment when learning Pythagorean Theorem was significantly higher when metacognitive prompts were introduced at the end of each lesson compared to control groups taught by the same teacher (Baliram & Ellis, 2019)⁵.

The prompts completed by the students were:

- 'Today, I learned...'
- 'I can now apply...to solve...'
- 'I understand...but still don't understand...'

The first 5-10 minutes of the next lesson was dedicated to whole-class feedback based on any misconceptions identified by the teacher from these prompts.

Practical ideas for structured reflection

This is why we build in structured reflection time into our Third Space Learning lessons. Structured reflection time is when the AI tutor questions students to encourage active reflection on their learning.

Metacognitive Questions for Mini-Plenaries	
Creating	Can you think of other strategies you might have used when calculating (link to lesson...)? How would you check if someone had understood this lesson?
Evaluating	How efficient were the strategies you used to find the answers? Which part of this lesson do you feel you did really well on? Which part of this lesson did you find the hardest?
Analysing	What made the learning easier? Explain how the strategies you used were successful.
Applying	How could you use what you learned here in other areas of Maths? When might you need to use what you have learned in real life?
Understanding	What do you think are the most common mistakes people make when learning about (link to lesson...)? What is the most important thing we need to know when learning about (link to lesson...)?
Remembering	Tell me 3 things you remember from this lesson. Tell me one new thing you have learned today. What skills did you use in this lesson?

The 3 stages of metacognition in the math classroom

Here, we'll see how metacognition might look in the math classroom while students are planning, monitoring and evaluating.



Planning Stage

- ✓ When presented with a probability question, a student decides whether to draw a sample space, Venn diagram or tree diagram.
- ✓ When preparing for an assessment, a student chooses between reviewing notes or answering practice questions.
- ✓ When approaching a math problem, a student asks themselves questions such as:
 - Have I done something like this before? If so, what did I do?
 - How is this similar or different from the examples I've seen before?
 - What can I find out, even if it isn't what the question is asking for?



Monitoring Stage

- ✓ A student checks their answers while completing an exercise to see whether they are using an effective strategy.
- ✓ When solving questions involving angles, a student checks whether their answers make sense compared to the diagram. For example, asking themselves if an acute angle makes sense in that particular situation.
- ✓ A student may ask themselves the following type of questions:
 - Am I getting the right answers?
 - Am I using the most efficient method?
 - Could I get the same answer using a different strategy?



Evaluating Stage

- ✓ A student reflects on the effectiveness of a strategy selected in terms of accuracy and efficiency. For example, realizing that using the alternate segment theorem would have been a quicker approach than using geometrical reasoning and other circle theorems to reach the correct answer.
- ✓ When evaluating their performance, students may use self-assessment questions such as:
 - Were any of my steps irrelevant?
 - What could I do differently to be more efficient next time?
 - Which units should I revise before the next assessment?

10 practical metacognitive strategies for the classroom

Planning Stage:

1 Break the problem down

Math problems, especially multi-step word problems or problem-solving questions, can be overwhelming and daunting. Students might rush in and make mistakes, or not answer all parts.

Get learners to take a step back to 'unpack' the question to make sure they understand it. Ask them questions like:

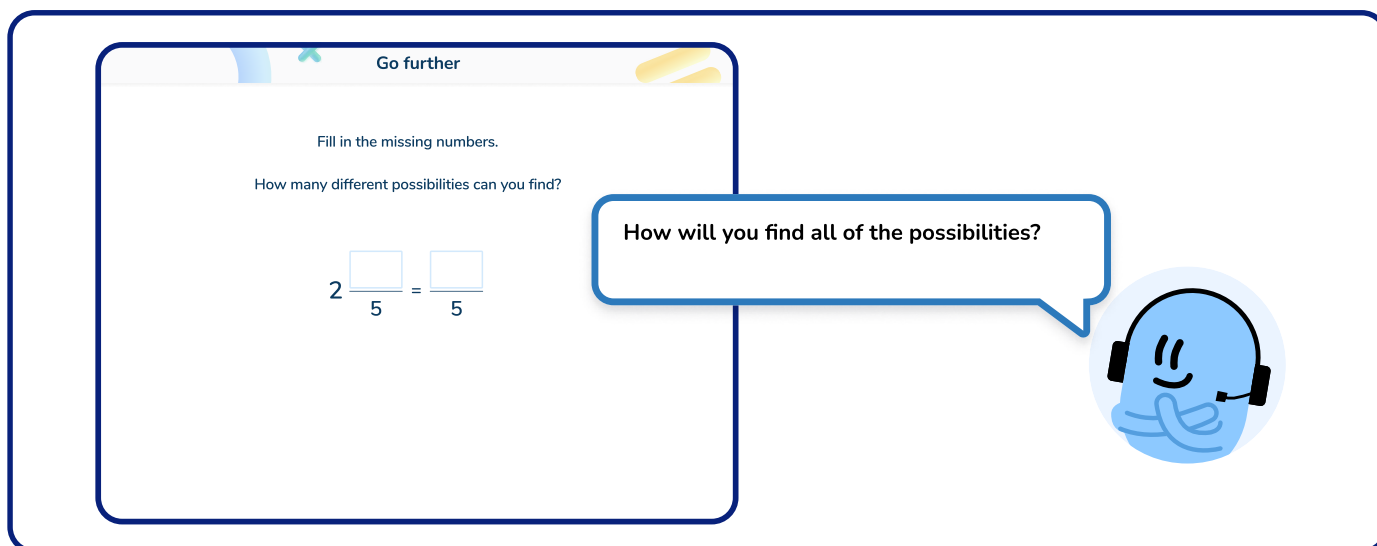
- ✓ Is this something you have done before?
- ✓ Is it similar to something you have done before?
- ✓ Is there anything you recognize?
- ✓ What are the important elements of the question or task?
- ✓ What resources do I need to answer this question?

Not only will it boost their self-confidence if they know they have solved a problem like this before, but it will also help them to make connections in their learning and activate prior knowledge.



Read: [Effective Questioning In The Classroom: 9 Tried and Tested Techniques For Teachers⁶](#)

5 min read



The screenshot shows a digital interface for a math tutoring session. At the top, a header bar says "Go further". Below it, the text "Fill in the missing numbers." is followed by the question "How many different possibilities can you find?". The math problem is $2 \frac{\square}{5} = \frac{\square}{5}$. To the right of the problem, a speech bubble from a blue cartoon character wearing a headset asks, "How will you find all of the possibilities?".

Online one-on-one math tutoring lessons are structured to guide students from guided to independent practice. Skye uses teacher written question prompts to help students to use metacognitive strategies when working more independently.

2 Peer and partner work

Talking with their peers, asking reflective questions, and debating approaches to problem-solving helps learners to develop **higher-order thinking and reasoning skills**. Such conversations can create productive conflicts that help learners develop multiple perspectives, leading to deeper understanding.

Interacting with peers can be more effective in achieving successful learning than working only independently and can be as effective as working one-on-one with an adult.

Purposeful peer work allows learners to:

- ✓ Examine their thinking process and the approach they used in order to identify different ways of solving a particular problem;
- ✓ Explore diverse appropriate strategies or varying viewpoints;
- ✓ Use active listening and reading strategies;
- ✓ Think aloud;
- ✓ Test out ideas and methods that are different from their own;
- ✓ Debate or negotiate to reach a consensus in decision-making before presenting to the group.

In practice, this often means reducing teacher talk time. At the beginning of a lesson, a teacher will speak for a short time to set up a task, with learners then working independently to decide on an effective strategy and engaging in discussion and 'metacognitive talk' with their peers.

With younger students or those not yet confident with peer work, teachers can provide a structure for discussion, through questions, guidance and templates.

3 Goal setting

During the planning stage, learners should set themselves short-term goals or targets. This might look like a checklist or a success criteria.

Short-term goals:

- ✓ **Keep students on track** – Breaking a learning task up into smaller, more easily attainable chunks, in the form of goals, will enable learners to keep track of their progress.
- ✓ **Make students more productive** – Learners are less likely to procrastinate if they only have to focus on one small task at a time.

“Coming from a program where kids are just clicking through to get to the end, to one where they're monitored, directed, assisted, and held accountable for their learning - that's amazing. With Skye, students have to take the time. They have to understand what was wrong, why it was wrong, and how to fix it.”



Kathy Garcia
Principal, Moffat PK-12



Monitoring (or doing) stage:

4 Questioning

Many learners are intimidated or afraid to ask their teachers or their peers for help for fear of looking silly or inattentive. However, it is important that a teacher creates a safe and comfortable learning space that encourages learners to ask for help and not to fear making mistakes.

This will avoid cementing any misconceptions or misunderstandings they may have into their long-term memory. Asking questions allows learners to not only consolidate their new and prior knowledge, but also enables students to figure out which units they don't understand as well.

Asking questions allows learners to seek feedback and advice on how to improve or adapt their strategies so they can become better learners.

Questions might include:

- ✓ What steps should I take first?
- ✓ What do I already know about this unit?
- ✓ How can I check that I am doing this right?

5 Progress monitoring

Learners need to constantly progress monitoring while completing a task. This might look like:

- ✓ Referring back and assessing their progress towards their goals.
- ✓ Self-questioning to ensure they are on the right track.
- ✓ Checking methods and looking out for calculation errors which might affect the outcome.

6 Improving self-regulation

Self-regulation, or metacognitive regulation, can be defined as one's ability to manage thoughts, feelings, and actions while striving towards a goal. In other words, they are students who actively engage in the full metacognitive cycle and are aware of which phase they are working at.

How can we help learners to improve their self-regulation?

- ✓ **Manage time effectively** – Encourage learners to keep to deadlines and to adapt strategies based on how long the task is taking them.
- ✓ **Remove distractions** – Help learners to remove different distractions and help them to reflect on its impact on their productivity.

7 Developing resilience

When working on a new or difficult task, learners can find it daunting. When learners are stuck, they should ask themselves metacognitive questions, such as:

- ✓ What could I do differently?
- ✓ Have I seen anything like this before?
- ✓ What support will help me? (*for example, books, resources, manipulatives, peers, teachers*)

This will put them in a position to overcome obstacles along the way and, where possible, try different strategies before going to the teacher or teaching assistant for help.



Read: [What Is A Growth Mindset And What Does It Mean For Kids and Parents?](#)⁷

3 min read

Evaluation (or reviewing) stage:

8 Self-evaluating

After successfully completing a task, learners may not remember what they struggled with, and may not realize how much new knowledge they have acquired.

It is important that learners engage in self-evaluation so that the next time they complete a task, they can apply what they have learned and avoid making the same mistakes.

Teachers can encourage self-evaluation by asking learners to review their corrected homework, classwork and exams, engage with teacher feedback and perform self-marking against a success criteria.

Teachers can also ask students to self-question:

- ✓ What did I learn about this unit that I did not know before?
- ✓ What was easy for me?
- ✓ What content was challenging to learn?
- ✓ Do I understand it now?
- ✓ Why did I make the mistakes that I did?
- ✓ Where did I succeed?
- ✓ Where did I go wrong?



“[Self regulated] learners are proactive in their efforts to learn because they are aware of their strengths and limitations and because they are guided by personally set goals”

BJ Zimmerman, *Becoming a Self-Regulated Learner: An Overview*⁸



All AI math tutoring sessions end with a short summative assessment, called the Skill Check Out. This post-session question helps check the student's understanding of the Learning Objective. The outcome of this assessment helps to progress monitor over time and inform the program of lesson objectives the student will cover in future sessions. This is part of the overall reporting schools receive to monitor student progress and engagement with Skye.

**Understanding place value
relationships in multi-digit whole
numbers**

Skill Check Out

Fill in the blank to make the statement true.

The value of the 9 in 1,943 is times greater than the value of the 9 in 698.

TTh	Th	H	T	O
		6	9	8
	1	9	4	3

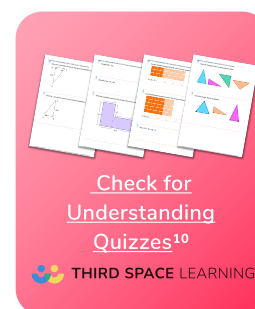
Skills Check Out questions help students to reflect on their learning

9 Test yourself

Learners can use self-assessing to help them remember information and to control the learning process. Self-assessing and retrieval practice allows learners to review what content they know well, identify what they need to practice more, and what they need to re-learn.

There are various ways in which teachers can encourage students to self-test, including:

- ✓ Completing practice tests
- ✓ Quizzes
- ✓ Flashcards
- ✓ Teaching peers



10 Identifying the best metacognitive strategies

There are many metacognitive strategies out there and there will be some which are more effective than others – but this will be highly dependent on the individual using them!

If students spend time building their own individual armoury of metacognitive skills to draw upon, they can make the most out of their learning in the classroom.

Teachers can encourage learners to do this in many ways, such as:

- ✓ Reflect on the pros and cons of the methods and strategies students have used;
- ✓ Rank metacognitive strategies from the most to the least effective for them;
- ✓ Recognize what mistakes they made when trying new metacognitive strategies and what they can improve on the next time they use this strategy.



How to embed metacognition across your school

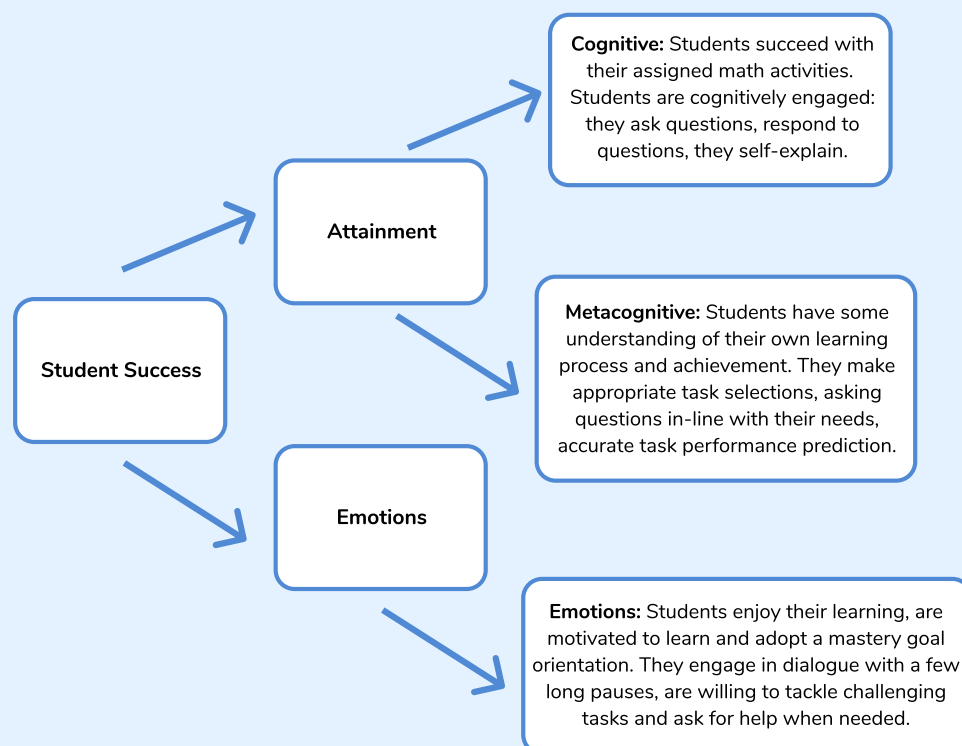
Overall, the costs associated with implementing metacognition in schools are low and can broadly be divided into two main costs: skills and support.

Boosting staff skills

It is key to invest in appropriate continued professional development - this is where the majority of costs associated with metacognition arise. However, it is an essential start up cost as teachers need to be confident in understanding the metacognitive demands of the units they are teaching so that they don't miss opportunities to develop students' metacognitive knowledge and skills.



This explicit training is embedded into the design of the AI math tutor. Skye is trained to promote the development of metacognitive skills within the one-on-one tutoring context.



*Third Space Learning framework for student success,
with a focus on metacognition and cognition*

Supporting staff to develop metacognition

Once teachers have received initial training, schools should support teachers to implement ideas into lessons.

To do this, schools should ensure metacognition features regularly on their professional development timetable, with opportunities for teachers to discuss and share good practice. It is also a good idea to include it as a focus for observations and learning walks to see good practice in action and identify opportunities for further development. This requires school leadership team & staff time and resources to complete, but should be a low cost considering schools should already be covering staff salaries, materials and equipment for teaching.



Third Space Learning's approach to delivering high-quality, metacognition-focused support has been integrated into Skye. This ensures that the AI tutor consistently delivers lessons that encourage and support students' metacognition and offers both an affordable and scalable solution.

Reflect on the success of metacognition in your school

As with any school initiative, it's important to reflect on its success to decide if existing approaches are having the intended outcomes or if changes are required.

Challenges of embedding metacognition

While metacognition is a valuable tool for students, it also comes with its own set of challenges:

1 Metacognition is difficult to define

Metacognitive skills can become automatic, especially for teachers, which can make them difficult to identify, verbalize and teach. It can be hard to be defined and has been described as an 'elusive' concept.

It's also something that we, as humans, sometimes do and develop naturally so it can be tricky to identify concrete examples. However, it is the explicit instruction of these techniques that can have a huge impact on student progress, especially among disadvantaged students.

2 Metacognition requires professional development opportunities for staff

Teachers, and other educational staff, need to be shown how to develop students' self-regulation, emotional control, and independence.

Although metacognition is about learners taking control of their own learning, a teacher's role is vital to develop students' metacognitive skills and strategies to empower them to do so.



A great place for staff to start is over on the Third Space Learning blog:

- [What Is Metacognition And Why Does It Matter For Education?¹¹](#)
- [Metacognition In The Classroom: 6 Tips For a Practical Approach To Teaching Math¹²](#)

3 Metacognition requires careful planning

Metacognition is most effective when embedded in a school's curriculum and a specific subject lesson. As John Hattie says, "we need to know what to do when we do not know what to do. Such self-regulation, or metacognitive skills, are one of the ultimate goals of all learning" (Hattie, 2012).

Introducing new content alongside metacognitive skills can cause cognitive overload, which can hinder the learning process. Metacognitive teaching activities should be strategically integrated to avoid disrupting the ongoing learning process.

Organizing the planning process with the aid of templates, teacher modeling, worked examples, and breaking down tasks into smaller steps can prove advantageous in achieving this objective.

References

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- ⁹ <https://thirdspacelearning.com/us/math-resources/assessments-tests/> 21
- ¹⁰ <https://thirdspacelearning.com/us/math-resources/quizzes/> 21
- ¹¹ <https://thirdspacelearning.com/us/blog/what-is-metacognition/> 24
- ¹² <https://thirdspacelearning.com/us/blog/metacognition-in-classroom/> 24

Further reading

MO EDU-SAIL Educational Systems and Instruction for Learning
 - [https://www.moedu-sail.org/lessons/metacognition-importance-overview/#:~:text=%E2%80%9CWe%20need%20to%20develop%20an,%E2%80%9D%20\(Hattie%2C%202012\)](https://www.moedu-sail.org/lessons/metacognition-importance-overview/#:~:text=%E2%80%9CWe%20need%20to%20develop%20an,%E2%80%9D%20(Hattie%2C%202012))



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