

Science 101: Different teaching fosters better comprehension

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Calvin Kalman is principal of Concordia's Science College and a professor in the Department of Physics. Credit: Concordia University

Introductory science courses – in biology, chemistry, math and physics – can be challenging for first-year college, CEGEP and university students. Science 101 courses can make or break a student's decision to venture into a scientific field or even pursue higher education.

"The language, fundamentals and scope of science gateway courses can be akin to a foreign culture," says Calvin Kalman, principal of Concordia's Science College and a professor in the Department of Physics. "[Students](#) can have great difficulty reading scientific texts – even when they are written in their native language – and they must also cope with complex knowledge taught by their professor."

Since 1995, Kalman has investigated new ways to ease this learning curve. "The main problem in [teaching](#) science is that its approach is not holistic," he explains, noting high school through university-level textbooks aren't necessarily consistent and don't employ user-friendly language. "They offer layers of scientific results, coming from competing interpretations, deposited during centuries."

Kalman's most recent paper, published in the journal *Science & Education*, followed CEGEP and university students over the course of a semester. He asked that they practice what he calls "reflective writing" – a process where students digest, analyze and pen their thoughts on assigned readings before classroom discussions. "It's a way of getting students to wrestle with materials and grasp their meaning, rather than just summarizing," he explains.

As part of his study, students were interviewed three times and asked to describe how reflective-writing helped their comprehension of course content. "They felt that they had to put the information into their own words, which really helped them refine key concepts," Kalman says. "Reflective writing gets students to initiate a self-dialogue about texts and ask: 'What do I understand?' and 'What do I not understand?'"

Kalman says teaching and learning is most successful when a student's outlook on a course is close to that of their professor. "Students are often looking for basics to pass courses, but that doesn't engage them," he says. "Unless they come to class prepared to ask questions, students end up serving time."

Kalman's solutions aren't radical: He encourages professors to go beyond PowerPoint presentations and lectures to promote critical thinking both inside and outside the classroom. His research has garnered collaborations with peers in Toronto, Vancouver and, internationally, in Portugal, Vietnam and China. Improving science education, Kalman

says, is the only way for nations to remain at the forefront of the knowledge-based economy.

"Bolstering student understanding of basic science courses can improve retention rates in this field," he says. "But if students don't understand what they're learning they'll drop out and we'll lose ideas and people who will move their countries forward. What countries need are people who think critically – who are entrepreneurs – and that begins with how they're taught."

More information: The paper, "Enhancing Students' Conceptual Understanding by Engaging Science Text with Reflective Writing as a Hermeneutical Circle," is published in the journal *Science & Education*. www.springerlink.com/content/y381547786k21420/

Provided by Concordia University

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