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How does teacher pedagogical knowledge impact instruction?

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How does teacher pedagogical knowledge impact instruction?

As teachers' pedagogical content knowledge increases within the context of a strong knowledge of content, their ability to impact student learning also increases.

Research and Best Practice

Pedagogical knowledge means understanding the methods and strategies of teaching. Specific methods or strategies that have been proven to work well in one content area, such as science, are referred to as pedagogical content knowledge. Good pedagogical content knowledge in science is the ability to teach science well.

According to the *National Science Education Standards*, the most direct route to improving science achievement for all students is through better science teaching. However, despite significant changes throughout society over the last half-century, teaching methods in most science classes have remained virtually unchanged. Many science students spend much of their time memorizing facts and definitions.

Student knowledge improves substantially when their teachers have strong content and pedagogical knowledge. Strong teacher content knowledge alone does not change student knowledge. On the other hand, use of effective pedagogical methods without adequate content knowledge does not improve student achievement substantially, and in some cases may actually reinforce student misconceptions.

Three components influence student achievement: teacher characteristics (e.g., educational background, years of experience), professional development (e.g., training to support classroom practices), and classroom practices (e.g., small-group instruction or hands-on learning). The greatest role is played by classroom practices. The most effective practices engage students in higher-order thinking skills and hands-on learning activities. Other proven teaching practices that increase student conceptual understanding, thinking skills, and often attitudes, include use of a learning cycle lesson plan (e.g., exploration, invention, and application), cooperative learning, wait time, graphic organizers (e.g., concept maps), realistic computer simulations or actual observations, clear objectives, and ongoing feedback on student work.

Specific strategies that assist students with learning for deeper understanding encompass generating and testing hypotheses; determining similarities and differences (e.g., comparing, classifying, using metaphors and analogies); summarizing and notetaking; and activating prior knowledge about science concepts. In addition, professional development tailored to increase teacher repertoires of classroom practices, coupled with content knowledge, supports high student academic performance.

To obtain copies of *EDThoughts: What We Know About Science Teaching and Learning*, contact McREL at 303-337-0990 (voice), 303-337-3005 (fax), or info@mcrel.org

Classroom Implications

One teaching method is not better than other methods; however, there are limitations in relying on just one teaching method. Different methods accomplish different goals. Effective science teachers employ a large repertoire of instructional methods, strategies, and models to produce more successful learners. Different methods accomplish different goals for different students. Teachers should carefully select and plan for experiences to provide meaningful science learning opportunities for their increasingly diverse student population. High-quality science teaching

- Includes a deep knowledge of subject matter
- Incorporates inquiry as a primary mode of teaching
- Encourages all students to learn for understanding
- Focuses on the skills of observation, information gathering, sorting, classifying, predicting, and testing
- Fosters healthy skepticism
- Allows for, recognizes, and builds on differences in learning styles, multiple intelligences, and abilities
- Grounds itself in careful alignment of curriculum, assessment, and high standards
- Measures its effectiveness through student performance and achievement
- Builds on real-life situations that apply concepts in new contexts
- Incorporates a variety of technology tools such as computer simulations
- Provides opportunities for discussion and reflection
- Uses ongoing written communications

Contrary to the idea that the ability to teach is innate, specific teaching skills can be acquired through training, mentoring, collaborating with peers, and practice. To change the way they teach, science teachers must have first-hand opportunities to learn in different ways. These varied methods can include inquiry, constructivism, wait time, the learning cycle, graphic organizers, cooperative learning, and science laboratory activities.

Teachers need to observe, practice, and refine high-quality teaching to master the art of teaching science well. As teachers' pedagogical content knowledge increases within the context of a strong knowledge of content, their ability to impact student learning also increases.

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