Personalized Instruction in an Introductory Biology Course

Charles R. Barman

IN THE LATE 1960s, "personalized" instruction emerged as a common method of teaching used in colleges and universities. According to Ruskin and Ruskin (1977b), a personalized course includes the following features:

- Written materials are used to present some of the content, which is usually divided into small, sequential units.
- Objectives for each unit are clearly defined in behavioral terms.
- Course materials are self-paced; students must demonstrate a clear understanding of each unit before progressing to the next one.
- If formal lectures are included, they are used primarily as opportunities for students to explore topics not included in the course material.

Personalized instruction is an effective educational tool in many colleges and universities (Ruskin 1977a). One study demonstrated that significant attitudinal changes occurred when personalized instruction was incorporated into a college chemistry course (Torop 1978). Students in this course felt more confident in dealing with difficult material than students enrolled in a traditional lecture/laboratory course. Pascarella (1977) reported that using personalized instruction in an introductory calculus course significantly improved student attitudes and performance. Kulik and his colleagues (1976) found that the achievement levels of students given personalized instruction were significantly greater than the levels of students taught by the traditional lecture method. In addition, they report nine studies that have demonstrated that personalized instruction increases student retention of course material.

Based on this information, I decided to use the personalized instruction method in an introductory biology course for non-majors at the University of Wisconsin-Superior (UW-S). I was convinced that personalized instruction was a sound pedagogical alternative for non-major science students who, at that time, were only able to select courses in the lecture/laboratory format. This article describes the basic components of the course and outlines the way in which the personalized course was developed and implemented. In addition, student reactions to the course are described. Finally, I offer some personal observations on the course during its first year of existence.

The Personalized Biology Course at UW-S

The Wisconsin Department of Public Instruction's "A Guide to Science Curriculum Development" divides science into four categories: (1) concepts and facts; (2) process skills; (3) the cultural implications of science; and (4) the nature of the scientific enterprise. Equal treatment of each of these categories is stressed. Guided by this philosophy, we constructed a list of topics and process skills and placed them in a sequence of nine individual modules. Once this list was developed, objectives describing the expected educational outcomes for these topics and process skills were written. Once the objectives were established, we constructed learning activities to help students meet the objectives for each module. The general topics covered in each of the nine modules are displayed in figure 1.

Course Contents

Module	
A	The Nature of Science
B	An Introduction to the Cell and the Microscope
C	Physical Cell Processes
D	Basic Cell Chemistry and Cell Division
E	An Introduction to Genetics
F	Scientific Theories of Evolution
G	The Diversity of Living Things
H	Reproduction
I	Environmental Interrelationships

FIGURE 1.

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The main characteristics of the personalized course at UW-S are enumerated below:

1. The course is self-paced; it allows students the flexibility to proceed through the course at their own speed and is designed to be completed in one quarter (10 weeks). Generally, it takes most students from 7 to 10 weeks to complete all nine modules. Students are encouraged to work in groups, but this is not a mandatory component of the course.

2. A manual, composed of nine sequential modules, was written for the course (Barman 1979). Each module is self-contained and does not require a specific textbook to supplement the course content. However, students are urged to consult one or more of the references present in the classroom or use the school library if they want to probe a specific topic in depth.

3. Each module consists of a mixture of learning modes, depending upon the concepts being presented. The learning modes include: audiotutorial presentations, films, simulation exercises, programmed learning, guided inquiry activities, and "hands-on" experiences. We attempted to precede abstract concepts with concrete learning experiences. In addition, the course material is related to the human body, whenever possible.

4. The time required for each learning activity varies from 15 to 45 minutes. Because of the self-paced nature of this course, students who are unable to complete an activity in one class session can resume their investigation at another time. The only exceptions are those exercises that require immediate observation and data gathering. As students progress through this course, they learn to budget their time in accordance with the type of learning activity they are being asked to perform.

Examples of activities that appear in Modules E and H, respectively, are given in tables 1 and 2. "How Genes are Inherited" is preceded by material on meiosis and designed to provide students with a concrete experience before another abstract concept is introduced. "Seed Germination" is a guided inquiry activity that provides students with the opportunity to observe seed germination.

5. The objectives are listed at the beginning of each module. Students are advised that the test items for each module have been written from these objectives. Figure 2 lists the objectives for Module A and the test items for that unit.

TABLE 1. Sample Exercise on Genetics.

"How Genes Are Inherited"

Materials needed:
1 Penny

Procedure:
1. Toss a penny 40 times.
2. Record how many times you receive heads and tails during those 40 tosses below.
3. Now, assume that the penny was a pair of chromosomes. One chromosome (the heads of your penny) contained a gene for blue eyes and on the other (the tails) was a gene for brown eyes. If each toss of the coin represented the formation of a sex cell (meiosis), what were your chances of forming a sex cell with a blue-eyed gene? a brown-eyed gene?

Genes are inherited in much the same way. Genes occur in pairs. When sex cells undergo meiosis, each egg or sperm cell has a 50-50 chance of receiving one gene or the other.

Heads	*Tails*
Total _____	Total _____

TABLE 2. Sample Exercise on Seed Germination.

"Seed Germination"

What conditions do you feel are necessary for a seed to germinate (sprout)? Use the following space to list the conditions.

In the following exercise, you will test the ability of bean seeds to germinate under various conditions.

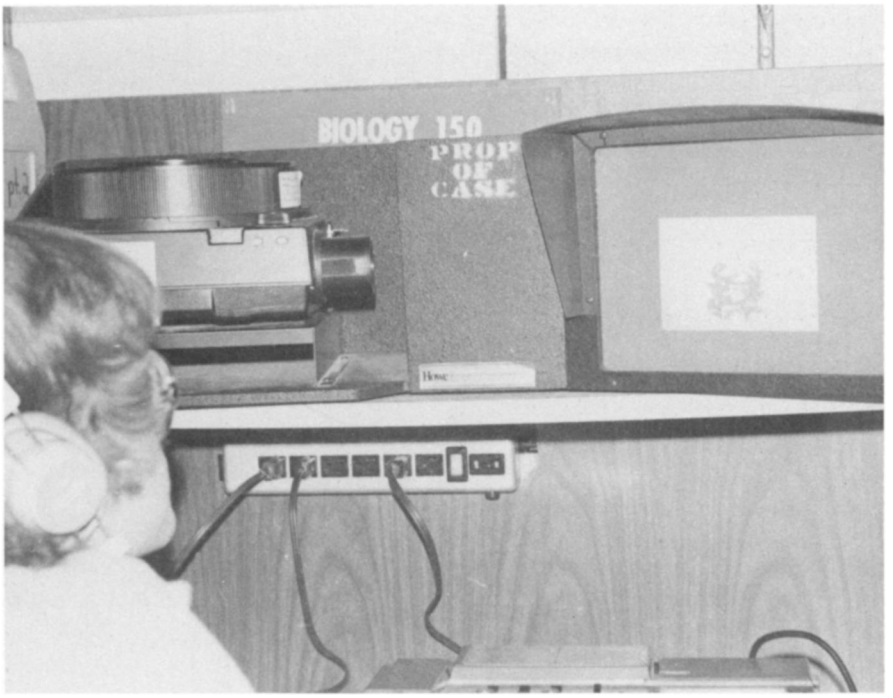
Materials needed:

4 Paper cups	Paper toweling
Plastic wrap	4 Bean seeds
Tape	

Procedure:
1. Number the cups 1-4.
2. In the bottom of cups 1 and 3, place a piece of moist paper toweling.
3. Place one bean seed in each cup.
4. Cover each cup with plastic wrap, and tape the wrap to the cups to prevent evaporation.
5. Place cups 1 and 2 in an area well lit by sunlight and at room temperature.
6. Place cups 3 and 4 in a dark area that is at room temperature.
7. After 4-5 days examine the seed in each cup.
8. Complete the table below by using the phrases "germination has occurred" or "germination has not occurred."

Based upon the results of this activity, list what you now believe to be essential for the germination of a bean seed.

Seed in Cup	*Results*
1	
2	
3	
4	



There are audiovisual components to some of the course modules.

6. After the students complete a module, they are required to take a test to assess whether or not the objectives for that module have been mastered. This way, they are given immediate feedback about their progress in the course. Students are advised not to go on to new material until they demonstrate a clear understanding or preceding concepts.

7. A student assistant is available, along with the instructor, to provide more personalized attention.

8. Periodically during the quarter, time is set aside for a discussion or a presentation of a special topic. This creates an opportunity for students to explore new topics not covered in the course and provides time for additional peer interaction.

Course Development and Implementation

We wrote the course manual during the 1977-78 academic year and the 1978 summer session. A few slide-

Module A—The Nature of Science	*Test Items for Module A*
Objectives for Module A	Answer each of the following questions. If you require more space to answer one or more of the items, attach additional page(s).
The Student will be able to:	
1. Describe how science information is obtained.	1. In your own words, explain how scientific information is obtained.
2. Explain how science disciplinary areas differ from other academic disciplines.	2. From a local or regional newspaper, cite three recent examples of how science has had an impact on society or how society has influenced science. (Be sure to document your source(s) of information.)
3. Explain how scientific information affects society.	3. Scientific knowledge could be referred to as certified knowledge. Why?

FIGURE 2.

tape presentations were developed and commercial audiovisual presentations previewed and selected for use in the course at the same time.

After the initial writing and audiovisual development and selection, a number of my colleagues evaluated the course materials. We then field tested the materials on campus during the 1978-79 fall quarter. At the end of this quarter, the materials were re-evaluated and developed into their present form.

Student Reactions to the Personalized Course

Student reactions to the personalized course have been favorable as indicated by the student response on a course evaluation form (figure 3), which was distributed to each person enrolled in this course upon completion of the last module. The combined results of Parts I and II of this evaluation from students that were enrolled in this course for one of three quarters during the 1978-79

Course Evaluation

Please fill out this student evaluation form and return it to the Science Office in Barstow 207. Your comments will assist in the constant modification and improvement of this course.

CLASS—FRESHMAN	X	SEX—MALE	X	GRADE YOU EXPECT—PASS/A	X
SOPHOMORE	X	FEMALE	X	B	X
JUNIOR	X			C	X
SENIOR	X			D	X
OTHER	X			FAIL/F	X

I. Please read each statement carefully. Then select one of the five alternatives—STRONGLY AGREE (SA); AGREE (A); UNDECIDED (U); DISAGREE (D); or STRONGLY DISAGREE (SD).

1. SA A U D SD This course has stimulated my thinking.
2. SA A U D SD This course builds an understanding of concepts and principles.
3. SA A U D SD This course is adjusted to fit individual abilities and interests.
4. SA A U D SD I liked the self-paced design of this course.
5. SA A U D SD I would have preferred to have had the material presented in this class in a lecture format.
6. SA A U D SD The objectives of this course were clearly explained to me.
7. SA A U D SD I understand what is expected of me in this class.
8. SA A U D SD The tests in this class were a fair assessment of the material presented.
9. SA A U D SD I had easy access to equipment/materials required for this class.
10. SA A U D SD I am satisfied with my accomplishments in this course.
11. SA A U D SD I would recommend this class to a friend.

II. Please respond to the following questions:

1. What aspects did you like best about this course? _____

_____

2. What facets did you dislike most about this course? _____

_____

3. This space is provided for any additional comments. (Use back side of this page, if needed.) _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

FIGURE 3.

academic year, appear in tables 3 and 4 respectively. The responses for Part II were paraphrased and summarized so they could be placed in tabular form. However, the content of these statements has not been changed. In most cases, students elected not to respond to item 3 (additional comments) of this section.

Even though only 63% of the evaluations were returned, the results indicate positive feelings toward the personalized course. In addition, the enrollment of this class has doubled in one year, showing that a good number of students at UW-S will select a personalized course when given a choice.

Personal Observations

Based on my reactions to the program, I offer the following comments on the effectiveness of personalized instruction at our university.

TABLE 3. Course Evaluation—Part I

52 Total Respondents—Frequency of Responses in %	*SA*	*A*	*U*	*D*	*SD*
1. This course has stimulated my thinking.	65	30	5		
2. This course builds an understanding of concepts and principles.	74	24	2		
3. This course is adjusted to fit individual abilities and interests.	65	33	2		
4. I liked the self-paced design of this course.	86	10	2	2	
5. I would have preferred to have had the material presented in this class in a lecture format.	2	5	12	24	57
6. The objectives of this course were clearly explained to me.	65	35			
7. I understand what is expected of me in this class.	68	32			
8. The tests in this class were a fair assessment of the material presented.	47	45	8		
9. I had easy access to equipment/materials required for this class.	79	15		6	
10. I am satisfied with my accomplishments in this course.	60	38	2		
11. I would recommend this class to a friend.	86	14			

TABLE 4. Course Evaluation—Part II

1. *What aspects did you like best about this course?*

Student Responses to Item 1:

I liked the self-paced design which allowed me the freedom to set my own class schedule. I prefer this format to lecture.

The tests were a fair assessment of what we learned in each module.

I enjoyed learning by "doing." This gave me a clearer understanding of the course material.

The course inspired me to look to other sources for additional information.

I liked the audiovisual aids in this course.

2. *What facets did you dislike most about this course?*

Student Responses to Item 2:

Students should be instructed to set up a few of the activities in Module H before they begin this unit. This way they would not have to wait for the results of these activities.

There should be a better check on each student's progress in this course. It is easy to procrastinate!

1. The students who elected to work in groups were able to engage in excellent peer discussions. I am convinced that these interactions were far more successful than those that occurred in any previous lecture/lab class. This could be because these discussions were completely student-initiated, and they were not monitored by a teacher.

2. Personalized instruction provides excellent opportunities for one-to-one student-teacher interaction.

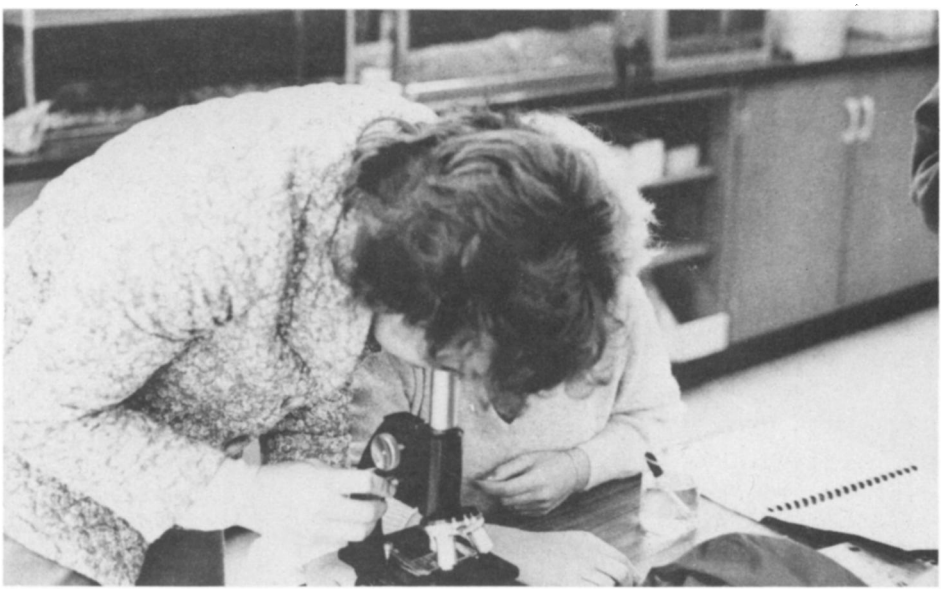
3. The format for this course worked well with certain physically handicapped students. For example, a paraplegic was able to complete the course with a minimal amount of difficulty. She was able to observe the results of specific lab activities by working with other students. This student felt the self-paced format was ideal for her. Without this design, she did not believe that she could have fulfilled her lab science requirement at UW-S.

4. Specific objectives, stated in the beginning of each module, clarify the skills and knowledge each student is expected to gain. This is a straightforward way to inform students what is essential for the successful completion of each module.

5. A test given at the end of each module is a good way to provide students with constant feedback about their academic progress.

I feel that this personalized course is meeting the needs of a number of freshmen at UW-S. However, I do not view this course as being completed. Like any course, it will undergo constant revision as it is used by more

(Concluded on p. 195)



Lab activities play an important role in this course.

This course has worked well for some physically handicapped students.

Students have an excellent opportunity to interact with one another.

trol population. Clearly, if humans do not choose to control their numbers, nature will.

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students and will continue to be modified to meet the changing needs of future students at UW-S. For example, during the 1979-80 academic year, this biology course is being used in the Extended Degree Program at UW-S. This is the first lab course offered to off-campus students at UW-S. Each extended degree student is given one year to complete all of the modules and has minimal face-to-face contact with the instructor. To date, only one student has completed the course in this manner. I am anxiously awaiting additional student reactions to this phase of the course's development.

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