

The Keller Plan: 25 Years of Personal Experience

Paul Herzberg
Psychology
York University

The system of instruction introduced by Fred Keller (1968) and subsequently known as the Keller Plan has been the basis for 21 offerings since 1976 of an introductory statistics course that I direct within a Department of Psychology. The course is a full-year course with a typical enrolment each year of 120 students. It is one of several courses which satisfy the Department's requirement that all Honours BA students complete introductory statistics. Many of the students enrolled in the course have considerable anxiety about their ability to learn statistics and mention the structure and support available in the Keller Plan format as features that attracted them to it. In this article I wish to describe the course, accenting those features to which I attribute its notable success in facilitating student learning. However, the system is complex and presents many challenges to instructors seeking to design a course around it. I will, therefore, also mention these difficulties and some of the means by which I have confronted them.

The Keller Plan

The primary features of the system as Keller (1968) described it (also referred to as the Personalized System of Instruction, PSI or Individualized Instruction) are:

- an emphasis on written materials that are divided into small units called modules
- a clear statement of the objectives of each module
- a requirement that students attain mastery of the objectives as evidenced by their performance on criteria-referenced unit quizzes that may be repeated if necessary
- infrequent lectures and demonstrations, presented primarily for motivational purposes
- undergraduate students called "proctors," "tutors" or "teaching assistants." These students administer quizzes, provide immediate feedback on quizzes, and offer tutoring and social support.

The central unifying aspect of Keller's proposal was the application of Skinnerian behaviour analysis principles to university instruction. However, I have not found these principles essential to the conduct of the course, and I have not used them to guide my design and modifications over the years. Rather I have proceeded more pragmatically, discussing problems and potential modifications with my students and teaching assistants, and then implementing the proposals we find most practical. The Keller Plan was the subject of considerable research in the 70's (for reviews of this research see [Kulik, Kulik & Carmichael, 1974](#) and [Kulik, Kulik and Cohen, 1979](#)) and was even the topic of a journal, the "Journal of Personalized Instruction". Despite extremely favourable reports of the format's value for learning, the Keller Plan is infrequently cited today, and I am unfamiliar with any other courses currently offered with this format as a basis. [Gallup](#) (1995), a strong advocate of the system, provides an interesting personal account of the difficulties he encountered in his attempt to maintain Keller Plan offerings over the years and the reasons he eventually gave up that attempt. I make no attempt in this article to prove the efficacy of the Keller Plan, nor to argue that its complexity can be easily overcome. My purpose is to document my experience with a structure that I feel has enhanced my teaching over a lengthy period, and I hope the example may encourage others seeking to enhance their own teaching.

Course Description

A detailed description of the current offering of the course is available in the [2000/01 Course Outline](#), the outline distributed to all students entering the course. Here I will describe in a more general way the features that I have retained from the Keller Plan and the modifications that I have introduced over the years. Those features I have retained relatively unchanged are: the division of the course material into

modules with extensive printed material for each, mastery quizzes for the regular modules, self-paced study of the modules, and tutorial assistance from undergraduate tutors (TAs) in a teaching lab devoted to the course.

The self-pacing has worked less and less well through the years and I have had to set deadlines for quizzes. Other modifications include: the addition of periodic review modules with non-mastery quizzes, the inclusion of regular lectures and problem sessions given by me, and the removal of TAs from any involvement in the evaluation of students with a shifting of their focus to tutoring and advising students. I will make a few comments on each of these modifications in the following section, but understanding them will require first some attention to the importance of the teaching lab and the interactions that occur there.

Physically the teaching lab has tables with seating for about 20 in a central area surrounded by a dozen small cubicles with space for one person. The lab is open to students for three or four hours each day, and one or more of the undergraduate TAs is available in the lab each of those hours. Students come to the lab to write their quizzes and to seek help with course material from the TAs or from other students. Students write their quizzes independently when they are ready for them, provided the deadline for the quiz has not passed. In the lab the TAs hand out and receive the students' quiz sheets; students work on the quizzes individually in the cubicles. Because students may consult their texts, notes and calculators freely during the quizzes, monitoring of the students in the cubicles is not a concern.

Quizzes are not marked immediately, but the results are posted in the lab the following day along with an indication of the objectives addressed by questions answered incorrectly. The marked quizzes themselves are only available for viewing at fixed times just before review exams. The quizzes consist of ten multiple-choice questions and students must answer eight correctly to satisfy the mastery requirement. Those who do not achieve eight correct must return to the lab for another attempt to demonstrate mastery; however students are not allowed to make this second attempt without turning in an acceptably completed assignment for the module. The acceptability of the assignments as well as the quizzes themselves are evaluated by a paid graduate assistant. If necessary, students may make repeated attempts to demonstrate their mastery of a module. Multiple forms of each quiz are prepared, thus reducing the likelihood a student will encounter the same questions when repeating an unsuccessful quiz.

In the central area of the lab students can seek assistance from the TAs, study course materials or prepare assignments, either alone or in groups. Prior to attempting the quiz on a module, students are encouraged to complete the associated assignment and practice quiz and then to review these with a TA in the lab. The lab has become very popular for these purposes, and many students build specific times into their schedules to work there. The atmosphere is supportive and formalizes the kind of assistance which students sometimes try to arrange amongst themselves in other courses. The fact that students write their quizzes in the lab probably enhances the use of the TAs considerably. In the process of writing their quizzes students quickly become familiar with both the TAs and the location. They see students asking questions of the TAs and others, and the advantages of the assistance offered there soon become clear.

Modified Components

The details of the weighting of the various assignments, quizzes and exams for the computation of a final grade can be found in the [2000/01 Course Outline](#). The original Keller plan imagined students simply continuing to master units indefinitely, eventually completing all units successfully and earning a grade of A. In practice, matters have been much more complicated, and the current implementation attempts to balance many factors; for example, the advantages of self-pacing with those of a structured learning environment. In this section I would like to comment further on aspects of the Keller Plan that my experience has led me to modify.

Deadlines

In the first year of the course students were permitted complete self pacing. Their mark was based on the number of modules they were able to master by the end of the course plus their final examination performance. However, many students left numerous modules until the final week or two of the course and they were generally unsuccessful, both with the modules and the final exam. Many other students, recognizing a bit earlier the inevitability of such an outcome, withdrew from the course. In fact, nearly half the students enrolled in that first offering of the course dropped out without credit, about double the percentage typical for our Department's statistics courses (20 to 30%). As a result, self-pacing has been restricted in subsequent offerings by establishing deadlines for completion of the regular module mastery quizzes. Students are permitted now to attempt a quiz anytime prior to the deadline, but those who have not been successful by the deadline for that quiz receive no credit for the module. The structure provided by deadlines has greatly reduced procrastination and the drop rate to the more typical level (though I have never been able to reduce the drop rate below that level).

Of course, some students have difficulty meeting the deadlines. For several years I tried to encourage such students to keep learning by frequently granting them extensions of deadlines. Unfortunately, these extensions were often not satisfactory as, once behind, many students stayed behind, found the lectures less and less useful, etc. Instead of granting extensions, a grace period was introduced in 1995/96 and has worked quite well since then to offer some flexibility to all students. During the grace period, the seven days immediately following a quiz deadline, students may still write a quiz, without penalty, and without seeking special permission. There is a catch however. Students who wait until the grace period to attempt a quiz are on their own in the sense that if some misfortune prevents them from writing the quiz in the grace period, they can not seek any further extension because of that misfortune. Of course, some students begin to view the end of the grace periods as the "real" deadlines and plan their work to those dates, and by the final weeks of the course relatively few are completing quizzes before the originally established deadlines. But the concept of a grace period has been a very successful means of balancing flexibility and structure in a manner that assists students to complete their work in a timely manner. Interestingly, while I used to agonize over the appropriateness of each extension request, the grace period concept has allowed me to feel relatively comfortable denying most requests—though I do continue to grant extensions when circumstances seem to warrant them.

Review Modules

By design each module of a Keller Plan course deals with a relatively narrow set of topics. In the early years of the course I saw that mastery of the separate modules did not guarantee that students would learn to integrate the topics of the separate modules. Thus I introduced review modules emphasizing synthesis of concepts and the practical use of them in reading published papers with statistical content. The course kit contains several papers associated with the topics of the regular modules; these papers are reviewed in the review modules and questions about them are included on the review exams. Four review modules are spaced evenly through the course and students take an exam associated with each. Unlike the quizzes, which are always in multiple-choice format, these exams require written responses and problem solutions. Also the mastery requirement does not apply to them; they are offered at fixed times and may each be written only once. The rationale for this limitation is simply pragmatic—the resources of the course and the time available for completing the course are insufficient to proceed otherwise. The review modules have improved students' preparedness for the final exam in comparison to the early years of the course, and many students mention the comprehension benefits that come from seeing the statistical concepts used in a realistic context.

Lectures and Problem Sessions

One of the aims of the course is to have "everything in print," but this does not mean that class meetings would be superfluous. Because comprehensive text material is available, the lectures do not have to cover all the all the topics in the modules but can focus on difficult topics and on giving an overview of each module. The lectures are quite interactive, featuring work with real data sets and samples as well

as many demonstrations. They also aim to help students integrate the modules and prepare for the review exams. There are two lecture periods per week. The first, a two-hour meeting, provides a general discussion of the current module. The second, a one-hour meeting, is a problem session during which the current assignment is discussed. Students are expected to bring questions about the assignment to that class and to have read the published paper associated with the module. Discussion of the paper is intended to help students learn how to read such papers, how to extract the most important ideas, and how to read the graphs and tables in them.

Undergraduate Teaching Assistants

Many of the students need a lot of help to complete the modules successfully and since they are proceeding at their own pace, it is important that help be available on a regular basis. It is obviously not possible to provide such extensive help alone. I select about a dozen undergraduate students each year to serve as teaching assistants. These undergraduates are not paid for this work but register in an independent study course for which they receive credit. They are selected on the basis of their excellent work in a statistics course the previous year and their promise as teachers. Their independent study course, [Teaching Statistics: 1 and 2](#), consists of further improving their knowledge of statistics and developing their skills as teachers. They are expected to formulate a set of personal goals at the beginning of the term and each meets with me at the end to discuss what has been achieved, essentially a self-evaluation. The grade they receive is based on the quality of their work. Given the careful preselection, I make the assumption that all TAs will earn a grade of A. Prompt feedback is provided to the very few who appear not to be meeting the expected standard. Consistent with the print intensive Keller Plan a [TA Handbook](#) is prepared for the TAs addressing expectations for them and providing supporting material.

The TAs do learn a great deal. While their administration of the quizzes is vital to the course structure, their learning is primarily in the context of tutoring and preparing for it. We meet together as a group for two hours each week to discuss the content of upcoming modules, review the associated assignments and prepare for the most likely student questions. The TAs each spend three hours per week in the lab responding to questions on the practice quizzes which accompany each module (but not on the actual quizzes), on the assignments and on the material generally. They are not expected to “know everything” and are encouraged to help students find their own answers when possible. A common theme in TA reports of their own learning is the fact that participating in these discussions with students and preparing for them has led to a much deeper level of understanding than they had anticipated with respect to concepts they thought they had already learned.

Do the TAs facilitate student learning? The students certainly believe they do, giving high marks to this aspect of the course. My own impression is that being students themselves, the TAs are able to empathize well with the statistics students and thereby appreciate and respond well to their questions. Many students who would feel awkward about asking questions in class or who feel their questions are too elementary to bring there are willing to approach a TA for assistance. More surprising to me than the quality of their tutoring is the extent to which the TAs have been willing to invest themselves in the creation and development of resources to assist the students. Several of these have been incorporated into the regular material of the course, for example a math preparation module by Linda Di Francesco; the *Mathematics Preparation Manual* by Alison Longhorn and Darryle-Anne Zink; *Discover Graphing!*, a graphing manual by Deborah Buehler; and *Steps to Statistics*, a set of general tips for students by Rose Monacelli. The TAs offer an Orientation Workshop and a Calculator Workshop in the first weeks of the course and it is common for one or more TAs to construct and offer materials or workshops on other topics during the year. The weekly meetings often feature lively discussions of suggestions for improving not only the tutoring, but also the course in general.

The Critical Features?

The Keller Plan is a complex system and a good deal of commitment to it is necessary to implement and maintain it in its full form. Such commitment does not come without cost, and I have sometimes

speculated whether my own commitment is not instead a single-mindedness that has come at the expense of broader teaching possibilities. While I am satisfied with my choice, I am not surprised that others might ask which features of the Keller Plan are most important for its success, seeking to gain the benefits of those features without the complexities of the system as a whole. I do think it is fair to say that the course has been successful. It is well-known and popular with the students, despite the feared subject matter. Students appreciate the great amount of help available and the flexibility in writing quizzes. I believe all the features described above have contributed to the success of my course, but which do I believe are the most critical? Perhaps the difficulty of implementing these critical features explains the apparent demise of the Keller Plan.

- First and foremost, I believe the course could only have carried on with the superb set of quizzes created by Elke Weber from 1979 to 1982. She started her work as an undergraduate and completed them while a graduate student at Harvard. (She is now a full professor at Columbia University.) These multiple-choice quizzes with many parallel forms are truly exceptional. Each question is based on one of the objectives for the module. These objectives, and a practice quiz, appear in Weber's study guide. The questions were derived in part from a large set of actual answers to earlier completion-form quizzes, but, more important, were created following a rational model of how students answer these questions. Each wrong answer is based on a particular misconception or error. Only by having quizzes of sufficient difficulty and depth can a university-level Keller course be justified. I was fortunate that Elke Weber was around when I started the course and my textbook.
- As already noted above, I make a distinction between regular modules and review modules. If a course has only regular modules, it is too easy, and students aren't being challenged by the depth and breadth of review modules. A university course has to have more than just regular modules, even with the exceptional quizzes that Weber created.
- The course materials are very extensive and thorough. They include the textbook I wrote (Herzberg, 1983), Weber's study guide (Weber, 1983), and a 200+ page course kit that I revise each year.
- The TAs are very carefully selected and I keep in close touch with them throughout the course. I observe them in the lab and meet with them weekly. In short, they have supervision together with considerable independence. They do not work in a prescribed mode in the lab, but rather use their intelligence and creativity to develop new teaching strategies on their own or by observing other TAs. It is always very satisfying for me to work with the TAs in my course. The 267 TAs I have had in the past twenty-five years are among the finest people I have known. Eighty of them returned for a reunion in May, 1999, and it was very moving to hear many of them speak of their work in the course as a highlight of their undergraduate programme. I must say that they have been my teacher as much as I have been theirs.

I acknowledge some disappointment that the course and, perhaps, the Keller Plan itself are not likely to continue beyond my retirement in a few years. I will be very pleased if my account encourages some instructors to explore seriously the features of the Keller Plan which, in my career, I have found so beneficial to my students.