Genesis of Elementary Analysis Courses

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The 1960s was a time of turmoil and change for our nation, education, and mathematics. One change after the 1960s was that more students attended college, many with weaker backgrounds and diverse expectations. This led to changes in the goals and curricula in college and precollege mathematics. Some of these changes were national efforts—for example, calculus reform and discrete mathematics—undoubtedly because they involved client disciplines outside mathematics where students needed calculus for a variety of reasons. Meanwhile, largely within the confines of mathematics departments, elementary analysis courses were quietly popping up without any organized national effort.

This happened spontaneously in response to the following changes. Prior to 1960, calculus courses were taught almost exclusively at the college level, and these courses included a fair amount of theory. The few students who were motivated to go on in mathematics and study analysis at the junior-senior level, as exemplified by the fine "baby Rudin" book [3],[1] were able to cope if not thrive. In the 1970s, the calculus courses dropped their focus on theory to accommodate the diverse skills and interests of their clientele. The gap between these calculus courses and the rigorous baby Rudin courses posed a big problem.

Several college teachers independently tackled this problem, and I was among them. Since my effort led to a text [2] that was widely used and helped make the addition of elementary analysis courses to core mathematics curricula a viable option, I thought it might be of interest to describe the process that led to our course at the University of Oregon. I was the colleague most focused on the problem during the 1970s.

When I arrived at Oregon in 1965, an honors calculus sequence was already in place. Up to about 1970, this sequence served the better students well, though sometimes the better students would master the theory at the expense of learning the techniques. And some of the less-motivated students would get discouraged and leave mathematics when they might well have evolved into strong and useful members of the mathematics community. Also, more and more of the better students were coming to college with advanced placement in calculus and were not motivated to go back and take an honors calculus sequence that necessarily began at the beginning.

Since many worthy students did not take our honors calculus sequence, we experimented with the idea of offering an optional two-credit adjunct to the standard calculus sequence. The experimental courses worked well for a limited number of students,[2] but making this a standard course presented logistical problems with scheduling and

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[1] *This book was affectionately called "baby Rudin", because he wrote two other fine textbooks that were more advanced,* [4] *and* [5].

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[2] *Seven students completed the sequence in 1974–75.*

staffing. We were also concerned that, as with the honors calculus sequence, too many potentially successful mathematics students would either miss this optional minicourse or get discouraged in it. Moreover, others who didn't take this adjunct sequence might feel at an automatic disadvantage if they were to pursue more advanced courses in the mathematics program. For a while we used a very nice book by Colin Clark [1].

We finally made the big decision to require mathematics majors to take a one-quarter course that would bridge the gap between calculus and the baby Rudin course. It would also provide other students with a basic background so that they would prosper in analysis courses such as several-variable calculus, differential equations, numerical analysis, complex analysis, Fourier analysis, and mathematics for physicists.

With this required course in mind, I contacted my friend Colin Clark (at the University of British Columbia in Canada) for permission to have our bookstore copy and sell his out-of-print book. Colin consulted his barrister,[3] who advised him to deny such permission. At about the same time, the assistant head of our mathematics department told me that we couldn't or shouldn't require an undergraduate course without a text. I responded, "Then I'll write one." The rest is history [2].

It may be of interest that I was the only teacher of this course until the book was published in 1980.[4] I used my own notes, and I wrote and rewrote the key sections up to §26 using feedback from the students. I never taught the course again, because I feel students in such a course should get two points of view: that of their teacher and that of the textbook. Incidentally, the course assumed that the students were sufficiently comfortable with derivatives and integrals, so it focused on convergence of sequences and series, uniform convergence of sequences of functions, and so on.

In January 1978 I sent the book proposal and most of the first four chapters (§§1–26) to the Springer editor Walter Kaufmann-Bühler.[5] The mathematician-editors for the Undergraduate Texts in Mathematics were Frederick Gehring and Paul Halmos; Paul was my patron. I explained that I would not submit the proposal to any other publisher.

After the book was published, more than one person wrote and thanked me for writing the book because "they" had created such a course. I resisted offering a second edition until early 2012. Fortunately, Springer had always asked whether I wanted or needed a new edition, not the statement "it is time for a new edition," with the understanding that this was not optional, because this was the way to obstruct the used-book market. A key feature of the second edition is that the first edition is embedded in it with compatible numbering of sections, theorems, lemmas, examples, exercises, etc. In other words, users of the first edition will find the transition to the second edition quite straightforward.

I am happy to admit that I had baby Rudin [3] on my desk while I was writing my book [2]. My intention was to have my book provide a relatively smooth transition to Rudin's book. There was one topic that I was not going to include unless I could do better than Rudin—that was Riemann-Stieltjes integrals [3, Chapter 6]. However, I was able to modify the treatment so that the results were more in line with the more generalized Lebesgue-Stieltjes integrals, so I included this development in my book [2, §35].

References

[1] Colin Clark, *The Theoretical Side of Calculus*, Wadsworth Publishing Co., Inc. 1972.

[2] Kenneth A. Ross, *Elementary Analysis: The Theory of Calculus*, Springer-Verlag, two editions: 1980, 2013.

[3] Walter Rudin, *Principles of Mathematical Analysis*, McGraw-Hill, Inc., three editions: 1953, 1964, 1976.

[4] _____, *Real and Complex Analysis*, McGraw-Hill, Inc., three editions: 1966, 1974, 1987.

[5] _____, *Functional Analysis*, McGraw-Hill, Inc., 1973.

[3] *Lawyer or attorney.*

[4] *There were four of these well-attended courses from fall 1977 through fall 1979.*

[5] *Walter was a wonderful editor who understood and loved a lot of mathematics. He died way too young!*