Integrating Value Clarification With High School Biology

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JOHN AND MARY SMITH'S first child seemed normal at birth, but later he proved to be the victim of a serious birth defect. He was physically handicapped and mentally retarded. The Smiths did their best for him, but they yearned for a normal, healthy child. Their friends and parents urged them to try for another child. They told John and Mary that the chances of having another handicapped child were extremely low. Finally it looked as though the Smiths' wish was going to be fulfilled. Mary was pregnant and everything seemed to be going fine.

However, today John was told by a doctor that there was a new technique called amniocentesis that may be able to determine whether the child a woman was carrying would be mentally or physically normal. In this process, a doctor extracts a small amount of the fluid that surrounds the embryo of a pregnant woman. This fluid contains some of the same cells that make up the embryo. By studying the chromosomes of these cells, a doctor might be able to determine whether the embryo will develop into a healthy child. If the embryo has a serious defect, the parents might consider having the pregnancy ended.

Please respond to the following questions:

1. What would you consider a severe human defect?
2. If you were John Smith, would you want Mary to have her potential child examined for any defects?
3. If after amniocentesis, you found that the embryo had a serious defect, would you want the pregnancy ended?
4. Can you think of any problems that amniocentesis could present in our society?

How did you respond to the preceding questions? Can you see a need for a discussion of this type in biology instruction?

The following exercises are other examples of value situations that confront society. Unfortunately, many biology students are not given the opportunity to make decisions concerning their beliefs about these and other controversial issues.

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Uniform Anatomical Gift Act

Less than a decade ago, the miracle of organ transplantation was beyond belief. Today medical research has significantly improved the technique of kidney, cornea, and heart transplants. However, there are still great shortages of available organs.

Recently, the state legislature of Wisconsin has passed the Uniform Anatomical Gift Act, Statute Section 155.06. The purpose of this law is to make it possible for anyone who desires to give one or more of his organs to some other individual by simply signing a uniform donor card in the presence of two witnesses. This card states that when the bearer dies, he authorizes his organs for use in a transplant operation so others may live.

Do you agree, agree somewhat, have no opinion, slightly disagree, or disagree with the following statements?

1. The philosophy of organ transplants is beneficial to man.
2. At this time, I would consider signing a uniform donor card.
3. I feel uneasy about donating parts of my body when I die.
4. There could be some people I would not want to donate organs to.
5. If I needed an organ transplant, I would be in favor of receiving one.

Genetic Counseling

Genetic counseling provides and interprets medical information based on expanding knowledge of human genetics, the branch of science concerned with heredity. Its major goal is to prevent the occurrence of birth defects—abnormalities of body structure or function or in mental development.

Birth defects may be inherited or may result from environmental factors during pregnancy. Although individual birth defects may seem to be relatively infrequent—occurring in about 7% of all births, each year about 250,000 American babies are born with physical or mental defects of varying severity.

Using the basic laws of genetics, plus the knowledge of the frequency of genes that cause specific birth defects in our population, a genetic counselor can predict the probability of recurrence of a given abnormality in the same family. This means that if a child is born that has a severe physical or mental defect, the parents can be made aware of their chances of having another child with the same defect. If these chances are too high, the parents may elect not to have any more children.

The above information has been taken from *Genetic Counseling,* a booklet printed by the National Foundation for the March of Dimes. Please indicate whether you agree, have no opinion, or disagree with the following statements. Then there will be a discussion concerning your responses.

1. Genetic counseling will benefit mankind.
2. I feel that, at some time, I would consider using the services of a genetic counselor.
3. Genetic counseling should be made available free to all members of our society.
4. The government should pass laws so that people advised by a genetic counselor not to have children could not.
5. Students in high school should be made aware that genetic counseling exists.
6. The government should provide adequate publicity of genetic counseling on the TV and radio, so more adults would be aware of this service.
7. Mankind should not interfere with human procreation in any way.

Values Continuum

Directions. Below are some issues that were discussed in the film *Future Shock.* They have been placed on a continuum as shown below.

agree completely			partial agreement			do not agree
1	2	3	4	5	6	7

The numbers between 1 and 4 and 4 and 7 indicate a feeling not exactly described by the choices listed above. Put a "B" by the number on the continuum that best describes your feeling about each issue. Then in groups of about five students discuss your responses.

1. A rapid changing society has direct effect on the mental stress of the human population.			Rapid change only affects the mental stress of some people in our society.			Rapid change does not affect the mental stress of the people.
1	2	3	4	5	6	7
2. The advancement of science and technology should be controlled by our society.			Only certain aspects of science and technology advances should be controlled.			The advancement of science should not be controlled.
1	2	3	4	5	6	7
3. Geneticists should be allowed to research the possibilities of creating a society of identical individuals.			Research on creating an identical society should be carefully controlled by our government.			Research on creating an identical society should not be allowed.
1	2	3	4	5	6	7
4. The freezing of humans, who die of an incurable disease in hope to find a cure for them at a later date, should be researched further.			The freezing of humans, who die of an incurable disease, may have some merit.			The freezing of humans, who die of an incurable disease, is a wasted effort.
1	2	3	4	5	6	7
5. All changes in our society brought about by our technology are good.			Only some changes caused by our technology are good.			Our advanced technology has not produced any good changes in our society.
1	2	3	4	5	6	7
6. The U.S. should continue nuclear bomb tests.			The U.S. should put greater limits on nuclear bomb tests.			The U.S. should stop all nuclear bomb tests.
1	2	3	4	5	6	7

Formulating Solutions

After the discussion of this lesson, have the students read through the statements again. Then ask them to place an "A" by the number on the continuum that indicates their feelings. When they are finished, check how many students changed their original responses. This may lead to another class discussion.

The lessons cited above are examples of value clarification strategies used in a high school biology class. These techniques provide students with a means to examine their own beliefs about issues that are presently of concern to society. It is not a method of indoctrination, but rather a way for a student to formulate his own solutions to areas of conflict.

Biosocial issues, such as those comprising the above lessons, encourage student interaction. Discussing controversial topics with peer groups may assist a student in viewing more than one alternative before arriving at a decision, thus aiding the student in making more rational judgments. It is this type of instruction that creates an educational environment germane to a student's everyday life (Harmin et al. 1973).

A course that is found relevant by students will probably generate interest and positive attitudes. Green et al. (1971) found that the way a student feels about a specific subject is directly related to his

achievement. Consequently, teachers should strive to use classroom activities that develop good student feelings toward their course.

Studies by Klevan (1957), Jonas (1960), Raths (1960), Lang (1961), Raths (1962), and Brown (1966), employing value clarification techniques in nonscience instruction, have shown a positive gain in student attitude and achievement. Therefore, it seems reasonable to assume that value clarification may have the same effect in a high school biology class.

Testing the Effectiveness Of Value Clarification

To see if value clarification would affect student attitudes toward science and biology and would improve achievement in a BSCS Yellow Version biology course, two colleagues and I compared a control group of students not taught with value clarification and an experimental group taught using these techniques. These comparisons were made via a pretest, posttest control group design.

Evaluation of the affective domain was accomplished by the Schwirian Science Support Scale—Form A (table 1) and the Affective Domain Measuring Scale (table 2), while the cognitive domain was assessed by using the BSCS Yellow Version Comprehensive Final Examination—Form J (table 3) and self-evaluation inventory (table 4) based on behavioral objectives for BSCS Yellow Version biology.

One hundred fifty-five students were chosen for this study. The sample was drawn from those students enrolled in a BSCS Yellow Version biology course, at Nathan Hale Senior High School in West Allis, Wis., for the 1973-74 school year. The course was an elective and no prerequisites were required for enrollment.

Table 1. Schwirian Science Support Scale.

This is an unpublished Likert scale developed by Patricia M. Schwirian from Ohio State University. It was employed in this study to measure student attitudes toward science.

The students respond to each statement by either strongly agreeing (SA), agreeing (A), being undecided (U), disagreeing (D), or strongly disagreeing (SD). The scale is scored by awarding five, four, three, two or one points for responses of SA, A, U, D, SD respectively to a positive statement (that is, 1 and 2). If the statement is negative (3 and 4), the scoring order is reversed. Then, the total points are tallied.

The following are four sample items from a total of twenty:

1. The work of any scientist should be judged without regard for his political views.	SA	A	U	D	SD
2. In the long run man's lot will be improved by scientific knowledge.	SA	A	U	D	SD
3. The meaning of any discovery should be judged by man's moral standards rather than by his intellectual need for truth.	SA	A	U	D	SD
4. When the findings or theories of science conflict with a religious belief, it is better to accept the religious belief.	SA	A	U	D	SD

Table 2. The Affective Domain Measuring Scale.

This is a Thurstone Scale developed by Gary E. Downs, science education consultant for Iowa's Department of Public Instruction. This instrument has been copyrighted by the author.

It was used in this study to measure students' attitudes toward their biology class. There are point values for each of the 26 items of this test. If a student agrees with the statement he receives the points that correspond to that item. Higher point values are given to more positive statements. A student's score is a result of his total points.

The following are sample items and their appraised values:

(9.2) I find most material in this class interesting.	Agree	Disagree
(3.4) I feel that my science class contributes very little to help me understand myself and my problems more clearly.	Agree	Disagree
(8.7) I usually assume an active role in laboratory activities.	Agree	Disagree
(2.9) Hardly any of the material studied in this class intrigues me.	Agree	Disagree

Biology students were assigned to their respective biology classes through the use of a computer. Their placement in these classes was based on the openings and their class schedule for one of seven periods per day. The students were indiscriminately placed in the classes, and no particular effort at preselection or homogeneous grouping was planned or carried out.

The control group consisted of 77 students. The experimental group consisted of 78 students. There was no loss or gain of students in either group during the period of this study.

Both groups were taught units in ecology, cell biology, genetics, and evolution, using the BSCS Yellow Version (2nd ed.). However, the experimental group was instructed with value clarification lessons integrated with the BSCS material once a week for 18 weeks.

The students in each group were pretested during November 1973. Due to organization of the Yellow Version biology course arranged by the instructors, it was necessary to use the BSCS final exam to sufficiently evaluate the student's achievement during the time this study was conducted.

The instructional methods for the control and exper-

Table 3. The BSCS Comprehensive Final Examination—Form J

There are 50 multiple choice items to this cognitive achievement test. It is published by the Psychological Corporation, 304 East 45th Street, New York, N.Y. 10017. The sample item cited in the test booklet appears below:

1. Which of the following diseases is transmitted by a mosquito?
   (A) small pox
   (B) tetanus
   (C) malaria
   (D) pneumonia

Table 4. The Self-Evaluation Inventory.

This instrument was adapted from examples cited in the book *Behavioral Objectives and Evaluational Measures*, by Robert B. Sund and Anthony J. Picard (1972). The inventory is based on behavioral objectives from the BSCS Yellow Version course (2nd ed.).

The student indicates his feelings of the degree of skill and knowledge he possesses now compared with what he had at the beginning of the course. He is asked to place a "B" on the continuum (1-9) to show his skill at the beginning and an "E" to display the knowledge he now has. The self-evaluation inventory is scored by calculating the difference between the "B" and the "E" of each statement and finding the total points from all the items.

A few of the examples of the 35 item inventory are listed below:

The student has the ability to:

1. describe a typical succession within an ecosystem.

Low			Moderate					High	Difference = 5
1	2	3	4	5	6	7	8	9	
	B					E			

2. calculate the types of offspring resulting when one gene of a pair is incompletely dominate over the other.

Low			Moderate					High	Difference = 2
1	2	3	4	5	6	7	8	9	
	B		E						

Total = 7

imental groups, detailed above, were administered following the pretests. During the latter part of March 1974, the two groups were posttested with the same instruments. The pretest and posttest mean scores derived from these examinations were evaluated statistically by analysis of covariance.

In addition, the students were given a self-evaluation inventory (SEI) based on behavorial objectives for BSCS Yellow Version biology in the posttest phase. The mean scores obtained from the SEI were treated statistically by the *t*-test.

Results

The achievement of the experimental group, as assessed by the BSCS exam and the SEI, was significantly greater than that of the control group. However, data from the Tri-S scale and the ADMS failed to indicate significant differences in attitudes toward science and biology between the two groups. While no support was found for the notion that gains in the affective domain were responsible for increases in achievement, there is evidence which supports the contention that the value clarification techniques employed did have a positive effect on achievement.

A very important aspect of this study is that value clarification, integrated into a BSCS Yellow Version biology class, does improve achievement. However, a nonmeasurable phase of this research that I feel was equally significant was the interest displayed by the students during the use of the value clarification lessons.

The lessons used in this study can be obtained by writing to the author.

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