



Kentucky Department of
EDUCATION

Evidence-Based Instructional Practices

Questioning and the Kentucky Academic Standards for Mathematics

The [Questioning Overview](#) provides the research base associated with this evidence-based instructional practice.

What are connections between Evidenced-Based Instructional Practice #5: Questioning and the KAS for Mathematics?

The *KAS for Mathematics* contend:

“In order to create, support and sustain a culture of equity and access across Kentucky, teachers must ensure the diverse needs of all learners are met. Acknowledging and addressing factors that contribute to different outcomes among students are critical to ensuring all students routinely have opportunities to experience high-quality mathematics instruction, learn challenging mathematics content and receive the necessary support to be successful (Adapted from the National Council of Teachers of Mathematics Equity and Access Position, 2018).”

Asking questions to address the content within the *KAS for Mathematics* is important but asking questions to ensure students engage with the content at the depth and complexity required to reach the full intent of the standards is equally important. If teachers do not fully understand what the *KAS for Mathematics* are asking students to know and be able to do, then the level of questioning asked of students will differ across the state and not be equitable for all Kentucky students.

Intentional use of purposeful questions is critical to the successful delivery of instruction aligned to the *KAS for Mathematics*. The questions asked of students (whether embedded in a task, used to drive discussion or provided as the basis for reflection) can provide powerful insight into student thinking. Effectively engaging students in the standards for mathematical practice requires that students are routinely expected to:

- Explain, clarify, and elaborate on their thinking.
- Reflect on and justify their reasoning, not simply provide answers.
- Listen to, comment on, and question the contributions of their classmates.

Student-generated questions are particularly valuable within the *KAS for Mathematics* and are explicitly called for in several areas including, but not limited to:

- When students engage in the four-step investigative process at the elementary level (Measurement and Data) before deepening their understanding around Statistics and

Probability concepts in middle and high school. Students use the statistical process to seek to understand the world around them, taking time to pursue the entire process in order to gain insights, looping back to revise the question or data gathering if the results they have do not adequately address their question (MP.1).

- When students engage in the mathematical modeling process to grapple with real-world situations through the lens of mathematics (MP.4). The *KAS for Mathematics* define Mathematical Modeling as a process in which students identify something in the real world they want to know, do or understand and consider questions such as:
 - What information and relationships are relevant?
 - How might this real-world situation be modeled using mathematics?
 - Does the model address the problem? Does it make sense when applied in the real world? Are the answers reasonable? Are the consequences acceptable?

For more information on the Modeling Cycle see p. 8-10 of the *KAS for Mathematics*.

When designing instruction that integrates the mathematical content and practices in such a way that every Kentucky student will benefit mathematically, questioning is paramount. However, educators should keep in mind that questioning doesn't exist in a vacuum. Keeping this interconnectedness in mind when developing questions and selecting questioning strategies is critical to advancing implementation of the *KAS for Mathematics* and positioning every Kentucky student for future success.

What are planning considerations for the successful implementation of the Evidenced-Based Instructional Practice #5: Questioning to ensure that all students have equitable access and opportunity to learn the standards contained in the *KAS for Mathematics*?

The National Council for Teachers of Mathematics (2014), "Effective teaching of mathematics uses purposeful questions to assess and advance students' reasoning and sense making about important mathematical ideas and relationships." Educators should consider the following:

- **In order to elicit student thinking through questioning, it is important to first cultivate a learning environment where students feel safe and celebrated for sharing their perspectives.**
 - Ask questions that encourage students to reflect on barriers they may encounter and help them think about ways they can overcome challenges. Embedding systems and routines, such as [Routines for Reasoning](#), can better equip students to engage in productive struggle and take ownership of their progress and growth toward intended learning outcomes. While specific routines may vary among educators and even across different class sessions, routines can help foster a sense of predictability and safety for students as they learn mathematics.
 - Provide open-ended questions to allow students to define their own mathematical thinking and not be led in only one pathway to find the solution.
 - Consider how questions might offer all students an entry point into mathematics, such as using [Would You Rather](#) prompts or [I Notice, I Wonder](#) routines.

- Ask questions that encourage students to reflect on their own strengths, draw connections among mathematical strategies/representation with others and revise their thinking, if needed.
- **Crafting purposeful questions is dependent upon teacher clarity around grade level expectations and how learning progresses within the *KAS for Mathematics*.**
 - Utilize [Breaking Down a Mathematics Standard](#) to gain clarity on the target of the standard (conceptual understanding, procedural skill/fluency, application) and where the standard fits within the Coherence/Vertical Alignment. See [EBIP #2](#) for support clarifying and sharing clear learning goals.
 - Anticipate when misconceptions are likely to arise in the lesson and plan to take quick pedagogical action using strategies, such as [Talk Moves](#), to support students to clarify and advance their learning.
 - Reflect upon the depth and complexity of the questions currently being used throughout instruction. As part of the KDE's [Mathematics Assignment Review Protocol](#), the Cognitive Complexity matrix can be a valuable resource for educators to use when reflecting on the current depth at which students are being asked to engage with the content and in considering what, if any, shifts might elicit student understanding at a deeper level.
- **Utilizing questions to collectively move learning forward is difficult to do without structures and supports in place to ensure students are equipped to build off one another's thinking.**
 - Ensure all students get the same [opportunities to communicate and collaborate](#) through classroom discussions.
 - Equip students with moves that might help [strengthen reasoning and communication skills](#).
 - Model questioning for students through think-alouds or think-alongs, including metacognitive or self-questions to empower students as questioners.
 - Utilize activities, like [Which One Doesn't Belong](#), to engage students in explaining their approach to a problem, critiquing the solutions of others and comparing the different approaches in terms of whether they are accurate and efficient (MP.3).

What strategies and resources can support the implementation of Evidence-Based Instructional Practice #5: Questioning within the *KAS for Mathematics*?

- The KDE's [Engaging the SMPs: Look Fors & Questions Stems](#)
As a supplement to the *KAS for Mathematics*, the Engaging the SMPs resource provides guidance on ways teachers can design instruction to allow students to engage in the standards for mathematical practices. Engaging the SMPs resource includes Student Look-fors, Teacher Look-fors and potential Question Stems for each of the eight mathematical practices.
- The KDE's [Getting to Know the *KAS for Mathematics* Module](#) specifically, Section 1C: A Closer Look at the Standards for Mathematical Practice.

Questions often serve as the invitation for students to engage in the practices of mathematics. The discovery task in Section 1C (SMP Sample Task Match Up) might be particularly powerful for teachers to engage in as the conversations around what the mathematical practices might look like in classrooms can be especially impactful.

Included with Module 1 are a [Facilitator's Guide](#) and [PowerPoint](#) that provide suggestions for structuring each section of Module 1, recommended activities to prompt meaningful investigation of the *KAS for Mathematics* and guidance on talking points to use with the provided slideshows.

- The KDE's [Building a Culture of Math Learning Professional Learning Modules](#)
Developed through a partnership between KDE and Leading Educators, this professional learning series can support educators in gaining a deeper understanding of the Standards for Mathematical Practice, exploring related instructional moves (including selecting purposeful questions) and connecting them directly to the mathematical content and standards for mathematical practices within the *KAS for Mathematics*. The modules provide space for educators to practice designing instruction intentionally aligned to a specific mathematical practice, including how to utilize the Engaging the SMPs: Look Fors and Questions Stems within lesson planning.
- The KDE's [Grade Level Samples: Breaking Down a Standard and Assignment Review Protocol](#)
The annotated samples available of the Breaking Down a Standard resource and the Assignment Review Protocol can support teacher clarity around a standard. Having clarity around the target of the standard and where the standard fits within the coherence/vertical alignment can better equip educators to select questions that will elicit student understanding aligned with the expectations of the standards while also moving learning forward. Educators can also reflect upon current questioning practices using the Complexity Matrix (within the Assignment Review Protocol). Annotated samples are made available for each of the resources mentioned above per grade level (K-8) and each conceptual category for high school.