2005

Calculus-Based Physics Modules, Authors and Anecdotes

Robert Fuller
*University of Nebraska - Lincoln*, rfuller@neb.rr.com

David Winch
*Kalamazoo College*

Follow this and additional works at: [http://digitalcommons.unl.edu/physicspsikeller](http://digitalcommons.unl.edu/physicspsikeller)

Part of the [Physics Commons](http://digitalcommons.unl.edu/physicspsikeller)

---


[http://digitalcommons.unl.edu/physicspsikeller/9](http://digitalcommons.unl.edu/physicspsikeller/9)

---

This Article is brought to you for free and open access by the Instructional Materials in Physics and Astronomy at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Personalized System of Instruction (PSI), or Keller Plan, Materials by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.
Calculus-Based Physics Modules, Authors\(^1\) and Anecdotes

A poster hosted by
Robert G. Fuller and David Winch

Fifteen experienced Keller Plan physicists gathered on the University of Colorado Boulder campus in the summer of 1975 to create a complete Keller Plan course for calculus-based physics\(^2\). After three weeks, the original drafts, almost 1100 pages, were completed and the authors scattered to their places of employment. This poster tells stories about these module authors since 1975 and how the calculus-based physics modules were used.

Footnotes:
\(^1\) OWEN ANDERSON, Bucknell University, STEPHEN BAKER, Rice University, VAN BLEUMEL, Worcester Polytechnic Institute, FERNAND BRUNSCHWIG, Empire State College, DAVID JOSEPH, University of Nebraska – Lincoln, ROBERT KARPLUS, University of California – Berkeley, MICHAEL MOLONEY, Rose Hulman Institute of Technology, JACK MUNSEE, California State University - Long Beach, GARY NEWBY, Boise State University IVOR NEWSHAM, Olivet Nazarene College, WILLIAM SNOW, University of Missouri – Rolla, WILLARD SPERRY, Central Washington State College, ROBERT SWANSON, University of California - San Diego, JAMES TANNER, Georgia Institute of Technology, DAVID WINCH, Kalamazoo College.

\(^2\) Supported by the National Science Foundation College Faculty Workshop grant, HES75-11210.
I have not made any significant use of the CBP materials except to include it in my resume (I was alphabetically the first named author). I used my own self paced, mastery based materials extensively in small class, summer school courses where they worked very well. My colleagues in the physics department were never very enthusiastic about teaching in the self paced format and after the CBP modules became available I was not involved in teaching the appropriate course. My department spent much more effort in development of an introductory course with a much more modern physics approach than any materials based on the classical texts that were used with the CBP modules.

A Keller Plan course persisted at Rice for a number of years, perhaps as many as ten, after the CPB materials were produced, but I was not teaching that course after about 1980. I think, during that time, we made use of the set of mastery tests that was in the CBP materials when they appeared. At that time, both Keller Plan and regular lecture mode courses were being taught. But with changes in the syllabuses of the "engineering" and "pre-med" courses and a contraction of personnel in the department devoted to these courses, the Keller Plan was abandoned. I think my experience with Keller Plan did affect the way I subsequently approached my role as a course lecturer/supervisor, but I also grew more doubtful of the "mastery" concept, since end-of-semester exams didn't seem to indicate greater understanding of the material by Keller Plan students than by students in conventional format courses.
CBP Author

Van Bluemel
Worcester Polytechnic Institute

Worcester Polytechnic Institute physics department continued to use the Keller Plan for a few years after 1975.

CBP Author

Fernand Brunschwig
Empire State College

I haven't actually used the CBP modules. I've taught lots of other subjects and done lots of other things, including administration and now science teacher education at graduate level, but my physics students were occasional, and most of them weren't pursuing a calculus-based course.
Dave Joseph recalls attending Ben Green's summer workshop at MIT before starting his Calculus-based Keller Plan physics courses, 211K-212K. A starting year of 72-73 for him is likely since he had well-developed materials by the time of the CBP project in 1975. He continued to teach Keller Plan CBP courses into the late 1970s and went on to other commitments by about 1980.


Professor Karplus continued to teach Keller Plan calculus-based physics at UCB after the summer of 1975. He used mostly his own Keller Plan materials, borrowing some items from the CBP materials. He turned the Keller Plan courses over to other faculty members in the late 1970s as he went on to other tasks. The Keller Plan disappeared at UCB after a few years.
I regret to say that I only used the CBP modules for a student who transferred into Rose in the late 70's. The physics he had taken did not fully meet our specs, so I gave him a set of maybe a half dozen modules to work out to satisfy the course requirement for transfer credit.

CBP Author

Michael Moloney
Rose Hulman Institute of Technology

I used the materials that we produced at Colorado for about five years. I modified the materials considerably based upon the mistakes that students made on the tests in an effort to increase the pass rate of the tests. Things generally went well in the course until the time of the first exams in other courses at which point the number of students taking tests dropped off considerably and never fully recovered. After about five years we switched textbooks, and I had to drop the Keller Plan as it was becoming too much of a burden on the department secretaries (this was before we had word processors) to produce the new materials and continually revise them. The experience of using the Keller Plan taught me much about how students learn and what problems they had with specific materials which then modified my courses when I went back to the lecture method. My workload went down considerably when I went back to the lecture mode, but I felt that the students weren’t getting as much out of the course as they would have gotten had I continued with the Keller Plan. As with any method of instruction, it wasn’t good for all students nor all professors. But for those students who liked it, I think that they got a better understanding of the material. Three or four of my colleagues at CSULB tried the Keller Plan. Some used the material that we produced, and some didn’t. One thing that caused a problem was that we had adapted a new text (Bueche), and it was so disliked that we dropped it at the end of one semester. Some of the people who used the Keller Plan were so discouraged at the prospect of adapting the Keller Plan to a new text that they dropped the Keller Plan.

CBP Author

Jack Munsee
California State University
Long Beach

(doing a gravity experiment on my 70th birthday)
In the calculus based physics course that I was teaching for several years after 1975, I exclusively used the workshop modules along with Halliday and Resnick. I certainly made a 110% attempt to use the Keller Plan successfully but I apparently came away feeling that it wasn’t that much better than the traditional lecture approach and it certainly wasn’t as efficient in handling large classes. I apparently didn’t impress my colleagues with any big strides with the Keller Plan as it was not used in the CBP course after I rotated out. I did use the modules, in making up transparencies during my next tenure in the CBP course but I don’t think I used the sample problems from the modules because I chose problems from the assigned textbook.

I used CBP for about 3 years in my general physics classes and then went on to another responsibility at my institution (not teaching). It was interesting for awhile but needed lots of tweaking and pedagogical changes to be effective. I am currently back teaching physics and engineering with combined online and face-to-face instruction.
Thanks for making me aware of your presentation on the rise and fall of the Keller Plan. Shortly after John Park and I collaborated on developing the PSI at UMR, I was lured away to Silicon Valley industry, and have lost track of physics teaching. I haven’t used PSI since my Rolla days. I did the demonstration lecture for all the students in the CPB course at UMR in the 70’s, and a couple of the many quiz sections for the course. You don’t get close to many students in the lecture, but in the Keller quiz sections, I really enjoyed observing and engaging in the student-to-student efforts to pass the torch of knowledge. It’s fun to see the lights go on when they finally get it, isn’t it?

Keller talked to the PNACP in the late 60s or early 70s. His talk was "Goodbye Teacher" and was revolutionary in both good and bad ways. He left no doubt in my mind that his method was worth trying, and I did. A technology improvement that was important to implementing the Keller Plan at that time was the then recent change over from a mimeo-based production of the course materials to a copy machine-based one. It was now easier for a potential KP author who had scissors, Scotch tape, and a photocopy machine to produce and modify the necessary voluminous materials more-or-less âla do-it-yourself. By far the most positive KP experience for me was the Boulder workshop. The missionary zeal with which we worked together created an intellectual and social experience nonpareil. But, I overlooked that it had taken us 45 man weeks to produce just a part of a KP course. In spite of my continued enthusiasm for Keller’s ideas actually teaching the KP course was not satisfactory, mainly because I didn’t have time to get the course together the way I found I wanted it to be.
When the CBP materials were published, we at UCSD switched our Keller plan introductory physics over to using them. They remained the core of the course for many years, but of course evolved as other faculty taught the course, edited the modules, and wrote new quizzes.

Our department only used the Keller/Self Paced Plan in the calculus based introductory physics course (60 - 90 students) until 1990. From 1990 to 1992 students had a choice between the lecture format and the Keller method and we discontinued the Keller Plan in 1993. On occasion I used the Self Paced Plan in our junior/senior level thermo/stat. mechanics and modern physics courses. I have always a modified form of the Self Paced Plan materials (Objectives, Background, Problems without solutions and sample tests) in every course that I have taught since 1978 - this put to an end the "what is going to be on the test" question.

In 1982 the University of Nebraska-Lincoln hired me to adopt the CBP materials for their Correspondences College and I revised the UNL lessons in 1986.
I graduated from St. John’s College in Annapolis, the “Great Books Program,” with a BA in liberal arts in 1970. I then worked as a science editor in New York for several years, including a stint as the Senior Editor of the Journal of Chemical Physics for the American Institute of Physics. Reading physics all the time, I decided I wanted to become a physicist. Because my education was classical and did not include modern math and science, I attended the University of Nebraska at Lincoln in 1974-75 as a physics undergrad to make up my deficiencies to apply for graduate school. Dr. Pearlstein, one of my teachers, told me that Dr. Fuller needed a science editor for his project, and in the summer of 1975 I worked for him to help produce the Keller Plan Calculus-Based Physics modules.

Dr. Fuller had hired several technical typists to type the manuscript on IBM Selectric typewriters with a symbol ball. For those who know, this is an extremely tedious, time-consuming job as you have to change the ball constantly. I would mark up the copy to be typed (for grammar, spelling, style, which symbol to use, etc.), proofread the typed pages against the handwritten manuscript, and then type the corrections, producing camera-ready pages. I worked in the sub-subbasement of the physics building, right next to the nuclear reactor. Dr. Fuller never knew, but it was very creepy down there, especially on weekends, and I would sneak my dog Maedh in to lie at my feet as I worked.

The Keller Plan fascinated me and I worked through many of the modules, both to check that the ideas were clear to an undergraduate working on his own as well as to help me master physics. Dr. Fuller was a wonderful boss and a superb physics teacher, who made physics seem so simple! He did an amazing job of getting the authors to produce complex material in a simple format and style that made physics accessible to an independent student. He always found time to help me with producing the modules or understanding the physics. The other authors were also extremely dedicated and prompt in responding when a question concerning their modules came up.

All in all, the summer of 1975 was a fantastic experience that helped me not only understand physics but realize that I was not a physicist. I ended up getting a Master’s in Biology, my true love. I worked in a molecular biology lab for several years as a lab assistant. I created a science magazine for children and have also been a biology teacher at the high school and college level. Currently I edit biology journals for Cold Spring Harbor Laboratory Press in New York.
I remember enjoying getting paid and keeping busy doing whatever I was asked to do, and having fun getting to use the physics I had learned the year before. I think there was a main entrance area with donuts and or other snacks that made it extra fun to come to work. It was very exciting to be part of a team project that had so many friendly people working together to make things better for future students. I felt important. I also recall very much enjoying the Boulder area, including some hiking, climbing the 3rd flatiron and hearing learning about the strange weather that Boulder can have with freak snowstorms in August. One family highlight of the summer was going to the campus football stadium for a big 4th of July fireworks festival. It was a very festive and beautiful evening.

I remember bombing across the plains in a 44-hour sprint from Pennsylvania to Boulder. The gorgeous dining room with the spectacular view of the Flat Irons is etched in my memory. It made meals there a real pleasure. And there were several hikes in mountains to see the Flat Irons from behind and other sights. My memory of working on problem sets is vague, but the experience made a mark because the name Karplus has always brought back memories of that summer.

Andy and Ted, both high school students and sons of CBP module authors, were hired to work the practice test and the three mastery tests that went with each module. They worked on them independently and were supposed to keep track of how long it took them to complete each test. Then we checked their work against the grading key and if it took them longer than 10 minutes we thought it was too tough for our typical students and we made the tests shorter.
After the CBP workshop he returned to UNL with about 1100 pages of rough draft materials for a complete calculus-based Keller Plan physics course. Catherine A. Caffrey was hired as the copy editor with complete control over the final production of the CBP materials. She hired several technical typists and the final product was ready for reproduction by October. A total of about 800 copies were made and sold, for about $10 each plus postage. They were printed on only one side to make copying by the user easier. The complete set was a stack of paper about 15 cm thick! Once the CBP materials were completed the UNL Correspondence School decided to offer a correspondence course for CBP. They hired Dave Winch to prepare those modules, based on the CBP materials. They became available at Physics 211X and 212X in 1982. In the fall of 1976 Fuller went to UC Berkeley and taught the Keller Plan CBP course there for Robert Karplus. Karplus had run both semesters of the physics course via the Keller Plan at the same time. In the fall of 1977, after he returned to UNL, he offered the CBP Keller courses at UNL for a while and he ran both semesters of the course at the same time. At one time there were four physics faculty members at UNL who had taught using the Keller Plan and they had offered algebra-based physics, CBP, introduction to modern physics and thermodynamics via the Keller Plan. The Keller Plan faculty members’ teaching assignments gradually evolved into other courses and the Keller Plan courses ended at UNL in about 1980.

Robert Fuller received funds to hire the UNL Instructional Media Center to make the 16 mm film, *Personalized System of Instruction: An Alternative* (black and white, 13 ½ minutes) in 1972. He also co-authored a guide to the Keller Plan with David Joseph and Vernon Williams for the UNL Media Center in 1974, *A Guide to What, How, Why and Why Not of PSI*.

He spent the 1975-76 year as a visiting faculty member at UNL where he assisted in the production, sales and distribution of the CBP modules. After he returned to ICC, he used some Keller Plan ideas in his teaching, but he never taught the CBP course as a Keller Plan course.