Evidence-Based Instructional Practices

Discussion and the Kentucky Academic Standards (KAS) for Mathematics

The Discussion Overview provides the research base associated with this evidence-based instructional practice.

What are connections between Evidenced-Based Instructional Practice #4: Discussion and the *KAS for Mathematics*?

Effective teaching of mathematics requires cultivating a culture of math learning within the classroom in which teachers facilitate regular opportunities for students (independently and collectively) to engage in the practices of mathematics, including analyzing their own misconceptions and refining their approaches as part of the learning process. Within the *KAS for Mathematics*, the standards for mathematical practice (SMPs) reflect the value of discussion and the view that learning is a social process, implicitly calling for teaching practices that leverage the power of a positive classroom climate and opportunities for collaborative learning. Evidence of the need to cultivate rich discussions within mathematics classrooms can be found within the SMP descriptions, such as:

- **MP.1 Make sense of problems and persevere in solving them** as students explain correspondences between mathematical representations and strategies.
- **MP.3 Construct viable arguments and critique the reasoning of others** as students justify their conclusions, communicate them to others and respond to the arguments of others. Students at all grades can listen or read the arguments of others, decide whether they make sense and ask useful questions to clarify or improve the arguments.
- **MP.6 Attend to precision** as students communicate to others, using clear definitions in discussions with others and in their own reasoning.

The National Council for Teachers of Mathematics (2014) upholds, "Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments." Educators planning to use discussion strategies can support students by:

- Providing every student, the opportunity to share, listen to, honor and critique the reasoning of others.
- Strategically selecting and sequencing "evidence of student thinking" to highlight mathematical ideas and language for whole class analysis and discussion.
- Making explicit connections among student approaches and reasoning. (NCTM, 2014)

Effective implementation of the *KAS for Mathematics* will rely on the ability of educators to

create a classroom culture which encourages students to share their own thinking and to offer feedback on the thinking of others. Equipping students to engage in mathematical discussions will be critical to making the vision of the *KAS for Mathematics* a reality for Kentucky students.

What are planning considerations for the successful implementation of the Evidenced-Based Instructional Practice #4: Discussion to ensure that all students have equitable access and opportunity to learn the standards contained in the *KAS for Mathematics*?

While specific strategies may vary, NCTM provides the following considerations for facilitating productive discussions that support successful implementation of the *KAS for Mathematics.*

When planning discussions, how do I ensure students feel socially and emotionally safe to share in classroom conversations? Consider:

- Attending to the classroom culture. Creating a learning community is essential for mathematical practices that are interpersonal by nature, such as MP.3. For a more in-depth discussion around establishing the learning environment in mathematics, see EBIP #1.
- Exploring incorrect solutions. By thinking about when misconceptions are likely to arise in the lesson, teachers can plan to use strategies, such as Talk Moves, that will support students to clarify and advance their learning. Planning to use these strategies allows teachers to be ready to quickly take appropriate pedagogical action and can offer opportunities to normalize mistake-making and celebrate intellectual risk-taking.

When planning discussions, how do I ensure teachers are responsive to students' interests and knowledge base? Consider:

- Choosing high-level mathematics tasks. Engaging with tasks that provide multiple pathways for success and require reasoning and problem solving in a relevant or meaningful way can be a great opportunity to foster discussion (MP.4). For a more in-depth discussion around selecting high quality, standards aligned tasks, see EBIP #2.
- Examining and planning questions. Using purposeful questions can assess and advance student's reasoning and sense making about important mathematical ideas and relationships (NCTM, 2014). Utilizing activities, such as Which One Doesn't Belong, can encourage students to find and explain correspondences between multiple mathematical representations. For additional support integrating the Standards for Mathematical Practice using questions, access the KDE's Engaging the SMPs: Look fors and Question Stems.
- Being strategic about "telling" new information. Revealing new information in a strategic way is an important part of 3 Act Tasks, a common framework for modeling tasks. Utilizing slow reveal graphs, as demonstrated here, can be a powerful tool in creating curiosity, offering multiple entry points to a discussion on data and eliciting profound noticings from students.

When planning discussions, how do I ensure students feel empowered and equipped to be facilitators of their own learning conversations? Consider:

- Allowing student thinking to shape discussions. Position students as mathematically competent by encouraging students to construct mathematical arguments and engage in the reasoning of others. Empower students to give and receive constructive feedback.
- Using teacher discourse moves to move the mathematics forward**.** Consider what teacher moves might help students strengthen reasoning and communication skills, along with ways to empower students to use similar strategies in collaborative groups. Throughout classroom discourse, consider ways to encourage active listening among students to further explore the arguments of others, asking useful questions to clarify or improve the arguments (MP3).

What strategies and resources can support the implementation of Evidence-Based Instructional Practice #4: Discussion within the *KAS for Mathematics?*

Explicit Teaching of In-Depth Discussion Skills

Teachers must model through words and actions the importance of grappling with content to build a deep understanding; they must equip students with the content knowledge and problem solving tools to find multiple pathways to a given solution; and they must facilitate regular opportunities for students to engage in the practices of mathematics.

- For a more in-depth discussion around explicit teaching and modeling in mathematics, see EBIP #3.
- For additional support engaging students in the practice of discussing mathematics, see KDE's Implementing Social, Emotional and Academic Development (SEAD) within the *KAS for Mathematics* resource library. The resource library is intended to support educators in looking for authentic opportunities to interweave the development of one (or more) social emotional competencies with the development of the mathematics content and practices.

Engaging All Students in Discussion

Sometimes students may memorize terms and definitions or learn how to manipulate symbolic forms without ever drawing connections among them. As a result, students cannot easily apply that knowledge beyond the specific examples or situations used in instruction. Students enter school with informal, personally constructed ways of making sense of math and often use that informal understanding to solve problems. Informal language often relies on superficial features, such as the position of symbols on the page, rather than on the underlying mathematical operations. Consider:

- What opportunities do I have to connect students' intuitive understanding to formal mathematical concepts and notation?
- While it is not harmful to use informal language in the classroom, it is necessary for students to know precise mathematical language and understand the logical meaning behind it (MP.6). How might I model precise mathematical language within my

instruction? Are there any areas where I feel I could be more intentional in this?

Importance of Intentional Planning

To build deep and enduring understanding of math, teachers must place emphasis on the "how" and "why" and push students to justify their thinking. One approach, outlined by Smith and Stein in the book 5 Practices for Orchestrating Productive Mathematics Discussions, involves five stages for highlighting and sequencing student thinking:

1. Anticipate likely student emerging ideas and alternative solutions to mathematical tasks.
2. Monitor students' actual responses to the tasks.
3. Select student responses to feature during the discussion.
4. Sequence student responses in a purposeful order to build a coherent math story.
5. Connect different students' responses through math discussion.

For additional support, see the 5 Practices for Orchestrating Productive Mathematics Discussions.

References

Smith, M. S., & Stein, M. K. (2011). 5 practices for orchestrating productive mathematics discussions. Reston, VA: National Council of Teachers of Mathematics.