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ABSTRACT

This investigation of the impact of an Individualized Audio-Tutorial (IAT) biology learning unit upon students in five ninth grade classrooms in an urban junior high school in Israel focused on the students' perceptions of their classroom learning environment, and their attitudes toward IAT and toward science and understanding the process of science. The sample consisted of 105 students in the experimental group and 65 in the control group; the latter group received instruction via a traditional lecture-laboratory approach. Data from pre- and post-assessments using the Audio-Visual Student Attitude Inventory (experimental group only) and the Inventory of Scientific Attitudes were treated by analysis of covariance. Applications of the t-test to the results indicated that such positive factors as cooperation and cohesiveness did not diminish in the IAT group as they did in the control group, and such negative factors as cliqueness, favoritism, and competition did not increase in the experimental group as compared with the control group. Although students in the experimental group expressed favorable attitudes toward some aspects of the IAT method (performing experiments individually, development of independent thinking, self-examination, rate of learning, and self achievement), no changes occurred in their attitudes toward science and understanding the process of science as a result of being instructed in an IAT setting. The only major difference between the boys and girls was that girls expressed more favorable attitudes than boys toward the individualized aspects of the IAT method. Three data tables and a three-page list of references complete the report. (Author/JB)

The Affective Domain of Junior High School Students in an Audio-Tutorial Biology Setting

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Studies regarding the IAT implementation at the junior and high school levels reported findings related to: a) achievement of students with different academic status and abilities; b) attitudes toward the method, toward science and understanding the process of science; and c) few studies were related to the investigation of the learning environment of a classroom in an IAT setting (Kahle, 1978; Lazarowitz & Huppert, 1981, 1982a, 1982b).

In IAT classroom instruction one can ask if students are to display changes in their attitudes toward the learning process and science, and to express positive perceptions relating to their classroom environment. Since students learn on an individualized basis one can ask if this method does not enhance individualization upon cooperation and if it can be free of competition. In contrast to a classroom frontal approach, where competition dominates the class climate, in the IAT approach, one can hypothesize that competition will decrease. Several other questions can also be raised as to what can be the aspects of students' satisfaction, cohesiveness and cliqueness in an IAT setting as compared with traditional frontal classroom instruction. What are students' feelings regarding favoritism and difficulty of the learning material, as well as apathy and classroom situations which tend to appear disorganized?

Finally, since the IAT method allows students' failures to be private and not known to other students or teachers (Gagne & Briggs, 1974) will this increase students' positive attitudes toward the IAT method and toward science in general?

Thus the purposes of this study were to investigate the impact of the implementation of an IAT learning unit in Biology in 9th grade junior high school upon: a) students' perceptions of their classroom learning environment; and b) students' attitudes toward the method, and toward science and understanding the process of science. In this study, the two methods of

instruction, the IAT and the conventional classroom-laboratory method (CCLM) which uses a frontal instruction, and gender served as independent variables while the learning environment inventory (LEI), students' attitudes toward the methods and toward science and understanding the process of science, served as dependent variables.

Theoretical Basis

Classroom learning environment as a research variable was based on Getzels & Thelen's (1960) sociopsychological theory which sees the classroom as a social system. Based on this assumption Walberg and Anderson (1968) investigated the social-learning climate of the classrooms where Harvard Project Physics was taught, developed and validated the Learning Environment Instrument (Anderson & Walberg, 1974) which was later used in different variations in several studies.

Walberg & Anderson (1968) identified two aspects of the social climate of the classroom. First, the structural dimension which refers "to the structure or organization of student roles within the class", goal direction and democratic policy. Second, the affective dimension which in their words "pertains to idiosyncratic personal disposition to act in a given way to satisfy individual personality needs" satisfaction, intimacy, and friction. The LEI includes the factors mentioned above. According to Walberg (1971) the learning environment of the classroom relates to instruction as students' ability relates to achievement.

In a study in which the Harvard Project Physics (HPP) taught in science classes was evaluated, Anderson, Walberg and Welch (1969) found that students perceived their classrooms as more diverse and democratic, less difficult and goal-directed, and having a better environment and less friction. Walberg (1971) in his evaluation of the HPP found positive correlations between cognitive learning and class difficulty and between

measures of interest and satisfaction, and in contrary negative correlations between various measures of learning and class friction and apathy. In other studies, Walberg (1969), Johnson (1976) and Lawrenz (1976, 1972) reported that interest in learning, effective adjustment, and students' motivation were related to students' perception of their learning environment. Hofstein et al. (1979, 1980) found that some aspects of the learning environment can predict students' attitudes toward chemistry, and Sharan and Yaakobi (1981) emphasized that positive social climate in biology classrooms can be promoted by school educational policy. Finally based on Anderson, Walberg and Welch (1969) and Levine (1980) and Fraser (1982) concluded that when LEI was used as a criterion for curriculum evaluation, students' perceptions of their classroom learning environment had "differentiated revealingly, usefully and appreciably between classrooms following alternative curriculum, materials, or teaching strategies."

Attitudes Toward IAT

Both Santiesteban (1976) and Novak (1970) have indicated the necessity of investigating student attitudes toward new teaching approaches and the relative ease of interpreting different aspects of IAT because of its structured nature.

Shulman and Tamir (1973) mentioned also that attitudes as outcomes of modes of instruction "are at least as important as their cognitive counterparts". Studies have shown a positive relation between each of the following factors and the IAT method: increased student motivation (Waskoskie, 1973; Martin, 1975); increased student confidence in getting a better education, increased individual attention from the instructor and reduced pressure (Shavelson & Manger, 1970); and increased feelings of responsibility (Krockover, 1971).

The frontal classroom mode of instruction is teacher centered. On the contrary the individualized audio-tutorial (IAT) approach developed by Postlethwait et al. (1972) is a mode of learning in which students are expected to read learning material, to perform experiments in the laboratory where science is learned, to take self examinations and to use audio-visual aids such as viewers and slides which represent pictures of the topic, and tape recorders which coordinate all the activities in a desirable sequence. This way of instruction enables students to participate in self-paced learning, and requires them to be responsible in the learning process. Thus one can assume that in a class which uses the IAT method, the individualized mode is emphasized, and it is student centered.

Therefore the IAT method facilitates students' interaction in an individualized manner with the learning material and the teacher's role changes from that of facilitator of the learning environment, to a one who guides, helps and stimulates needy students. While the IAT was developed and used mainly at the college level, in its implementation at the high school level several difficulties are encountered, such as the rigid school timetable, the fact that classrooms and laboratories are available only during the learning hours when schools are open, and the fact that high school students are limited to the amount of time given to them for a specific topic. These constraints were described by Geisert (1977) and are in conflict with the original intentions as presented by Postlethwait et al. (1972) and by Kahle (1978). Studies have also demonstrated that in spite of the individualized aspects of the IAT method, junior high school teachers who used this mode of instruction emphasized the need of having weekly classroom meetings in which they were able to discuss and clarify problems which arose during the learning process (Lazarowitz & Huppert, 1981).

Erhart (1969) found that when taught by the IAT method, not all students wanted to study all subjects in this way. Hinton (1970) reported that students felt their teachers were isolated during the learning process. Hahn (1971) reported that students were satisfied with the IAT method, and positive attitudes toward IAT were reported by Butzow et al. (1977) and Lazarowitz and Huppert (1982b) who found significant differences in the individualized aspects of the IAT, learning rate, and achievements related to gender.

Attitudes toward science. Moore and Sutman (1970) mentioned that even people who are not involved directly in science should have an understanding and appreciation of the dynamic values of science knowledge and the nature of different sciences. Katzir (1971) emphasized the fact that positive attitudes toward science among students are an accepted and desirable goal in the education process.

While Glass and Yager (1970), and James (1972) found positive relation between attitudes toward science and understanding of it and the IAT method, Krockover (1971) did not find such a relationship. In the Lazarowitz and Huppert (1982b) study, no significant difference was found on attitudes toward science and understanding the process of science between the experimental (IAT method) and control (CCLM) groups. However, a significant difference was found between the pre- and post-test mean scores of the experimental group only. This difference was attributed to boys and happened only on the affective subscale of the test and not on the cognitive part of it.

The Research Design

The Sample. One hundred and eighty students from five 9th grade classrooms participated in this study. All students from an urban junior high school were randomly assigned to an experimental group (3 classes,

N = 105) and to a control group (2 classes, N = 65). Students' age ranged from 13.5 to 14.5 years. In seventh and eighth grades, the students studied "The Animal and its Environment" and "The Plant and its Natural Habitat"; they are supposed to finish their biological education in 9th grade by studying the "Unity" part of the BSCS program, which includes the structure and function of the cell. Thus, none of them had previously studied the subject to be taught during the experiment, namely the "Cell". The number of subjects differ for the different tests taken by students during the research.

Description of the audio-visual learning unit and the procedure

The learning units used in the IAT settings were "The Cell Membrane", "The Cell Nucleus" and "The Cell Organelles". A description of the learning units developed for audio-visual instruction, as well as a description of the procedure, experiments, the learning process, and a description of a typical period were presented in a previous paper (Lazarowitz & Huppert, 1981). The study lasted 6 weeks, and each learning unit was studied during two weeks. The control group studied the "cell" topic using the BSCS learning material in a conventional classroom-laboratory method of instruction also during six weeks.

Instruments

Learning Environment Inventory (LEI). Developed by Walberg and Anderson (1968), the LEI was translated into Hebrew and used by Hofstein et al. (1979) with 11th grade chemistry students. A short version of it was translated and used by Sharan and Yaakobi (1981) in 10th grade biology high school classrooms in city and kibbutz schools. This short version included 42 items in a Likert-type on a 4 point scale. Using the Factor analysis technique, they identified the following nine factors with the number of items in each (indicated by the parentheses): Cooperation (9); Satisfaction

(3); Cohesiveness (5); Cliqueness (3); Favoritism (5); Difficulty (5); Competition (6); Apathy (5); and Disorganization (4). Hofstein et al. (1979) reported Cronbach reliability coefficients in a range of 0.64 to 0.81 for the different factors. In this study, LEI was administered as a pre- and post-assessment, thus allowing the performance of an analysis of covariance between the two groups. Scores on LEI were calculated for each factor, thus obtaining nine mean scores for the statistical analysis.

Attitudes toward IAT. The Audio-Visual Student Attitudes Inventory (AVSAI) developed by Lazarowitz and Huppert (1982b) was used. The inventory included 47 items, half phrased in a positive manner and half in a negative one. Using the Likert scale, positive items were valued from five to one, and the negative statements from one to five. Content validity for the AVSAI was obtained with a group of six high school biology teachers, who were trained in the IAT method. Each item was checked for its content appropriateness for the IAT method. They also categorized the 47 items into eight factors according to their content, and obtained an 87% level of acceptance, which can be considered as a measure of reliability. AVSAI was administered as a pre- and post-assessment and the mean scores were calculated for each factor, by dividing the factor's sum by the number of items of which it consists (see Table II for factors and number of items).

Inventory of Scientific Attitudes (ISA). Attitudes toward science and understanding the process of science were assessed by the Inventory of Scientific Attitudes developed by Moore and Sutman (1970). ISA consists of 60 items related to intellectual and emotional attitudes and uses a Likert scale from 1 to 4 points (strongly agree, agree mildly, disagree mildly, and strongly disagree). Moore and Sutman (1970) reported about construct validity.

Novick and Duvdvani (1976) translated ISA into Hebrew and reported about content validity, and a level of 80% agreement among a group of scientists and science educators related to validity on each item as a measure of the designated scale. The ISA was administered to the control and experimental groups as a pre- and post-assessment, and analyzed separately for the intellectual and the emotional subscales.

Results

Results regarding the classrooms' learning environment of the experimental and control groups are presented in Table I.

INSERT TABLE I HERE

An analysis of covariance was performed using the pre-test scores as covariate. Only on two factors were significant differences found between the two groups. While in the factor "Satisfaction" the experimental group expressed lower attitudes than the control group ($F = 14.03$; $p < .001$), in the "Difficulty" factor, they found that the learning material taught in the IAT method was not as difficult as the control group found ($F = 9.44$; $p < .001$). In the rest of the nine factors while the scores between the two groups differed, these differences were not significant.

Students' attitudes toward the IAT method were measured by AVSAI which was administered to the experimental group only. The mean scores on pre- and post-tests were analyzed by two-tailed t-tests on eight factors and are displayed in Table II.

INSERT TABLE II HERE

As can be seen, significant differences were found in five factors out of eight. In the post-test, students favored the individualized performance of experiments (t-value = 2.84; $p < .001$), and the individualized aspects of the IAT method (t-value = 1.67; $p < .10$). Students thought that the IAT method enhanced their independent thinking process (t-value = 4.17; $p < .001$), and liked the opportunity of self-examination offered by the method (t-value = 4.83; $p < .001$). Finally, they found that they improved their achievements and rate of learning (t-value = 3.93; $p < .001$).

In the other three factors (attitudes toward science, student-teacher interaction and use of audio-visual media) results show that students did not score higher as a result of IAT instruction.

In Table III, mean scores on AVSAI between boys and girls were compared by analysis of covariance. The pre-test scores served as covariate.

INSERT TABLE III HERE

Significant difference was found between boys and girls in one factor only: development of independent thinking ($F = 8.15$; p .001). Girls found the IAT approach as a stimulator for independent thinking more than the boys. In the other factors, while no significant difference was found, girls scored higher than boys in the following factors: individualized performance of experiments, the individualized aspects of the IAT method, attitudes toward science and scientific thinking, self examination, achievement and rate of learning, and use of audio-visual media. In only one factor did they score lower than the boys; student-teacher interaction.

The Moore and Sutman (1970) Inventory of Scientific Attitudes was used for measuring students' attitudes towards science and understanding of the process of science. The two subscales, intellectual and emotional, did not

yield any significant difference either between the experimental and control group, or between boys and girls in the experimental group. Therefore data are not presented. These results regarding attitudes toward science are consistent with data presented in Table II where the experimental group did not change their attitudes on the factor "science and scientific thinking" as a result of the IAT instruction. Thus two independent measurements yielded similar results, adding reliability to this dimension.

Discussion

How do students find their learning environment when the physical structure of the classroom instruction is changed from a frontal approach to an individualized one, and a new format of learning material is integrated with a wide use of media? Sharan and Yaakobi (1981) classified LEI factors in two clusters: (1) cooperation, cohesiveness, and satisfaction as positive factors, and (2) competition, cliqueness, favoritism and difficulty as factors which reflect negative perceptions and relationships. The results of this study show that in an individualized audio-tutorial approach factors such as cooperation and cohesiveness did not diminish as against the frontal approach. It is of interest to mention two other factors. While students did not find the learning material difficult as the control group, still they were less satisfied. This unsatisfactory feeling can be explained as a student reaction to the requests for self responsibility and self pace, requests which one can assume that had put some kind of pressure on them. This pressure is missing in a classroom frontal approach where students can assume that it is the teacher's responsibility to teach and to keep the learning pace. One can hypothesize that long practice of the IAT method can change students perceptions, when they will realize the potential impact the IAT method can have in the development and maturity of their personality. As to the negative aspects of the learning environment factors

such as cliqueness, favoritism and competition, one can see that in an IAT method those aspects did not increase in their magnitude as compared with the control group. Thus the individualized approach allowed the teacher to interact with each student so that feelings of favoritism did not increase and the individual mode of learning did not introduce any kind of competition nor cliqueness among learners, higher than in a frontal classroom instruction. It could be concluded also that individualized instruction does not necessarily induce apathy among students, nor disorganize perceptions of the classroom.

As regarding students' attitudes toward the IAT method and toward science, the results show some inconsistency. While students expressed more favorable attitudes toward several aspects of the IAT method which were individual in their nature (performing experiments, development of independent thinking, self examination, rate of learning and self achievement) students' attitudes toward science did not change significantly. One can conclude that while students perceived positively the individual aspects of the learning process, thus relating only to their personal needs, they did not encompass more general aspects such as attitudes toward science. One may hypothesize that while the IAT method may meet some of the students' personal needs it did not have an impact on a broader scale of attitudes toward science in a short period of six weeks of IAT instruction. This explanation can be supported by other findings (Lazarowitz et al., 1985) which show that students' needs are an important factor in preferring certain science subjects to be studied.

Nevertheless, results regarding girls' attitudes toward the IAT as well as their equal academic achievements with those of the boys (Lazarowitz & Huppert, 1981) tend to support the assumption that girls liked this mode of instruction more than the boys. Girls reported that they achieved more

and developed more independent thinking. One possible explanation of this is that when girls became free from any kind of competition with boys in the classroom and did not have to behave according to internal or external social expectations in an IAT setting they performed better and achieved according to their real intellectual potential. Boys, even though they could not compete as in a frontal classroom, achieved on their usual level, but expressed more negative attitudes toward the IAT than did girls. Another possible explanation is that since the girls' physical and intellectual development precedes that of the boys at this age, the IAT method probably suits the needs of the girls better.

More studies are needed in order to investigate specific individualized aspects of the IAT method as to how they can meet students' needs in a heterogeneous class, since this method seems to have the potential answer.

TABLE I

Analysis of Co-variance of Mean Scores of Nine Factors on Learning Environment for Experimental and Control Groups on Post-Test Scores. (Pre-test Scores Served as Covariate.)

Factors	Exp. gr (N=103) Mean (SD)	Control gr (N=66) Mean (SD)	F
Cooperation	2.64 (.47)	2.63 (.45)	.45**
Satisfaction	2.09 (.48)	2.40 (.59)	14.03*
Cohesiveness	2.65 (.47)	2.64 (.59)	.70**
Cliqueness	2.98 (.51)	3.06 (.54)	1.33**
Favoritism	2.39 (.56)	2.42 (.54)	1.21**
Difficulty	2.12 (.43)	2.27 (.42)	9.44*
Competition	2.57 (.49)	2.50 (.46)	1.19**
Apathy	2.51 (.35)	2.46 (.41)	.93**
Disorganization	2.11 (.51)	2.17 (.50)	1.12**

* = significant at 0.001 level
** = non-significant

TABLE II

Two Tailed T-test for Mean Scores of Eight Factors on Attitudes Toward IAT Method for the Experimental Group (N=105)

Factors	No. of Items	Pre-Test Mean(SD)	Post-Test Mean(SD)	t-value
1. The individualized performance of experiments	7	3.00(.52)	3.22(.69)	2.84*
2. The individualized aspects of the IAT method	9	3.42(.44)	3.52(.52)	1.67**
3. Attitudes toward Science and scientific thinking	5	3.52(.57)	3.58(.71)	.67***
4. Development of independent thinking	3	3.50(.75)	3.88(.78)	4.17*
5. Self examination	3	3.53(.67)	3.99(.74)	4.83*
6. Student-Teacher interactions	2	3.72(.69)	3.82(.74)	.91***
7. Achievements and rate of learning	10	2.97(.51)	3.26(.72)	3.93*
8. Use of audio-visual media	8	3.88(.55)	3.83(.81)	.61***

* = significant at 0.001 level
** = significant at 0.10 level
*** = non-significant

TABLE III

Analysis of Covariance of Mean Scores on Attitudes Toward IAT

Method by Gender (Pre-Test scores served as covariate)

Factors	Boys (N=50) Mean	Girls (N=55) Mean	F
1. The individualized performance of experiments	3.11	3.33	2.49**
2. The individualized aspects of the IAT method	3.49	3.55	.06***
3. Attitudes toward Science and Scientific thinking	3.50	3.66	.96***
4. Development of independent thinking	3.65	4.11	8.15*
5. Self examination	3.95	4.03	.12***
6. Student-teacher interactions	3.90	3.75	.60***
7. Achievements and rate of learning	3.16	3.36	2.00**
8. Use of audio-visual media	3.68	3.98	1.97**

* = significant at 0.001 level
** = tendency of change on attitudes
*** = non-significant

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