Orientation for the new teaching assistant—A laboratory based program

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A traditional part of the "education" of a physics graduate student is facing his first class as a teaching assistant. Unfortunately, the most the new teaching assistant learns from this encounter is how little he knows about teaching. The laboratory instructors orientation program at Kansas State University offers the instructors an opportunity to see some of the problems he will face and some methods for handling them before *he begins teaching. The program, which includes introductions to Transactional Analysis and Piaget's theory of intellectual development, is based on laboratory experiences undertaken by the new instructor before classes begin.*

INTRODUCTION

The new graduate teaching assistant (GTA) is placed in a rather strange position. In most cases, he or she has neither taught a class nor been exposed to the methods of teaching. His or her purpose in teaching may vary from providing financial support for graduate studies to gaining experience for an eventual career in college teaching. Regardless of the GTA's background or motivation he is charged with the responsibility of providing an educational experience for undergraduate students.

Commonly the new GTA becomes a laboratory instructor. As such, he plays a very significant role in the educational experience of the student. In particular, because of his close contact with students, the laboratory instructor can help shape many of the attitudes which students form not only toward physics but also toward science in general. In short, the GTA carries an important burden in undergraduate teaching. Traditionally, the GTA has been placed in this position with no training in the field of education.

When the new GTA encounters his first class, he remembers advice all of us have heard: "To be a good teacher, imitate good teachers you have had." So off he goes—trying to imitate his quantum mechanics teacher while teaching physics to French majors. This approach frequently fails. It can also result in the laboratory instructor defensively complaining about "dumb students" and students complaining about "instructors who cannot communicate."

The field of education has evolved learning theories and teaching strategies which place emphasis upon the *uniqueness* of students. Each student, because of past intellectual or emotional experiences, requires different types of classroom interaction. The gifted teacher realizes this and evolves many educational strategies as a result of being very sensitive to the interactions with his students. Most of us, however, profit from a formal exposure to a variety of teaching strategies and an understanding of individual differences in intellectual development. The teaching assistant has, in his undergraduate days, seen *one* particular approach to *one* particular student —himself. If he believes the folklore, he will assume that this approach is good for everyone. His success in the teaching experience will be greatly enhanced by the destruction of this myth.

The Teaching Assistant Orientation Program we have developed at Kansas State University attempts to challenge the well-known myths and, at the same time, prepare the new GTA for his first teaching assignment. The program is based on four basic concepts:

The teacher must meet the students where they are, intellectually and personally.

To teach one must understand how students learn.

Tools and concepts developed by educators can aid in the development of a personal teaching style.

"I didn't learn anything because the teacher always answered my questions."[1]

THE PROGRAM

New teaching assistants in the Department of Physics arrive in Manhattan, Kansas, one week before the beginning of classes. Thus, the main problem with any GTA orientation program is the lack of time. Too much information exists to be assimilated in only one week. Additionally the GTA has had little past experience with which to interpret the information presented. Since the program occurs when classes are not in session, the GTA is unable to see in action what he will be doing the following week. The Orientation Program was thus evolved with these real limitations in mind. The program is meant to provide a foundation from which the GTA can build a personal and flexible teaching style. The GTA is also given a manual which provides a vast number of resources to supplement the first week's experiences. (The Appendix presents more information on the manual.)

Table I contains the Orientation Program schedule used during the Fall semester, 1973. During the week the GTAs spend an average of three hours per day in the Orientation Program. The new teaching assistant meets his first class one week after orientation begins. Thus, we have maintained a small program which concentrates on

the problems of teaching physics in the laboratory setting, rather than one of a more general nature designed for university-wide usage.[2]

The first session deals with the interaction of people. During the summer each new teaching assistant is sent a copy of *I'm OK, You're OK* by Thomas A. Harris[3] and asked to read this book before coming to campus. Teaching is dominantly an interaction between instructor and learner; transactional analysis provides a useful and simple model for understanding these interactions.[4] Some of the questions discussed include:

> Who assumes the parent role in a teaching situation?
> What makes a student feel NOT OK when he enters a physics class? As he works through the laboratory experiences?
> How can we use Transactional Analysis to improve communication with our students?

The inclusion of transactional analysis serves to encourage the teaching assistant to try to meet the students where they, the students, are.

At this point the teaching assistant usually begins to realize that, as an undergraduate, intellectually he may have been somewhat different from the average student he will meet. This concept is emphasized during the afternoon session as the current work in intellectual development is discussed. Most new graduate students are unfamiliar with the model of intellectual development of Piaget.[5] Once this model has been presented, the particular application to physics teaching is introduced in a discussion of Renner's findings.[6] These discussions underscore the importance of laboratories in the learning of physics. Of all the sessions during the week this one usually presents the new teaching assistant with the largest amount of new information. (Since we cannot expect anyone to assimulate this much information we include relevant material in the GTA orientation manual.) The discussion of both Piaget's model and Renner's experimental findings concerning college students emphasizes the necessity, in teaching, of understanding how students learn and of being flexible in interacting with individual students.

Table I. The orientation program for the fall semester, 1973.

Day	Time	Topic
Monday	10:30–12:00	Transactional Analysis
	1:30–3:30	Intellectual Development
Tuesday	9:30–10:30	Models of Instruction
	10:30–12:00	Experiment I
	Homework: Write up experiment and prepare quiz	
Wednesday	9:30–10:30	Discussion of Exp. I
	10:30–12:00	Experiment II
	Homework: Same as Tuesday	
Thursday	9:30–10:30	Discussion of Exp. II
	10:30–12:00	Experiment III
	Homework: Same as Tuesday	
Friday	9:30–10:30	Discussion of Exp. III Evaluation of Teaching Rules, regulations, mechanics of teaching

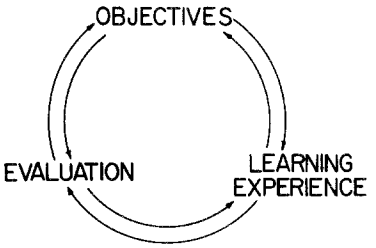

Fig. 1. A model of instruction showing the relation between the three aspects of education.

With the background material on personal interaction and intellectual development, we are ready to focus on the particulars of instruction.

The third session deals with the presentation and discussion of a model for instruction as shown in Fig. 1. This model presents a convenient structure for analyzing classroom difficulties. The meanings and interrelationships of objectives, learning experiences and evaluations are presented in the first session. The remaining three days' activities are centered around the application of this structure in the laboratory experiments.

The teaching assistants perform three laboratory experiments utilizing these different instructional strategies. The first experiment consists of a write-up containing thirty numbered steps to be completed by the student. It thus represents the strategy popularly known as "cook book" experiments. The second experiment is taken from an inquiry-based laboratory and presents the student few, if any, concrete instructions. The third experiment utilizes a strategy between the extremes of inquiry and cook-book experimentation, and is most similar to the particular strategy provided in most undergraduate laboratories at Kansas State University. This approach attempts to offer the student some freedom in designing his own experiment, but not so much freedom that he becomes frustrated by lack of direction. Thus, the laboratory write-ups focus on questions to be answered and means to answer them with the equipment available rather than detailed instructions of exactly what to do and when to do it. The emphasis of the experiments and amount of instruction depends on the level of the course and the background of the students.[7]

For each of the three experiments the teaching assistants are asked to prepare a report written in the same way as they will require their students to write it and to construct a quiz to evaluate the students' understanding of the experiment. The various strategies are discussed within the context of the model of instruction in order to clarify the three aspects of instruction (objectives, learning experiences, and evaluation) as well as to contrast the three strategies of instruction. Some of the questions discussed include:

> How do you *feel* when you are provided explicit instructions? No instructions?
> What can you expect students to learn from the experiments?

Table II. GTAs were asked: "How did the Orientation Program help you accomplish each of the following?" [Scale: 1 (extremely detrimental) to 5 (extremely helpful].

Function	Mean value of responses
Present introductions to experiments	3.4
Answer questions during the performance of experiment.	3.8
Prepare quizzes.	3.5
Grade laboratory experiments.	4.1
Grade quizzes.	3.2
Evaluate laboratory experiments as to their clarity, effectiveness and usefulness to the student.	3.7
Evaluate the students' total performance at the conclusion of the semester.	3.5
Assist in formation of overall objectives of the laboratory session.	4.1
Evaluate my own teaching.	4.1
Establish methods I used in teaching the laboratory.	4.0
Understand the Physics Department's teaching methods.	4.3
Establish a personal philosophy of teaching.	3.7
Understand the Physics Department's philosophy of teaching.	4.3
Understand the attitudes of students enrolled in the laboratories.	3.9
Understand the background of students enrolled in the laboratories.	3.9
Interact with the students.	3.6
Understand my attitude toward students	3.7

Do your expectations change if the strategy is different?
How did you write your laboratory report? Why did you write it in that manner? Were there differences among the teaching assistants?
Does your quiz test the objectives of the experiment?
Does your quiz require knowledge obtained from sources outside the laboratory? Are the quizzes different for the different strategies?

The discussion of these and other questions focuses attention upon the degree of interrelationship between the learning experience (strategy), objectives, and testing (evaluation).

Discussions following the experiments help the teaching assistants see what they are expecting from students and why. We discuss how the nature of the learning experience is changed by the strategy employed as well as by the personal response of the instructor to student questions. These sessions address themselves to the last two concepts presented in the introduction.

The program concludes with a discussion of the techniques of self-evaluation in teaching and the fundamental administrative mechanics of teaching at a university. All teaching assistants are required to use an instructor evaluation form developed for laboratory teaching as a method of obtaining student feedback.[8] The contributions and limitations of student feedback are discussed within a structure of encouraging continual self-evaluation in teaching. A copy of the evaluation form is provided to each teaching assistant.

During the semester follow-ups have been handled primarily on a one-to-one basis. We discuss individual problems with laboratory instructors frequently. However, group meetings have been limited to one or two per semester. Since the GTAs become involved with different types of students, sessions for each of the four introductory courses seem best. Unfortunately, such meetings are difficult to schedule, but we hope to begin them on a regular basis next year.

EVALUATION OF THE PROGRAM

Over the last three years the program has evolved into the one described above. While changes are still being made, the format has become relatively stable. Initial evaluation of the program has been limited to feedback from the teaching assistants themselves. A questionnaire was administered to sixteen teaching assistants who participated in the orientation program during the Fall semester 1973. The questionnaire was administered twice—at the end of the orientation program (before classes had begun) and again at the end of the Fall semester. Since these two evaluations gave very similar results, only the latter is presented.

The first section of the evaluation asks the teaching assistant to independently rate the contribution made by the orientation program to the various objectives. Reproduced in Table II are the mean values of the ratings the GTAs gave each of seventeen aspects. Significantly, all of the aspects received average values of greater than three. These results indicate that the program seems to have been somewhat helpful to all aspects of laboratory teaching.

The second part of the questionnaire asked the teaching assistants to comparatively rank the contribution of the orientation program to each of the various objectives. The results are summarized in Table III. The variances on these rankings are reasonably large, thus small differences in means are not significant. However, an overall pattern does seem to be present. The rankings seem to be highest on aspects related to the broad understanding of students, the GTA himself, and methods of teaching. The mechanics of day-to-day teaching were ranked at the other end of the spectrum. Since laboratory teaching is primarily a one-to-one interaction between instructor and student, these rankings indicate that our program is heading in the right direction.

Finally, in the third section we asked the GTAs to tell us if we spent too little or too much time on any one aspect of the program. The results of this section are pre-

Table III. GTAs were asked to rank the following from 1 (gain most from) to 10 (gained least from the orientation program).

Portion of orientation program	Mean value
Understand students	4.1
Establish methods and/or philosophy	4.2
Understand my attitudes	4.7
Evaluate experiments	4.8
Evaluate teaching	5.4
Evaluate students	5.6
Present introductions	5.8
Grade quizzes and experiments	6.2
Answer questions	6.3
Prepare quizzes	7.9

Table IV. GTAs were asked to rank the amount of time spent in the orientation program on each of the following items as: 1 (too little); 2 (just right); 3 (too much).

Portion of Orientation Program	Mean Value
Performing Experiments	2.3
Discussing teaching methods	1.6
Discussing procedures	1.9
Discussing goals and objectives	1.8
Discussing evaluation	1.3
Discussion interaction of people	2.3
Discussing intellectual development of students	1.9
Preparing and evaluating lab reports	1.4
Preparing and evaluating quizzes	2.2

sented in Table IV. The mean responses are around 2.0 with the exception of the area of evaluation. Here we seem to have hit the middle ground rather well.

CONCLUSIONS

The GTA Orientation Program was undertaken for the purpose of providing the new teaching assistant information and direction *before he begins* his teaching experience.[9] Because of the limitations of a graduate program in an academic discipline and the variety of motivations for becoming a teaching assistant, our program was not designed to fulfill the specific objectives of a teacher training program.[10] Evaluation has thus been initially limited to measuring the degree to which the orientation program makes contributions useful to the new teaching assistant. The results indicate that our program is making positive contributions and appears useful to the teaching assistant, especially in the area of personal interaction.

The program described here can be considered a model for use by other graduate departments. Major emphasis is placed upon teaching as a personal interaction among individuals, and thus attempts to sensitize teaching assistants to their experiences with students. By placing the emphasis upon human interaction rather than subject matter competency, the program in effect broadens the new teaching assistant's view of teaching. This approach is particularly useful for teaching assistants involved in a laboratory setting, as teacher-student interaction is frequently on a one-to-one basis.

Piaget's model of intellectual development and the model of instruction (Fig. 1) can also be utilized in any academic discipline. Both are exceptionally good structures from which to present the various components of teaching relevant to the actual classroom experience. Experience during the past three years has indicated, however, that these structures are most successfully introduced within the subject matter familiar to the teaching assistant. The vast majority of teaching assistants are unfamiliar with educational theory and, as Piaget would suggest, require concrete experiences with the concepts presented. In our particular case the laboratory experiments served as the vehicle by which the model of instruction could be concretely presented. Other types of activities could undoubtedly serve a similar purpose.

The ultimate evaluation of the orientation program, of course, is in its effect upon the quality of instruction provided to the students. Because of the pragmatic approach taken in evolving the present program the impact of its existence on the student has not been ascertained. Such evaluation will probably be undertaken as the program is expanded to incorporate video taping, course credit for the orientation, and in-service meetings. While we cannot ascertain the impact of the present program on the undergraduate students, we do know that during the past three years the increase of enrollment in introductory physics laboratories has far exceeded the increase of enrollment at the University. This observation combined with the response by teaching assistants who have participated in the program have encouraged us to continue in our efforts to provide a teaching assistant orientation program.

ACKNOWLEDGMENTS

The program would not have evolved without the support and comments from the teaching assistants involved. Support from the Department of Physics faculty, particularly C. E. Hathaway, has been extremely valuable.

APPENDIX

The GTA Orientation Manual contains a number of papers on various aspects of physics teaching as well as some material which pertains to the local facilities.

In the annotated table of contents below the material in Secs. 1–6 present reference materials for the discussions held during the orientation program. The Appendices offer other useful information to the laboratory instructor. For completeness, material related to local facilities has been retained.

Sec. 1. Introduction
The role of a teaching assistant at Kansas State is described.

Sec. 2. Communication and Interaction
An introduction to Transactional Analysis as it applies to physics teaching is presented. Much of this material is taken from Fuller and Sims.[4] The section concludes with "How to Lose Friends and Alienate Students" based on material in McKeachie.[11]

Sec. 3. Intellectual Development of Students
The model of Piaget is presented. Emphasis is placed on its application to college physics teaching and the studies of Renner and his co-workers.[6]

Sec. 4. A Model for Instruction
Examples of various components of the model of instruction are given. Their application to physics teaching is discussed.

Sec. 5. What Is The Science Laboratory?

Several definitions of the science laboratory are presented. McKeachie,[11] Nedelsky,[12] Rogers[13] and the National Education Association Department of Science Education (1905) are quoted.

Sec. 6. Experiments

Instructions for each of the three experiments are reproduced exactly as they would be presented to the students. No other material about the experiments is given in the manual.

Appendix 1: The First Day

A check list of activities a teacher needs to do on the first day of class is presented.

Appendix 2: "It's Your Laboratory" by Eric M. Rogers.[13]

Rogers discusses some ideas about laboratory teaching.

Appendix 3: "The Physics Activities Center"[14]

The Kansas State Physics Activities Center is described.

Appendix 4: Film Loop List

The Super-8mm film loops available at Kansas State are cataloged.

Appendix 5: PHSLABGD

This computer program offers a method of keeping grade records for each lab student.[15]

Appendix 6: Laboratory Evaluation

The instructor evaluation used at the end of each semester is reproduced.[8]

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[1] This comment was made by a student in our introductory physical science course.

[2] A recent review of university-wide programs appears in Stockdale and Wachok, Sci. Ed. **57,** 353 (1973).

[3] Thomas A. Harris, *I'm OK, You're OK,* Harper and Row, New York, 1967). Available in paperback from Avon Books, New York.

[4] See for example: R. G. Fuller and W. L. Sims, Phys. Teach. **12,** 217 (1974), and C. Johnson and James Cramer, "The OK Classroom," Instructor (May 1973).

[5] See for example: Jean Piaget, J. Res. Sci. Teach. **2,** 176 (1964) and Refs. 6.

[6] J. Renner and A. Lawson, Phys. Teach. **11,** 65, 273 (1973); J. Renner and J. McKinnon, Am. J. Phys. **39,** 1047 (1971).

[7] Courses for non-science students, pre-professional students and science and engineering students are offered. Further details about any of these labs can be provided by the authors.

[8] J.D. Spears, D. A. Zollman, and C. E. Hathaway, AAPT Announcer **3,** 23 (1973).

[9] A program which is conducted during the first semester of teaching is described in L. D. Muhlstein, B. DeFacio and Am. J. Phys., **42,** 384 (1974).

[10] Abstracts of different approaches appear in J. Coll. Sci. Teach. **3,** 100 (1973). A description of a program to prepare graduate students for careers as college physics teachers is presented in F. B. Stumpf, Am. J. Phys. **39,** 1223 (1971).

[11] Wilbert J. McKeachie, *Teaching Tips: A Guidebook for the Beginning College Teacher* (D. C. Heath, Lexington, MA. 1969)

[12] Leo Nedelshy, *Science Teaching and Testing,* (Harcourt, Brace and World, New York, 1965).

[13] Eric M. Rogers "It's Your Laboratory" in *Proceedings of the Northwestern University Conference on the Training of College Physics Laboratory Assistants,* edited by C. J. Overbeck (Northwestern University, Evanston, IL, 1954).

[14] Dean Zollman, Phys. Teach. **12,** 213 (1974).

[15] Written by Fred Zutavern.