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Reflections

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Publisher of ***Introductory Physical Science*** (*IPS*) and ***Force, Motion, and Energy*** (*FM&E*)
Thoughtful Curricula Developing Thinking Students

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Research Results: Making the Case for IPS *and* FM&E

By Harold Pratt

The availability of educational research has made it possible to determine if the instructional approach used in *Introductory Physical Science (IPS)* and *Force, Motion, and Energy (FM&E)* is effective and if it pays off in student achievement. Is it more effective than the approach used in conventional texts? Teachers often wonder about this when they compare *IPS* and *FM&E* to the last textbook they used or to other books being considered for adoption.

IPS and *FM&E* are different—considerably different—than most textbooks, so the questions are to be expected. Often when these questions are asked, it is assumed that a simple, controlled experiment can be conducted to compare the achievement of *IPS* or *FM&E* students with that of similar students studying the same topics in other classes. For such experiments to be successful, large numbers of students are required. Even then, it is virtually impossible to control the many important variables involved. An alternative, which will be used here, is to review what research has learned about the characteristics of effective science teaching and learning, and then compare the "best practices" revealed by those research findings with the pedagogical approach taken in the two courses from Science Curriculum Inc. We looked at two recent research sources and their conclusions about effective science education for a closer analysis of the efficacy of *IPS* and *FM&E*.

AERA Research Points

The first source is *Science Education That Makes Sense*, a four-page report published in summer 2007 by the American Educational Research Association (AERA).* In this meta-study, the authors selected and summarized over a dozen, well-designed research studies on student learning in science. The conclusions in the report included the following:

• **Some difficulties are good.** "Students do not always benefit when instructional materials make learning easier and faster. Requiring students to complete difficult tasks, such as generating a response rather than reading and responding to a multiple-choice question, slows learning but improves outcomes.

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Workshop Dates Announced at the Colorado School of Mines

"The workshop provided me with better understanding of the concepts and skills that students learn from IPS. *I have a passion for the program that was lacking in my teaching previous to attending the workshop,"* 2007 SCI workshop attendee.

Whether you've taught science for years or are just starting out, we've prepared summer workshops that will benefit both you and your students! Save the date for your workshop and, for more information, visit *http://sci-ips.com/ips/workshops_golden.html*.

Introductory Physical Science (IPS) **chapters 1-5**	**- July 13-18**
Introductory Physical Science (IPS) **chapters 6-10**	**- July 21-25**
Force, Motion, and Energy (FM&E)	**- July 21-25**
Writing Test Questions and Constructing Tests for Science Courses	**- July 14-18**

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Difficulties are desirable when students have to explain their answers."

• **Less is more.** Students need time to explore science topics in depth. Too many textbooks cover too many topics and "offer students an extremely incoherent and, at times, almost incomprehensible array of facts." They leave out the connections among ideas. Limited coverage of multiple topics results in an emphasis on memorization more than understanding, leading to quickly forgotten ideas and concepts.

• **Real or simulated experiences lead to improved long-term understanding.** Successful science curricula carefully guide students to gather evidence and connect findings to their existing ideas.

• **Visualizations help.** Research indicates that students gain insights when they are provided visualizations of complex phenomena that help them link school science to everyday situations, rather than using only text or static drawings.

TIMSS Video Study

The second source of research is a report of the *Trends in International Mathematics and Science Study (TIMSS) 1999 Video Study.* The study used videos of 100 randomly-selected eighth grade science lessons to examine science teaching practices in the U.S and four countries that out-performed the U.S. in science achievement on the 1995 and 1999 *TIMSS* Assessments. The study, available at *http://nces.ed.gov/timss*, reported the following:

• **Connecting activities to content.** "Each of the higher-achieving countries has a distinct core pattern of science teaching. In contrast, the U.S. lessons were characterized by variety." High interest activities were selected by U.S. teachers who typically did not connect these activities to the development of content ideas. Science content was more commonly organized as a collection of discrete facts, definitions, and algorithms, rather than a connected set of ideas.

• **Focusing on content increases achievement.** Although each country had its own approach, the higher-achieving countries had strategies to engage students with core science ideas. Their lessons focused on content. In U.S. lessons, content played a less central role and, sometimes, no role at all. Instead, lessons were typically built around engaging students in a variety of activities. One statistic, reported in the study and illustrated in the following table (see page 5), was the percent of lessons containing science content.

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News and Notes...

New Year Necessitates Textbook Price Increase

Science Curriculum Inc. is proud to offer quality curricula at lower prices than other publishers. In order to maintain our high quality of education research we found it necessary to increase our prices as of January 2008. The cost of the *IPS* textbook will increase $3, from $45 to $48, while the *FM&E* text will increase $2, from $33 to $35. For a complete listing of the 2008 price increases, including those for resource materials, see the product price list insert on page 3.

Earn Rewards for You and Your School!

One of the best marketing strategies for our textbooks is "word-of-mouth" advertising by our customers. Now you or your school can profit by publicizing our programs! SCI now offers incentives for "spreading the word."

If you know of a school that does not currently use *Introductory Physical Science (IPS)* or *Force, Motion, and Energy (FM&E)*, talk to them about our programs! Email us your colleague's adoption and contact information and we will add it to our database. If the school then purchases a class quantity of our textbooks within three years of when you spoke with them, you will receive a reward certificate good for any one of the following: a $100 credit for you or your school toward the purchase of any of the products we sell – textbooks, software, or films; a $100 credit for you toward the tuition cost of one of our summer workshops; a $50 cash payment to you!

The choice is yours, so start spreading the word and you can begin earning your rewards. The number of reward certificates you can receive is limited only by the number of "non-user" schools that you talk to and that subsequently purchase a class quantity of one of our textbooks.

(Certificate awarded for an initial purchase only, not for subsequent purchases.)

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Product Price List

(Effective 1/01/2008)

Introductory Physical Science (*IPS*), Eighth Edition (2005)

Haber-Schaim, Gendel, Kirksey, Pratt

Description	Item Number	ISBN	Price*
Student Textbook	SCI-808-4405	1-882057-25-2	$ 48.00
Teacher's Guide and Resource Book	SCI-810-1440	1-882057-26-0	$ 70.00
Assessment Package	SCI-820-9287	1-882057-27-9	$ 42.00
IPS and *Energy* Film "Loops" (VHS format)	SCI-220-2420		$ 40.00
IPS and *Energy* Film "Loops" (DVD format)	SCI-220-2420		$ 40.00

Introductory Physical Science (*IPS*), Seventh Edition (1999)

Haber-Schaim, Cutting, Kirksey, Pratt

Description	Item Number	ISBN	Price*
Student Textbook	SCI-023-9821	1-882057-18-x	$ 48.00
Teacher's Guide and Resource Book	SCI-201-2559	1-882057-22-8	$ 70.00
Assessment Package	SCI-020-5092	1-882057-23-6	$ 42.00
IPS and *Energy* Film "Loops" (VHS format)	SCI-220-2420		$ 40.00
IPS and *Energy* Film "Loops" (DVD format)	SCI-220-2420		$ 40.00

Force, Motion, and Energy (*FM&E*) (2002)

Haber-Schaim, Cutting, Kirksey, Pratt, Stair

Description	Item Number	ISBN	Price*
Student Textbook	SCI-555-2333	1-882057-12-0	$ 35.00
Teacher's Guide and Resource Book	SCI-666-4444	1-882057-14-7	$ 50.00
Assessment Package	SCI-777-3393	1-882057-15-5	$ 35.00

Mass of Atoms Film – Education Development Center, Inc.

Description	Item Number	ISBN	Price*
VHS Version	SCI-VHS-1965	1-882057-09-0	$ 55.00
DVD Version	SCI-DVD-1965	1-882057-10-4	$ 55.00

Diagnostic Analysis – Software for the Analysis of Multiple-Choice Tests

Description	Item Number	ISBN	Price*
Macintosh Version	SCI-192-2216	1-882057-16-3	$ 65.00
Windows Version	SCI-192-2612	1-882057-17-1	$ 65.00
IPS and *FM&E* Test Analysis Files	SCI-192-2650	1882057-20-1	No Charge**

KaleidaGraph Software – Synergy Software (Please specify Mac or Windows)

Description	Item Number	Price*
KaleidaGraph Classroom***	SCI-032-1111	$ 99.00
KaleidaGraph Student 5-Pack****	SCI-032-5555	$ 100.00
KaleidaGraph Building*****	SCI-032-9999	$ 300.00

Ordering Information

School Orders for Textbook, Software, and Videocassette/DVD
Schools ordering our textbooks, software, and/or videocassettes, should mail or fax purchase orders to:

Science Curriculum Inc.
200 Union Blvd., Suite G-18
Lakewood, CO 80228
Fax: 303-989-1473

***Teacher's Guide* and *Assessment Package* Orders**
Copies of the *Teacher's Guide and Resource Book* and the *Assessment Package* are sold only by school purchase order. Since the *Teacher's Guide* is not a stand-alone product, it is sold only to those schools who have also purchased at least one copy of the student text. The *Assessment Package* is sold only to those schools who have purchased a class quantity of the student text.
Please mail or fax your purchase orders to:

Science Curriculum Inc.
200 Union Blvd., Suite G-18
Lakewood, CO 80228
Fax: 303-989-1473

Textbook Orders by Individuals
Parents, students, and interested parties who would like to purchase an individual copy of *Introductory Physical Science* (7th or 8th Editions) or *Force, Motion, and Energy* can do so online or by telephone from Book Ends (http://www.bookendswinchester.com/) or 781-721-5933), or you can place a special order through your local bookstore.

For additional information, please call toll-free 888-501-0957 or visit our website, www.sci-ips.com , or you can email us at sales@sci-ips.com.

* Prices do not include shipping and handling or any applicable sales taxes.

** *IPS* and *FM&E* Test Analysis Files are provided to schools who have purchased the *IPS Assessment Package* and/or the *FM&E Assessment Package*.

*** Class license is for use on up to 35 classroom computers under the control of a single teacher. Available on CD for Windows or Macintosh. Please specify your platform/computer preference when ordering.

**** Student version will run for 6 years. If an upgrade is purchased during that time, KaleidaGraph will continue running for an unlimited number of years. Available on CD for Windows or Macintosh. Please specify your platform/computer preference when ordering.

***** Unlimited use license for use on any school-owned computer in the building. Available on CD for Windows or Macintosh. Please specify your platform/computer preference when ordering.

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Percent of Lessons Containing Content

	U.S.	Czech Republic	Japan	Netherlands	Australia
Learning content with strong conceptual links	30	50	70	27	58
Learning content with weak or no conceptual links	44	50	24	65	30
Doing activities with no content	27	0	6	8	12

As a result of the *TIMSS Video Study*, the researchers documented three implications for improving science achievement. First, teachers should **make the science content prominent** in lessons, with the goal of having lessons focus directly on the science ideas. Second, **devising a coherent storyline** that connects the activities in a group of lessons is an effective way to strengthen the understanding of the science content. Teachers can help by clarifying the learning goal and summarizing and synthesizing ideas along the way. And, finally, as the storyline progresses, teachers should highlight the important ideas and **make clear links between activities and the science content**, emphasizing more than just procedures or results. Often, engaging and motivational activities do not have a clear and explicit connection to the content in the learning goal.

Validation of IPS and FM&E

We think the research findings validate the learning approach used in *IPS* and *FM&E*, basing our conclusions on the following evidence:

• We sometimes hear that both courses are challenging, but manageable, if sufficient time is allotted for students to develop an understanding of the key ideas. As the AERA report points out, "difficulty," sometimes considered problematic, is actually an asset of both *IPS* and *FM&E*.

• Student explanations, based on their experimental data, are at the core of both courses.

• Both *IPS* and *FM&E* have clear storylines - there is clear progression and development of content, both within each chapter and from chapter to chapter.

• Each laboratory investigation has a clear and prominent connection to the content being developed and provides evidence for the content. Students not only must collect evidence, they are also required to use their data to generate explanations.

• Both books are excellent examples of meeting the "less is more" criterion. The smaller number of topics and the deeper experimental orientation of the books promote better understanding of the science content.

• When *IPS* and *FM&E* are presented as written, we estimate that the percent of lessons containing content with strong conceptual links is 90% or better. (See the above table for the average of U.S. teachers.)

A Final Note

The case for the effectiveness of *IPS* and *FM&E* being supported by research seems very substantial, but it must be said that the teacher is the key to the instructional environment in which students learn. Obviously, quality instruction is needed, along with high-quality instructional materials, if the benefits in the research are to be realized. SCI is well aware of this and provides workshops for both courses to support teachers in coupling their professional skills with the course materials.

The instructional strategies or pedagogy of our books matches what research has found to be effective, but the workshops will help teachers utilize the strategies effectively. For dates of the upcoming 2008 workshops, refer to the workshop announcement included in this issue of *Reflections*.

★ *Science Education That Makes Sense* is available online by AERA at *www.aera.net/uploadedFiles/Journals_and_Publications/Research_Points/RP_Summer07.pdf.*

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