The Academic Preparation In Human Genetics and Bioethics of Indiana High School Graduates

An Honors Thesis (ID 499)

by

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Introduction

Due to the ever-increasing knowledge base in human genetics and the potential effect of this knowledge on our lives, many science educators have stressed the importance of formal instruction in human genetics for all secondary school biology students.[2,3,5,6] This formal instruction includes not only learning the fundamentals of genetics, but also learning how to deal effectively with bioethical issues growing out of recent advances in human and medical genetics.[1,4]

In light of this realization, the staff of the Human Genetics and Bioethics Education Laboratory at Ball State University operated its first National Science Foundation-funded workshop on human genetics and bioethical decision-making for secondary school biology teachers in the summer of 1978. To date, a total of eight NSF workshops have serviced approximately 320 teachers, including 103 from Indiana. The primary goal of the summer workshops was to prepare secondary school biology teachers to incorporate a four-week unit on human genetics and bioethics into their high school biology courses. Evaluational data suggest that this goal has been achieved by the majority of teachers participating in the workshops.[7] In addition, some of the participating biology teachers have initiated free-standing courses in human genetics for advanced biology students in their high schools.

As a result of these developments in secondary school curriculum, one would expect that some students enrolling in a required freshman-level Honors College course, "Human Genetics and Bioethical Decision-Making" (Biology 199), at Ball State University, would be much better prepared than others in this field of study. Determining the level of academic sophistication of the students enrolling in this course and making any required modifications in the course to accommodate for this level of preparedness were the objectives of this research. Two methods were used to determine the potential background in human genetics of the students enrolling in the course. First, surveys were sent to 200 Indiana high school biology teachers, randomly selected from a list provided by the State Department of Education. The returned surveys provided data concerning career experience of the teachers as well as information about the human genetics/bioethics content of the courses they teach. Second, the 1987 state-adopted high school biology textbooks were analyzed for their content in human genetics. In addition, to obtain a specific measure of students' prior knowledge, an analysis was made of pretest data on a human genetics examination given to all Ball State University students enrolled in Biology 199 in Autumn Quarter, 1987.

The Survey

One hundred thirty-eight (69%) of the 200 high school biology teachers completed and returned the survey instrument. Of these 138, seventy-one percent have had at least ten years of secondary school biology or life science teaching experience and only nine percent have had fewer than two years teaching experience. Concerning their undergraduate and graduate preparation, eighty-nine percent had taken at least one genetics course; twenty-five percent had had an advanced genetics course; thirty-nine percent had taken human genetics; and only fifteen percent had had a bioethics course.

The responding teachers were polled relative to their experience in the last five years in attending conferences or workshops devoted to human genetics and bioethics, with the following results: human genetics (48%); birth defects (50%); bioethical issues (30%); bioethical decision-making (21%); and teaching controversial issues in biology (23%). When asked about the number of hours spent in their general biology courses on human genetics, twenty-one percent admitted to spending fewer than five hours; forty-one percent reported spending five to ten hours; thirty-two percent said they spent more than ten hours.

Within the time allotted for the study of genetics, the subjects addressed by more than eighty percent of the respondents included: nucleic acids in protein synthesis (90%); mitosis/meiosis (97%); Mendelian inheritance (96%); principles of probability (87%); genetics of plants and/or animals (88%); human genetic diseases (91%); and sex-linked defects (92%). Among human genetic diseases, sickle-cell anemia (90%); hemophilia (89%); colorblindness (92%); and Down Syndrome (90%) were the ones treated by more than eighty percent of the respondents.

The subjects addressed by under half of the respondents included: human gene therapy (24%); genetic screening (43%); genetic counseling (43%); ethics of human genetics (47%); genes, race, and IQ (30%); nature vs. nurture (46%); and Hardy-Weinberg law (39%). The genetic diseases treated by fewer than fifty percent of the respondents included cystic fibrosis (42%); Huntington Disease (44%); muscular dystrophy (28%); diabetes mellitus (44%); spina bifida (23%); cleft lip/palate (31%); polydactyly (32%); syndactyly (9%); and Marfan Syndrome (17%). The preceding data are summarized in Tables I and II. Note that the subjects most commonly addressed in the classroom are those that tend to be considered "safe" or non-controversial, while the controversial subjects are addressed by a smaller fraction of the teachers.

Also, as determined from the survey, only seven percent of the respondents' schools offer a course dedicated solely to human genetics. This fact suggests that a relatively small fraction of students enrolling in our Honors College course on human genetics and bioethics would have had a specialized background in human genetics.

Textbook Analysis

The chief instructional tool in most science classrooms is the textbook; as such, it has the potential for greatly influencing the learning experience of students. Each of the eleven biology textbooks adopted by the state of Indiana in 1987 was analyzed for its human genetics content. The number of illustrations and the number of paragraphs or pages devoted specifically to human aspects of each genetics topic were tabulated (Table I). All textbooks, for example, incorporate content on mitosis and meiosis, and over ninety-seven percent of all teachers reporting in our survey deal with these topics, but little or none of the content of the eleven textbooks specifically treats the human aspects of mitosis and meiosis.

The content of the textbook generally correlates with what most biology teachers teach. For example, nine of the eleven books and over seventy-two percent of the teachers treat phenylketonuria (PKU) (Table II). Furthermore, those genetic diseases and chromosomal defects -- sickle cell anemia, hemophilia, colorblindness, and Down, Turner, and Klinefelter syndromes -- treated by all eleven textbooks are also taught by the majority of the teachers surveyed. One apparent exception to this generalization involves the topic of Rh factor which was treated in only one book but by nearly eighty percent of the responding teachers. Generally, those genetic diseases treated in only a few of the

Table 1

Amount of Emphasis Given to Human Aspects of Various Genetics Topics in State-Adopted Textbooks

Topic	%	Textbooks (Identified by Letter in References) A	B	C	D	E	F	G	H	I	J	K
Nucleic Acids and Protein Synthesis	89.86	2s	7s		17s	7s		5s	1par+			
Genetic Engineering	68.12	1par +sup	5s	2par	.5p	1.25p			1.25p+	sup(1)	.66p	.33p
Human Gene Therapy	23.91		sup			1s						
Mitosis and Meiosis	97.10	5s	3s			(1)	8s	2par	sup	2s	.5(1)	1s
Mendelian Inheritance	95.65	1par	(1)	(1)	(1)	1par	1p(2)		1par	(2)	.66p(6)	
Principles of Probability	86.96				3par							
Genetic Screening	43.48											
Genetic Counseling	43.48	1par(1)	1.33p (1)	.5p	sup	.33p (1)	1par	.25p			1.33p (1)	1par
Prenatal Diagnosis	62.32	.33p	1.66p (4)	1p+sup (3)	5p(2)	1p		3p(7)	.5p+	3p(3)	1.33p (2)	1.33p (2)
Ethics of Human Genetics	47.10				*TG	*TG					*	*
Genetics of Men-Retardation	63.77											
Genes, Race/IQ	30.43						3s					
Nature vs Nurture	46.38		1.66p +sup(3)	1p(1)	1.75p (1)	1.33p (1)	1.5p (1)	1par	.75p(1)	.75p(4)		2par
History of Genetics	76.09											1s
Hardy-Weinberg Law	39.36			1par	.25p		.5p					

Note: % refers to the percent of teachers surveyed who taught that particular topic regardless of whether it was applied to human genetics; par = paragraph; p = page; (1) = 1 illustration; + = additional amount in excess of ...; s = sentences; sup = supplementary; TG = Teacher's Guide; * = item mentioned

Table II

Allocation of Textbook Space Specifically to Human Aspects of Topics Indicated

Condition	%	Textbooks (Identified by Letter in References)										
		A	B	C	D	E	F	G	H	I	J	K
Phenylketonuria	72.46	2par	1par	*(1)		1.33p(1)		.25p(1)	.33p	1.33p(1)	.66p(1)	1par
Cystic Fibrosis	42.03										.33p+	
Tay-Sachs	55.80	1par						.33p(1)			.66p	.25p
Sickle Cell Anemia	89.86	3par (1)	1par+ (2)	.66p+ (2)	(1)	1.33p(2)	1.33p	.75p(5)	.75p(2)	1.33p(3)	1.33p+ (1)	.66p (3)
Rh Factor	79.71										1.33p(1)	
Huntington Disease	44.20		3s	.5p(1)							.5p	
Hemophilia	89.13	*	.33p	1p+(2)	3par	1p	1par(1)	.75p(1)	.5p(1)	1p(1)	1.33p+ (2)	.25p (1)
Colorblindness	92.03	.66p(2)	.33p(1)	.66p(1)	4par(1)	.66p(1)	.66p(2)	.25p(2)	.33p	.66p(2)	1par+(1)	.5p
Muscular Dystrophy	27.54	*									*	
Diabetes Mellitus	44.20							.66p(2)			**	
Down Syndrome	89.96	*(2)	1par(1)	.33p(2)	3s	1par(1)	1par	.5p(2)	.5p(1)	.5p(1)	.33p(3)	.5p(1)
Turner Syndrome	69.57	*	1par	.33p	6s	.33p	nnm	.25p	.33p (.5)	.25p(1)	.33p(1)	.5p(.5)
Klinefelter Syndrome	68.84	*	1 par	.33p	4s	.33p	nnm	.25p	.33p (.5)	.25p(1)	.33p(1)	.5p(.5)
Spina Bifida	23.19				1par							
Cleft Lip/ Palate	31.16											
Polydactyly	31.88		*(1)		(1)		nnm		2s		1par+	
Syndactyly	9.42											
Marfan Syndrome	17.39									.33p		

% = % of biology teachers who teach subject; par = paragraph; p = page; (1) = 1 illustration; + = additional amount in excess of ...; nnm = name not mentioned; s = sentence; * = item mentioned; ** = item mentioned in two locations textbooks, were presented by fewer than fifty percent of the teachers surveyed.

Topics such as nucleic acids and protein synthesis, mitosis and meiosis, Mendelian inheritance, and principles of probablity are addressed by most biology teachers. Traditionally, these topics are taught using plant and animal examples with relatively little emphasis on human illustrations. Data in Table I confirm that, indeed, most of the textbooks place little emphasis on the human aspects of these topics. While neither the textbook analyses nor the questionnaire study provides hard data on the degree of emphasis given to human aspects when these subjects are taught, the textbook analyses suggest that human examples will not be stressed.

On the other hand, some topics listed in Table I, if taught in the classroom at all, must deal with human genetics. Such is the case for human gene therapy, genetic screening, genetic counseling, prenatal diagnosis, and others. The relatively low frequency with which some of these topics (e.g., human gene therapy) are taught correlates well with the lack of treatment in the textbooks. What is remarkable is that some of these topics (e.g., genetic screening or genetics of mental retardation), while not stressed at all in the textbooks, are still taught by reasonable numbers of the teachers surveyed. Prenatal diagnosis, while at least briefly addressed in ten of the eleven books, is taught by only sixty-two percent of the teachers. No doubt some such topics (e.g., genes, race, and IQ) are deliberately avoided by many teachers (and by textbook publishers) as being too controversial for the classroom.

<u>Pretest Data</u>

The method used to measure students' prior knowledge of human genetics involved analysis of pretest data. Eighty-eight students enrolled in Biology 199 in Autumn Quarter 1987 completed a fifty-item multiple choice pretest with a mean score of 12.9 (25.8%). The highest score earned on the pretest was 31 (62%). Seventy-seven percent of the students scored in the range of nineteen to thirty-eight percent on the pretest. These data suggest that a decided majority of the students do not have a good understanding of basic principles of human genetics.

The data (Table III) concerning correct responses for the questions related to each of nine genetics topics on the pretest also suggest that the students are not well versed on any of the genetics topics. Since there were five possible responses for each question on the pretest, the probability of correctly responding (on a purely chance basis) was one-in-five or twenty percent. With two or three possible exceptions (mitosis/meiosis, DNA/RNA/protein synthesis, and polygenic inheritance), student performance would appear to approximate what would be expected if one responded by chance. Nothing about student performance on the pretest suggests a level of preparedness warranting major modifications in the human genetics content of Biology 199 at Ball State University.

<u>Summary and Recommendations</u>

From the analyses of the data from: (1) the survey of Indiana high school biology teachers, (2) the state-adopted textbooks, and (3) the pretesting of Biology 199 students at Ball State University, one can conclude that high school students are not well grounded in their understanding of the basic principles of genetics as they apply to

Table III

Percent of Correct Responses by 88 Biology 199 Students

for Nine Genetics Topics on a 50 Item Pretest

Topic	No. of Questions on Topic	% Correct Responses
Mendelian Inheritance	7	23.86
Sex and Gene Transmission	4	27.27
Mitosis/Meiosis	8	30.97
Pedigree Analysis/ Probability	5	21.14
DNA/RNA/ Protein Synthesis	4	31.82
Polygenic Inheritance	5	33.86
Chromosomal Aberrations	5	18.18
Population Genetics	7	24.03
Multiple Alleles, Linkage, Epistasis	5	21.36

humans. While a high percentage of the teachers stress genetics in their teaching of high school general biology, much less emphasis is given to human genetics. Furthermore, the textbooks adopted by the State of Indiana place little stress on human genetics. Since the textbook often becomes the curriculum, most high school biology courses can be expected to give little emphasis to human applications of genetics. As a consequence, it is not surprising that college freshmen (mostly from Indiana) enrolling in Biology 199 at Ball State University did not do well on a course pretest on human genetics concepts.

Although courses and workshops on human genetics currently exist for the purpose of updating high school biology teachers on advances in human and medical genetics, more must be done to stress the incorporation of these developments in the courses, curricula, and textbooks used in the state. Since the state-adopted textbooks do not include much on human genetics, teachers should be encouraged to use suitable supplementary materials to fill the void. An increase in teachers' knowledge of human genetics and the identification of appropriate instructional materials for use in the high school classroom would both seem to be necessary prerequisites to improved student understanding of developments in human genetics as measured by the pretest used with the freshmen students at Ball State University.

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INDIANA STATE ADOPTED TEXTBOOKS - 1987

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B. Goodman, Harvey D. et al. Biology. Harcourt Brace Jovanovich, Inc. Orlando, Florida. 1986. 878 pp.

C. McLaren, James E. and Lissa Rotundo. Heath Biology. D.C. Heath and Co. Lexington, Massachusetts. 1985. 790 pp.

D. BSCS. Biological Science, A Molecular Approach BSCS. D.C. Heath and Co. Lexington, Massachusetts. 1985. 785 pp.

E. Otto, James H. and Albert Towle. Modern Biology. Holt, Rinehart and Winston, Publishers. New York, New York. 1985. 824 pp.

F. Bauer, Penelope H. et al. Experiences in Biology. Laidlaw Brothers Division of Doubleday. River Forest, Illinois. 1985. 672 pp.

G. Oram, Raymond F. et al. Biology: Living Systems. Charles E. Merrill Publishing Co. Columbus, Ohio. 1986. 758 pp.

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I. Slesnick, Irwin L. et al. Scott, Foresman Biology. Scott, Foresman and Company. Glenview, Illinois. 1985. 704 pp.

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Appendix A

APPENDIX A

Since a pretest was used to measure students' prior knowledge of human genetics, a comparison of pretest and posttest data was the method employed to measure the students' gain in knowledge of human genetics after taking Biology 199, a human genetics course at Ball State University. This comparison of pretest and posttest data was made possible since the two tests were indentical. A comparison of the data collected from both the pretest and posttest gave indications of the quality of the test questions and the amount of time spent dealing with a particular topic in class, as well as the students' knowledge of human genetics. For example, a small increase in the percentage of correct responses on a particular question from the pretest to the posttest may suggest an ambiguously worded or an especially difficult question, a minimal amount of class time spent dealing with the topic of that particular question, or little understanding of the topic on the part of the students.

More specifically, even though the students seemed to have more prior knowledge of the topic of polygenic inheritance than some of the other human genetics topics, as determined from the pretest data, only a relatively small increase (17.61%) occurred in the percent of correct responses on one polygenic inheritance question (number 20 of the pretest). This relatively small increase could indicate an ambiguously worded or especially difficult question, a minimal amount of class time spent dealing with this topic, or little understanding of the topic on the part of the students. In this specific case, since the percentage of correct responses to the other test questions dealing with polygenic inheritance showed appropriate increases from pretest to posttest, it is quite possible that one reason for the small increase for question number 20 may be that the question itself was ambiguously worded or especially difficult. If the topic had not been dealt with sufficiently in class, or if the students simply did not understand the topic of polygenic inheritance, one would expect little improvement on the other questions dealing with polygenic inheritance. (See manuscript, Table III, and Appendix A Table I and Figures I-X. Copies of the pretest and posttest are available upon the approval of Dr. J.R. Hendrix in the Cooper Life Science Building, Room 171D at Ball State University.)

A similar example of a small increase in the percentage of correct responses involved a question (number 48 on the pretest) dealing with chromosome aberrations. Correct responses increased by only 2.13 percent from the pretest to the posttest for question number 48. Once again, the percentage of correct responses to the other test questions dealing with chromosome aberrations showed appropriate increases. These results might suggest that question number 48 was ambiguously worded or especially difficult.

A small increase in the percentage of correct responses from the pretest to posttest also occurred for pretest question number 32 dealing with linkage. The correct responses increased by 6.52 percent. As before, this may be explained by an ambiguously worded or especially difficult question, a minimal amount of time spent in class dealing with the topic, or a lack of understanding on the part of the students. Since there were not any additional questions on the test concerning linkage, this would seem to indicate that not a great amount of class time was spent on linkage. Therefore, this might suggest that the small increase in the number of correct responses may be attributed to a minimal amount of class time being allotted to the topic of linkage, and not to an ambiguously worded question.

By carefully analyzing the pretest and posttest data found in the manuscript Table III, Appendix A Table I, and Figures I-X, as well as by examining the individual test questions, it may be possible to form hypotheses concerning the reasons for relatively small increases in the percentage of correct responses for individual questions on the pretest and posttest. By changing certain test questions that may be in need of clarification, or by changing the amount of class time spent dealing with topics that may not have been sufficiently dealt with in the past, these hypotheses could be tested. After these changes have been made, it may be possible to obtain a more accurate assessment of the students' actual understanding of human genetics topics once they have completed Biology 199.

Table I. COMPARISON OF STUDENT PERFORMANCE
ON PRE/POSTTEST QUESTIONS IN BIO 199
FALL QUARTER 1987

Pretest Question no.	Posttest Question no.	Topic	Pretest % Correct	Posttest % Correct	% Inc.
1	44	Mendelian Inh.	5.26	54.05	48.79
2	45	Mendelian Inh.	27.19	81.08	53.89
3	46	Mendelian Inh.	15.79	74.77	58.99
4	47	Mendelian Inh.	15.79	77.48	61.69
5	48	Mendelian Inh.	6.14	63.06	56.92
6	49	Mendelian Inh.	46.49	96.40	49.91
7	50	Mendelian Inh.	12.28	77.48	65.20
8	42	X-Linkage	7.02	86.49	79.47
9	43	X-Linkage	42.11	69.37	27.26
10	41	X-Linkage	15.79	82.88	67.09
11	40	Meiosis	52.63	97.30	44.67
12	39	Mitosis	43.86	59.46	15.60
13	38	Mitosis	34.21	80.18	45.97
14	34	Pedigree Analysis --Probability	21.05	94.59	73.54
15	35	Pedigree Analysis --Probability	29.82	92.79	62.97
16	36	Pedigree Analysis --Probability	24.56	62.16	37.60
17	37	Pedigree Analysis --Probability	23.68	80.18	56.50
18	33	Pedigree Terminology	6.14	93.69	87.55
19	32	DNA,RNA, and Protein Synthesis	19.30	93.69	74.40
20	31	Polygenic Inh.	18.42	36.04	17.61

Table I. (continued)

Pretest Question no.	Posttest Question no.	Topic	Pretest % Correct	Posttest % Correct	% Inc.
21	29	Polygenic Inh.	33.33	96.39	63.06
22	30	Polygenic Inh.	9.65	62.16	52.51
23	28	Polygenic Inh.	16.67	91.89	75.23
24	27	Polygenic Inh.	52.63	99.10	46.47
25	26	Klinefelter --Barr Body	24.56	91.89	67.33
26	23	Meiosis	14.04	41.44	27.40
27	24	Meiosis	14.04	75.68	61.64
28	25	Meiosis	17.54	29.73	12.19
29	22	Meiosis	7.02	67.57	60.55
30	21	Meiosis	7.89	65.77	57.88
31	20	Sex-Influenced	19.30	72.07	52.77
32	19	Linkage	7.89	14.41	6.52
33	18	Multiple Alleles --Rh	21.93	68.47	46.54
34	17	Multiple Alleles	14.04	20.72	6.69
35	13	Hardy-Weinberg	21.05	93.69	72.64
36	14	Hardy-Weinberg	12.28	32.43	20.15
37	15	Hardy-Weinberg	16.67	61.26	44.59
38	16	DNA,RNA, and Protein Synthesis	23.68	86.49	62.80
39	12	DNA,RNA, and Protein Synthesis	18.42	99.10	80.68

Table I. (continued)

Pretest Question no.	Posttest Question no.	Topic	Pretest % Correct	Posttest % Correct	% Inc.
40	11	DNA,RNA and Protein Synthesis	20.18	96.40	76.22
41	10	Hardy-Weinberg	25.44	85.59	60.15
42	7	Hardy-Weinberg	16.67	95.50	78.83
43	8	Hardy-Weinberg	16.67	95.50	78.83
44	9	Hardy-Weinberg	8.77	54.05	45.28
45	6	Chrom. Aberrations --Non-Disjunction	14.04	82.46	68.42
46	5	Chrom. Aberrations --Cri-du-chat	8.77	79.28	70.51
47	4	Chrom. Aberrations --Trisomy	10.53	89.19	78.66
48	3	Chrom. Aberrations --Aneuploidy	12.28	14.41	2.13
49	1	Epistasis	18.42	78.38	59.96
50	2	Epistasis	20.18	36.04	15.86

Fig. I. **Pretest and Posttest Comparison:**

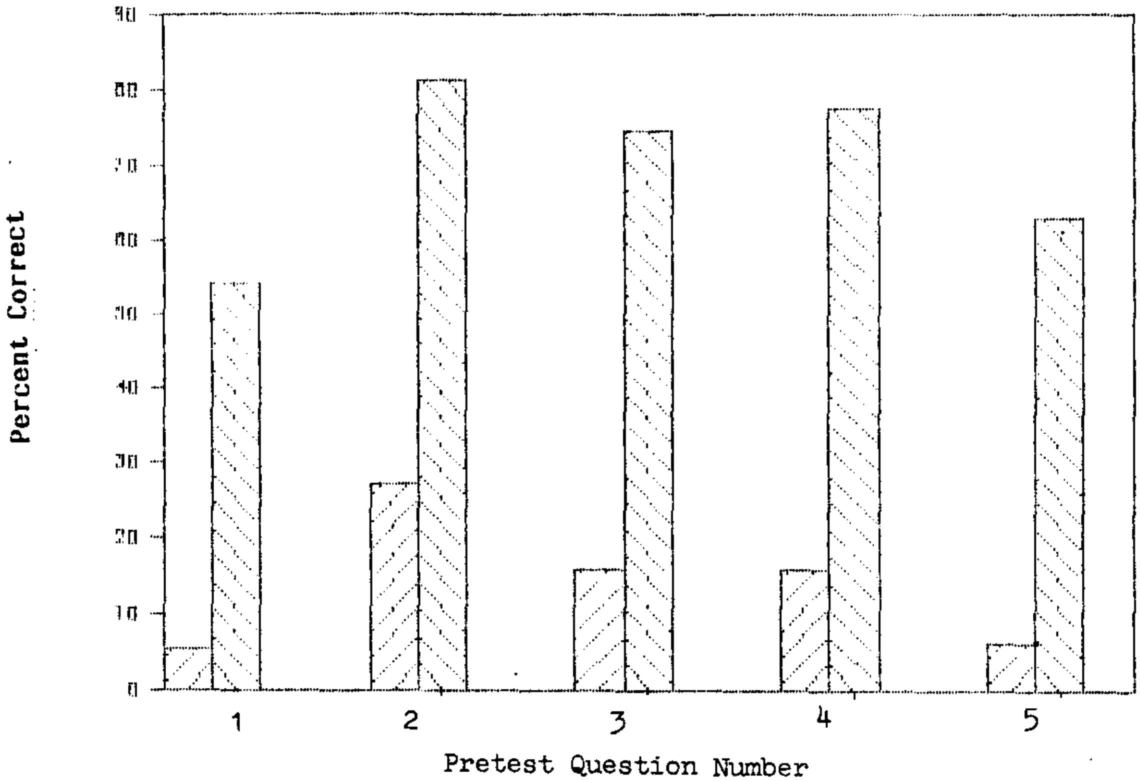


Fig. II. **Pretest and Posttest Comparison:**

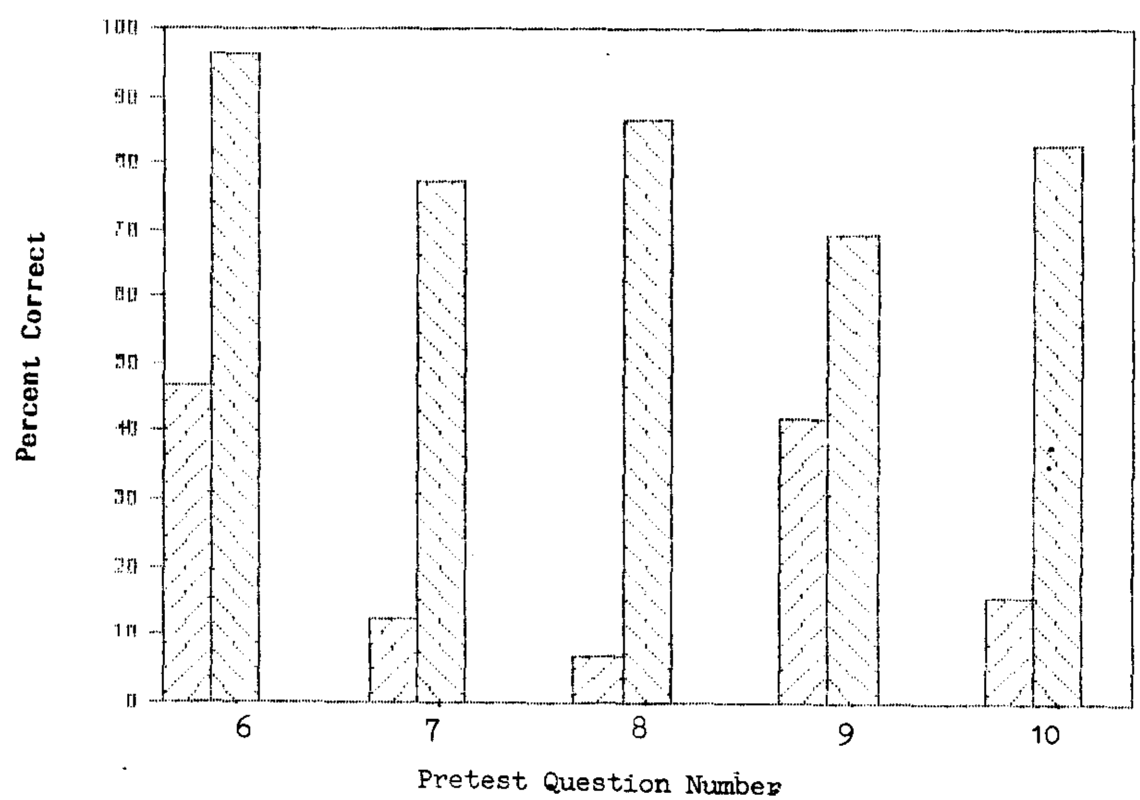


Fig. III. **Pretest and Posttest Comparison:**

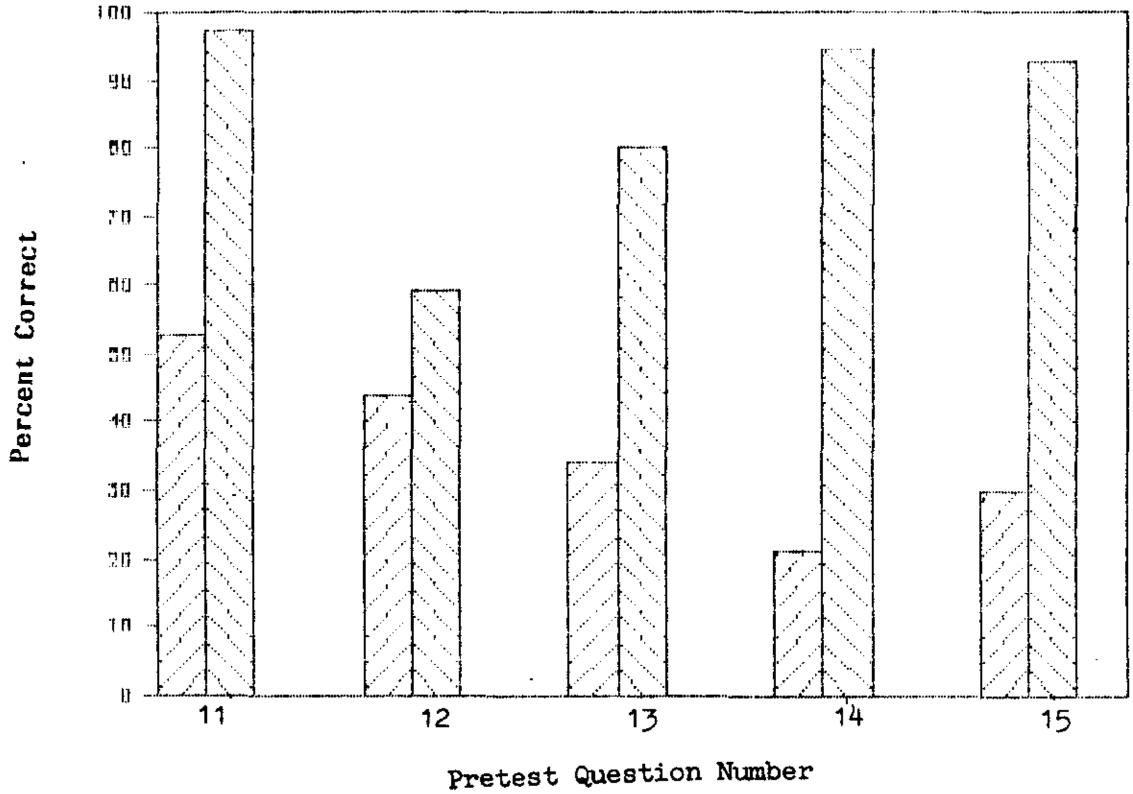


Fig. IV. **Pretest and Posttest Comparison:**

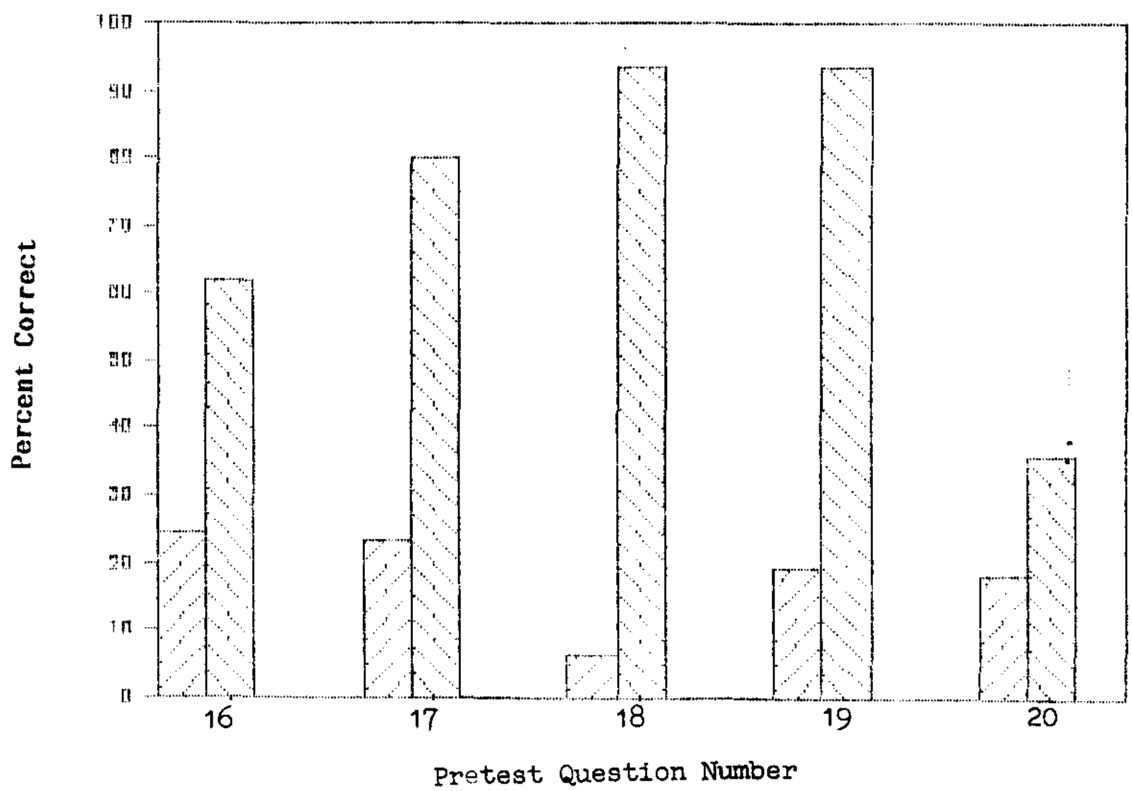


Fig. V. **Pretest and Posttest Comparison:**

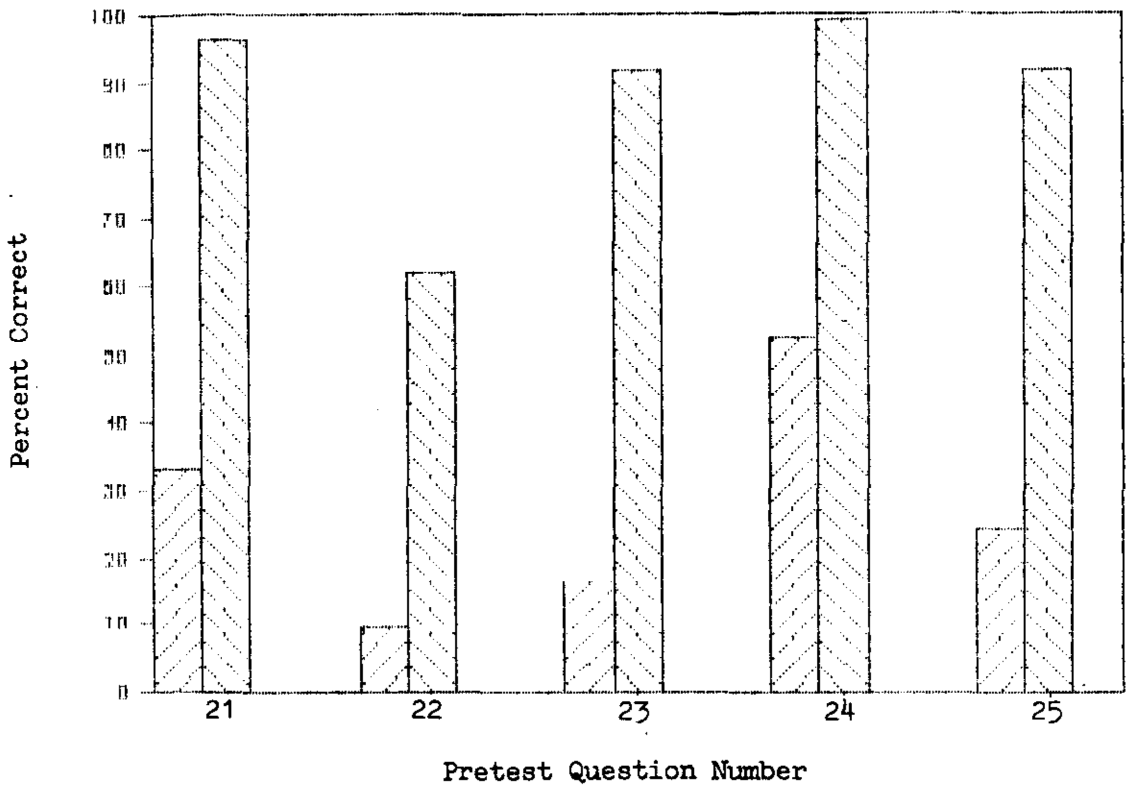


Fig. VI. **Pretest and Posttest Comparison:**

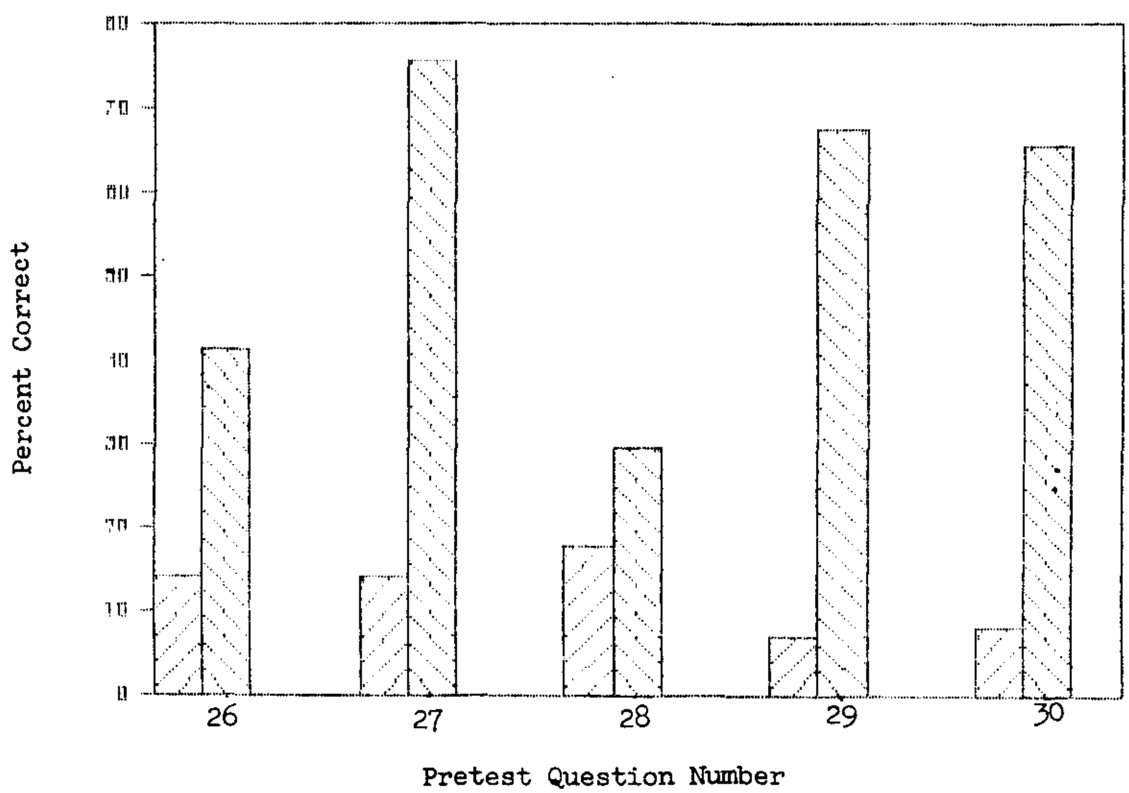


Fig. VII. **Pretest and Posttest Comparison:**

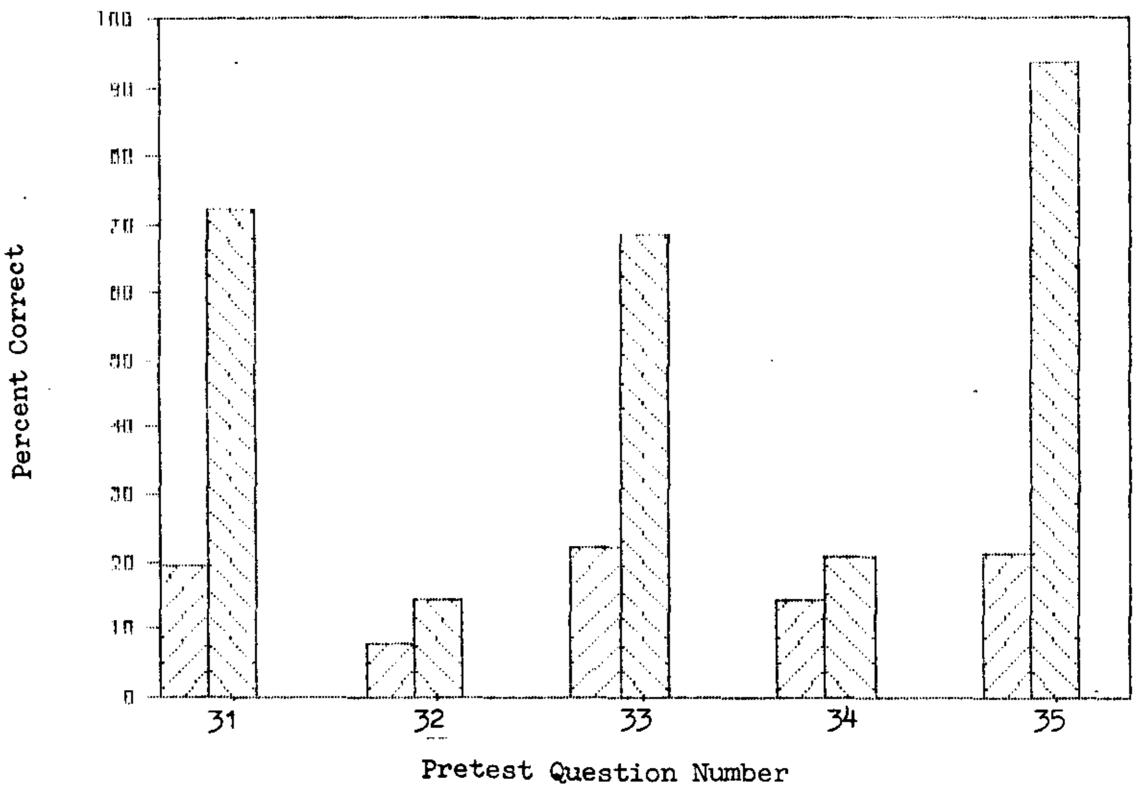


Fig. VIII. **Pretest and Posttest Comparison:**

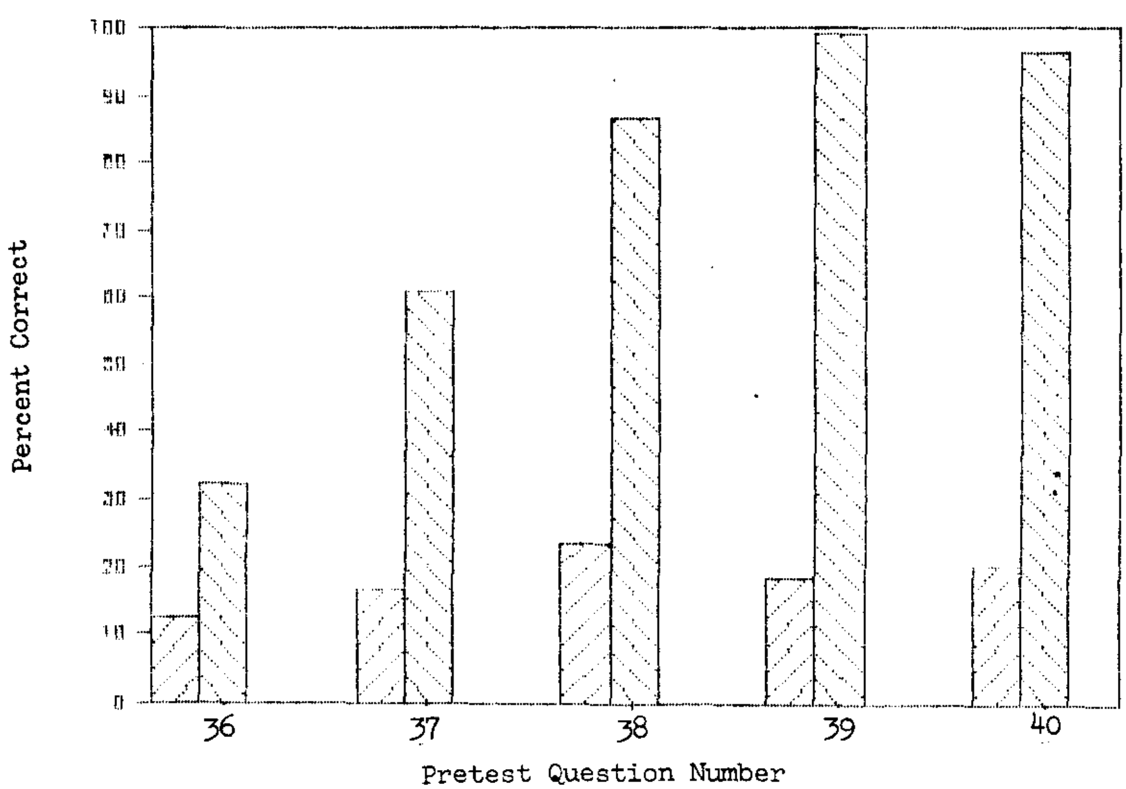


Fig. IX. **Pretest and Posttest Comparison:**

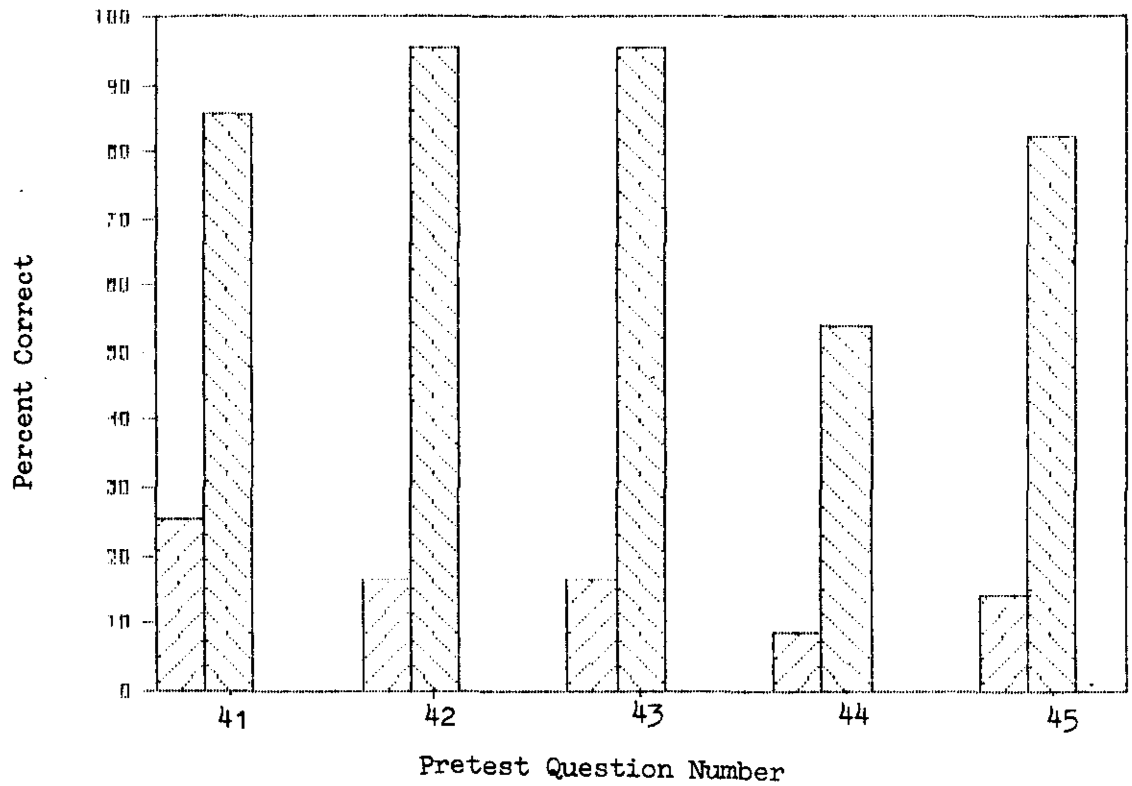
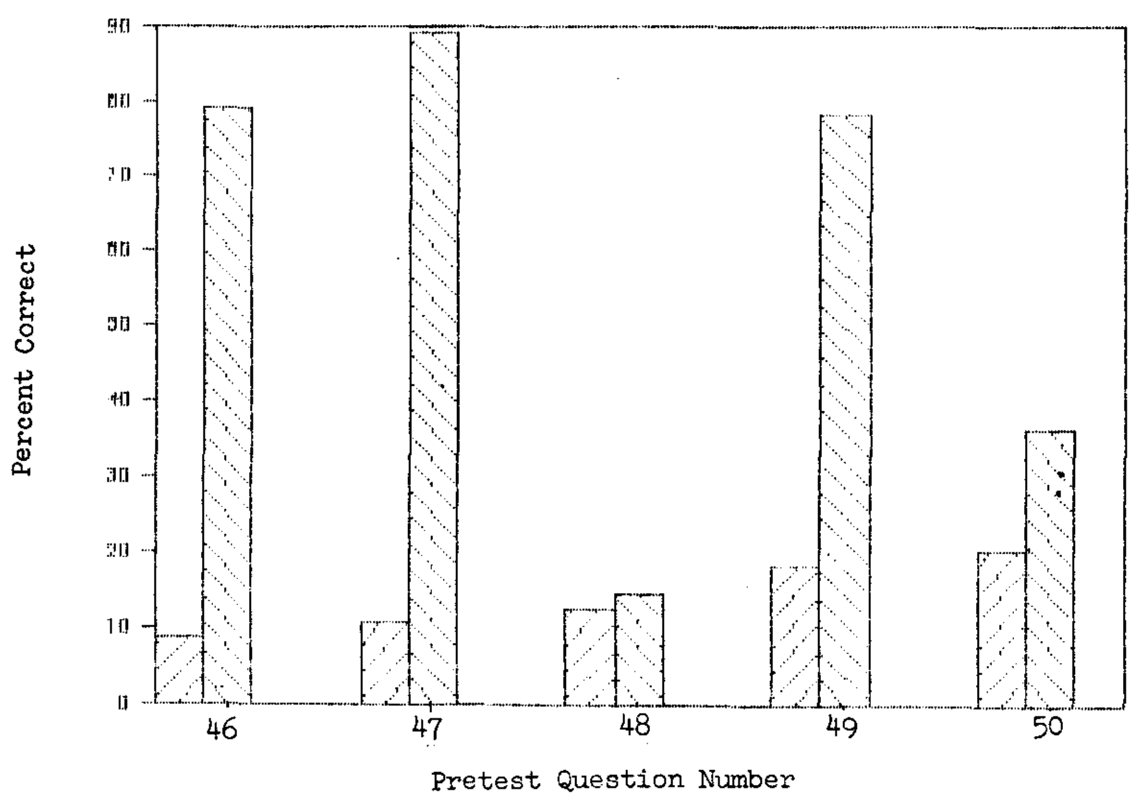


Fig. X. **Pretest and Posttest Comparison:**



Appendix B

Appendix B

The following two documents are a copy of the cover letter sent to the 200 Indiana high school biology teachers and a copy of the survey instrument that was also sent to those teachers.

Ball State University

College of Sciences and Humanities
Department of Biology

October 9, 1987

Dear Indiana Biology Teacher:

Greetings from the Department of Biology at Ball State University.

In 1976, Biology 199 was first taught as a required course in the Honors College Curriculum at Ball State University. In Biology 199, students are introduced to the principles of heredity as they apply to human beings and to diseases and defects that are genetically or chromosomally controlled. Biology 199 also presents the moral and ethical issues that have grown out of recent advances in human and medical genetics and provides opportunity for students to develop decision-making skills pertaining to these issues.

When this class was first developed most of the students who enrolled had little or no human genetics background; so the objectives of the class were geared to such students. Now we are finding that the students coming into the class often have a much more solid understanding of human genetics than before. Consequently, we need to modify the human genetics content of Biology 199 to meet the needs of these students. To do this more effectively we need information from you about what kind of instruction in human genetics and bioethics the students are receiving in secondary schools.

We are requesting that you provide us with the information that we need by completing and returning the enclosed questionnaire. Any information that you provide will be held in confidence, and any data released will be done so as group data. No data will be identified by teacher or by school. At the end of the project we will send you a summary of the findings.

In completing the questionnaire, we ask that you comply with the following instructions. Please use a number 2 pencil when answering the multiple choice questions on the answer sheet. Please fill in the blanks directly on the computer answer sheet or we will not be able to use it. Please return the questionnaire, the answer sheet, and the cardboard in the addressed, stamped envelope provided. Thank you for your time and assistance.

Sincerely yours,

Thomas R. Mertens
Professor of Biology

nms

317-285-8820 Muncie, Indiana 47306-0440

HUMAN GENETICS QUESTIONNAIRE

INSTRUCTIONS: (1) Please use a no. 2 pencil when answering multiple choice questions on answer sheet. (2) Please fill in blanks directly on questionnaire where appropriate. (3) Please do NOT bend or fold answer sheet. (4) Return questionnaire, answer sheet, and cardboard in envelope provided.

1. Are you currently teaching a biology course? (A) YES (B) NO

2. How many years of secondary school biology or life sciences have you taught prior to the current school year?
(A) 0-2 (B) 3-5 (C) 6-8 (D) 9-10 (E) more than 10

3-7. What is (are) your teaching assignment(s) [Please mark (A) for YES and (B) for NO for each of the items, 3-7]?
3. 9/10 grade general science
4. 9/10 grade general biology
5. 10/12 grade advanced biology
6. 10/12 grade botany
7. 10/12 grade zoology

8-11. Have you taken undergraduate or graduate courses in any of the following subjects [Please mark (A) for YES and (B) for NO for each of the items, 8-11]?
8. genetics
9. advanced genetics
10. human genetics
11. bioethics

12-16. Within the last five years, have you attended a conference or workshop which focused on one or more of the following subjects [Please mark (A) for YES and (B) for NO for each of the items, 12-16]?
12. human genetics
13. birth defects
14. bioethical problems/issues
15. bioethical decision making
16. teaching controversial issues in biology

17. Do you have a unit devoted to genetics within your general biology course?
(A) YES (B) NO

18. In your general biology courses how much classroom time do you usually spend on human genetics? [Please mark one answer only.]
(A) none
(B) 1-2 hours
(C) 3-4 hours
(D) 5-6 hours
(E) 7-8 hours
(F) 9-10 hours
(G) 11-15 hours
(H) 16-20 hours
(I) more than 20 hours

19-36. Which of the following topics do you usually include in your 9/10 grade general biology courses [Please mark (A) for YES and (B) for NO for each of the items, 19-36]?
19. nucleic acids in protein synthesis
20. genetic engineering; recombinant DNA
21. human gene therapy
22. mitosis and meiosis
23. Mendelian inheritance
24. principles of probability
25. genetics of plants and/or animals
26. human genetic diseases
27. sex linked defects
28. genetic screening
29. genetic counseling
30. prenatal diagnosis of genetic diseases
31. ethics of human genetics
32. genetics of mental retardation
33. genes, race and IQ
34. nature vs. nurture
35. history of genetics
36. Hardy-Weinberg law

continued on reverse side

37-54. If you teach a unit specifically devoted to genetics in your 9/10 grade general biology course, please indicate any of the following human genetic diseases/defects that you usually have time to use as illustrations [Please mark (A) for YES and (B) for NO for each of the items, 37-54]?

37. Phenylketonuria (PKU)
38. Cystic fibrosis
39. Tay-Sachs disease
40. Rh factor
41. Sickle cell anemia
42. Huntington disease
43. Hemophilia
44. Colorblindness
45. Muscular dystrophy
46. Diabetes mellitus
47. Down syndrome
48. Turner syndrome
49. Klinefelter syndrome
50. Spina bifida
51. Cleft lip/palate
52. Polydactyly
53. Syndactyly
54. Marfan syndrome

55. Does your high school offer an advanced biology course that is devoted exclusively to the study of human genetics?
(A) YES* (B) NO

*If you have a free-standing course in human genetics offered at your high school, please provide us with additional information about the course by answering questions, 56-62. Stop here if you do not have a free standing human genetics course.

56. If the school does offer a free-standing course in human genetics, how long is it?
(A) 6 weeks (B) 9 weeks (C) 12 weeks (D) 1 semester (E) 2 semesters

57. What is the total number of students who take the human genetics course in your school each year?
(A) fewer than 25 (D) 76-100 (G) 151-175
(B) 25-50 (E) 101-125 (H) 176-200
(C) 51-75 (F) 126-150 (I) more than 200

58. Does the human genetics course deal with social and moral/ethical issues resulting from the application of new genetic technologies?
(A) YES (B) NO

59. If you responded "yes" to question 58, about what percent of the course time is devoted to these issues?
(A) 1-5% (B) 6-10% (C) 11-15% (D) 16-20% (E) 21-25% (F) more than 25%

60. What textbook do you use in the course? ______________________________

____

61. Is there any lab work associated with the class? If yes, please give us a brief description of the nature of the experiments.

____

____

____

62. If possible, please include a course syllabus or an outline of the topics studied in the course when you return this questionnaire.