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ABSTRACT

One hundred and forty-eight student teachers from Israel Institute of Technology were subjects of an experiment investigating effectiveness of microteaching alone as compared with a category observation system as a training method, and interaction between the two when combined. Thirty-two subjects were assigned at random to each of the four cells of the 2 x 2 factorial design. Data was gathered by the Technion Diagnostic System (TDS) category observation instrument. Analysis of covariance results lead to the conclusion that while microteaching improves simple technical skills, TDS feedback of the entire lesson produces better results in achieving higher level objectives, even better than the combined use of the two systems. (Author)

THE COMBINED USE OF FOCUSING ON A SPECIFIC SKILL AND TDS FEEDBACK, HELP OR HINDRANCE IN IMPROVING TEACHER TRAINING - A THREE YEAR STUDY

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(First Draft)

Technion - Israel Institute of Technology

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OBJECTIVES

The objective of this study was to investigate the effectiveness of a feedback technique which focuses on a specific skill (FSS) relative to a feedback method using an ordered category observation system. The FSS was obtained using the microteaching method. In addition the effectiveness of the two methods when combined was also tested.

The different methods were applied in the training of student teachers in order to achieve a change in teaching behavior according to the following two behavioral objectives: 1) To redirect the teaching emphasis from a teacher-centered one to a student-centered one by increasing student participation; and 2) to improve the level of instruction by stressing analytical and creative thinking rather than just the absorption of knowledge.

THEORETICAL FRAMEWORK

The combined use of microteaching and category observation systems is highly recommended by its developers and users (Allen, 1969; Flanders, 1971). Many studies have been conducted to investigate and evaluate the relative effectiveness of the two systems when used separately and also in examining the interaction between them when used together (Rosenshine and Furst, Second Handbook of Research on Teaching.).

The difference between the methods is that in microteaching, the training in each lesson is focused on a specific skill and the training objective is to perfect the performance of that skill. The feedback analysis is based on a sign system in which the observer counts the number of times the specific behavior occurs and reports the total to the trainee.

In a category observation system emphasis is placed on changing the structure of the lesson as a whole and the ratio of various behaviors of the teacher and the student are analysed. All behaviors are recorded, organized in a matrix and ratios are established between the frequencies of the different categories. For this technique the purpose of the training is to change these ratios. Perlberg et al (1971, 1972) have previously described an ordered category observation known as the Technion Diagnostic System (TDS) which is based on Guttman's Facet Theory (Bar-On and Perlberg, 1973). A brief description of the TDS follows. The TDS includes 24 categories that are all the possible permutations of two sets. One set contains 8 categories which describe the teaching activities (FACET A)

and the second set contains three categories that describe the level of thinking (FACET B)*. The categories are:

FACET A	FACET B
a_1 - teacher lectures verbally	b_1 - knowledge
a_2 - teacher lectures non-verbally	b_2 - analytical thinking
a_3 - teacher gives instructions	b_3 - creative thinking
a_4 - teacher asks questions	
a_5 - teacher responds to pupil's reactions	
a_6 - pupil responds	
a_7 - teacher relates to pupil's initiative	
a_8 - pupil initiates	

The TDS was planned so that, in FACET A, teaching activities are arranged according to the amount of pupil participation, from a_1 (low) to a_8 (high). In FACET B levels of thinking are arranged according to increasing levels of pupil intellectual stimulation from b_1 (low) to b_3 (high). It should be noted that both facets are arranged from low to high pupil stimulation. The resultant Cartesian set which is partially ordered, enables computation of a general score for each lesson. Students were instructed to plan their lessons in order to achieve the highest possible score.

METHODS AND TECHNIQUES

The two methods of feedback mentioned were manipulated, and the following factorial design was used:

Category Observation System (TDS)**

Focusing on a Specific Skill (FSS)	YES	NO
YES	n = 32 (3)	n = 32 (2)
NO	n = 32 (1)	n = 32 (4)

** n = number of subjects; numbers in parenthesis designate treatments as defined below.

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* A more detailed description of the TDS and the way it was structured can be found in "The Facet Approach in Developing a Theory of Instruction", Bar-On, Jerusalem, 1973.

The four treatments were the following:

Focus on a specific skill (treatment 1)

The supervisor focused on the specific skill practiced during the lesson, and a discussion on how the skill was performed by each trainee took place. The skills practiced were set induction, probing questions, high order questions, the use of examples, and the use of audio-visual aids.

TDS feedback (treatment 2)

Supervision was focused on the relative frequencies of the various teaching behaviors and the calculated ratios between them. For this purpose the supervisor was supplied with a computer printout containing the various frequencies and ratios. The scores calculated expressed the amount of pupil participation and the level of thinking. The discussion aimed at how to increase these scores.

Focusing on a specific skill in combination with TDS (treatment 3)

Emphasis was placed on specific skills, but the trainee was also told to concentrate on pupil participation and the level of thinking. During the lesson, each three-second unit which was coded on a time-line display was classified by two peer observers according to one of the 24 categories of the TDS. Supervision focused on type of interaction between the trainee and the pupils and the use of high thinking levels in teaching the skill which was conducted that day. Here the skills that were mentioned under treatment 2 were practiced.

General supervision (treatment 4)

Supervision was neither focused on a specific skill nor on relative frequencies and ratios. The discussion consisted of general comments and recommendations for improvement. Both trainees and supervisor had in mind the general idea of changing the trainee behavior in the directions specified earlier but they did not act systematically towards this end.

THE TEST POPULATION

The test population consisted of students from the Teacher Training Department at the Technion, all of whom were taking the course Principles of Teaching, and were being trained to be science teachers. The same course is repeated every year, and in each of the four semesters starting with semester II. 1971, and ending semester I, 1973, all the mentioned four treatments were t The students in the four treatment groups differed only slightly (some

of them were on their first semester in the course and others in the second semester) and the investigators assumed that this small difference in the background of the trainees had no great influence on the results of the investigation. The whole sample consisted of 128 students - 32 in each semester. The 32 students that made up each treatment group were chosen randomly from about 80 students participating in the course.

THE TRAINING SITUATION

In order to limit the variation among treatments, the training method consisted of using a microteaching laboratory with a group of 4 students and a supervisor in each room. Every student taught one microlesson per week, in the subject in which he was majoring.

The microlesson lasted five minutes and was taught to five 7th grade pupils. For the 15 minutes following the trainee's own lesson he received a critique from the supervisor whose comments related to the objectives of the specific treatment group. In addition the student received feedback via comments by other students in his group and by seeing himself on television. Furthermore each trainee participated in the supervisory discussion of the other three trainees in his group.

Although not all the supervisors were the same ones during the whole period the investigations lasted, the core of the supervisors did remain the same. In order to limit the possibility that any type of bias on the part of the supervisors might affect the results, all the supervisors were trained in the specific method on which they concentrated and in addition they were provided with written instructions specifying how sessions should be conducted. From time to time they were videotaped in order to check whether their methods of supervision coincided with the intent of the investigations. In addition to all these means of eliminating the personal effect, a rotation system was also applied, so that each semester all supervisors worked with each group of 4 students.

Manipulated Variables

The use of TDS and the use of feedback focusing on a specific skill as a feedback mechanism - were the two factors manipulated.

Constant Variables

All the students in the four treatment groups had a similar (even though not identical) background in education and psychology, the methods of training were made uniform so that there would be no effect of supervisor bias and the same lecturer taught the course, Principles of Teaching, during the entire time the research was taking place

Data Source

In all cases the first (pretest) and last (posttest) videotaped lessons of each student were coded according to the Technion Diagnostic System (T.D.S.). The five-minute lessons were divided into 100 units of 3 seconds each, and every unit was classified into one of the 24 possible categories. The coding was done by three trained observers The same instructions were given to the students in all four treatment groups both for the pretest and the posttest.

It was explained to the students that they should give a five-minute lesson and try to make it the best that they could give. A General Score (GS) was calculated according to the following formula:[1]

$GS = K_1 + K_2 PT \Sigma X_i Y_i$ where

X_i - percentage of lesson time of category i ($0 \leq X_i \leq 100$)

Y_i - score of category i ($1 \leq Y_i \leq 10$) *[2]

P - proportion of pupils participating in the lesson

T - a variable that reflects the number of transactions from one category to another.

$K_1 = 40$

$K_2 = 0.125$

In addition to GS, the frequency of each of the 24 categories was calculated for each group and it was found that 8 combinations occurred most frequently in all four groups. These 8 categories alone covered at least 80% of each lesson,

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1) A more detailed description of the structuring of this score, its distribution and its significance can be found in "The Use of Computers in Evaluating Teacher Competency" Submitted to A.E.R.A., April, 1974.

*2) The structuple a_1b_1 was rated the lowest and given the grade of 1, a_8b_3 was rated the highest and given the grade of 10 and the other 22 structuples were rated in relation to their position to the two structuples mentioned above. Incomparable structuples (e.g. a_2b_1 and a_1b_2) get the same grade.

and since they also reflect the amount of participation of pupils in the lesson and the level of thinking, it was decided to use only these for the evaluation and ignore the other 16 categories.

The 8 categories referred to above were:

	Category score
1 - lecture on knowledge level a_1b_1	1
2 - lecture on analytical level a_1b_2	2
3 - knowledge questions a_4b_1	4
4 - analytical question a_4b_2	5
5 - teacher reaction - knowledge a_5b_1	5
6 - teacher reaction - analytic a_5b_2	6
7 - pupils response - knowledge a_6b_1	7
8 - pupil response - analytic a_6b_2	7

Each student was given 9 scores -- 8 of them were the frequencies of above mentioned eight categories plus one general score - GS. The same scoring technique was applied both for pretest and posttest.

Results

There was an a priori assumption that a linear relationship between the pretest and posttest existed and therefore an analysis of covariance (BMDX 69 computer program) was tried. In all cases the score of the pretest was used as the covariate and the posttest score as the dependent variable. It was hoped that if such linearity existed better precision might be attained by the posttest score according to the regression coefficient.

(insert table 1)

As can be seen from table 1, the F statistic for the MS covariate - MS error ratio was low and insignificant in all cases. The regression coefficients under each hypothesis show us that there are no linear relationships between pretest and posttest scores, a conclusion already reached in a previous study (Perlberg, et al. 1973)

Since no linear relationship between the pretest and the posttest was found, regular analysis of variance (ANOVA) was performed on the pretest scores in order to find out whether there were any initial differences in the scores of the four treatment groups. The ANOVA revealed no significant differences - and since there were no differences in the background of the groups, this result is quite understandable.

Because there were no differences between the groups, the posttests were also analysed by analysis of variances. Table 2 summarizes the effects of the Focusing on a Specific Skill treatment (FSS), the TDS treatment, and the interaction between them. It also gives the statistic ω^2 which is the percent of the variance that is explained by each factor. Since the F test is non-directional, the arithmetic means are also listed in order to enable the reader to see the direction of the difference between the four treatments.

(insert table 2)

The results can be summarized as follows:

1. The most efficient technique for the decreasing the time devoted to lecturing on the knowledge level is the use of the TDS. The training by the TDS decreased this score to an average 13.3% of the lesson, while the combined use of the specific skill treatment with TDS decreased it only to 25.7%. The use of FSS alone resulted in an average of 41.2% of lecturing on the knowledge so that the difference between the effectiveness of the two treatments for decreasing this score is quite obvious.

The effect of the TDS is significant ($p \leq 0.01$) and it explains 26% of the total variance.

2. Training by the TDS results in the greatest amount of lecturing on the analytical level ($\bar{x} = 12.2\%$) and the TDS combined with FSS gives better results than FSS alone. ($\bar{x} = 4.9\%$ and 1.7% respectively) Both the effects of TDS and interaction were significant, and the TDS explains 19% of the variance, the interaction 6%, and FSS only 3%.

3. FSS has a significant effect on increasing knowledge questions, and the combined use with TDS gives the best results although TDS alone has no effect. The FSS explains 10% of the variance and the interaction - 8% only.

4. In increasing the frequency of analytical questions, TDS is the only efficient technique, while FSS has no significant effect when applied alone or with the TDS. The TDS explains 23% of the variance, and the mean performance of analytical questioning is 12.3% under the TDS treatment, and only 3.2% under FSS.

5. In teacher reaction to pupils, response on the knowledge level, both the TDS and FSS have significant effects, but while the FSS treatment increases this score, the treatment by TDS decreases it. The means are $\bar{x} = 4.5\%$ for TDS .9% for FSS. There is no significant interaction effect.

6. For teacher reaction on the analytical level, the TDS has a very significant effect (it explains 38% of the variance) of increasing the frequency, while FSS has no effect at all. The mean for the TDS treatment is 6.9% while the mean for FSS is 0.7% only.

7. Pupils' response in the level of knowledge is affected mainly by the TDS (explains 20% of the variance) but it seems that this effect is in the negative direction, that is, it decreases the frequency of this category. Although FSS has no significant effect, the mean for the FSS treatment is the highest ($\bar{x}=22.3\%$) while the mean for the TDS treatment is 10.5% only.

8. In increasing the frequency of pupils' response on the analytical level, the TDS is the only factor that has any effect at all, it explains 32% of the variance and the mean for this treatment group is 18.6% The mean for the FSS treatment is only 2.6% and it explains only 3% of the variance. The interaction effect is also significant and explains 7% for the variance.

9. When a general score of pupil stimulation is calculated, the main effect is caused by the TDS and, even though the interaction effect is also significant, the mean for the treatment by TDS ($\bar{x}=90$) is much higher than that for the combined treatment ($\bar{x}=76$). The mean for the FSS treatment group was only 72.

To sum up the results it can be said that all scores measuring activities on the analytical level of thinking, were higher under the TDS treatment, while the activities on the level of knowledge (except for lecturing) were more frequent under the FSS treatment.

The only score which was higher under the combined treatment was the score for knowledge questions.

DISCUSSION

Since the study was carried out over a period of three years, it was impossible to keep all the environment variables constant, and the different treatments were given to students of somewhat different backgrounds by different supervisors. Furthermore, because of the various possible treatments that could be applied, the investigators decided to try a new one each semester instead of repeating a treatment that had been tried already - thus there is no replication for this study.

Nevertheless, the effects of the treatments were significant and for of the calculated scores the percentage of variance explained by the lated variables was quite large. Therefore it seems that the conclusions

of the study are independent of all the background noise.

The results have shown that for technical skills such as number of questions or teacher response on the knowledge level - the training that breaks up the instructional process into specific skills and focuses on each skill separately had the effect of changing the behavior - and increased the proportion of that skill in the whole lesson. Nevertheless, for objectives of higher order, like increasing pupil's participation and at the same time his level of thinking, the TDS as a feedback mechanism had better results, even better than the combined use of both techniques.

A theoretical analysis of a pattern of a good lesson would reveal the following: In order to achieve a lesson in which both the amount of participation and the level of thinking are high - the teacher has to plan it so that all the activities - from low to high on the pupil participation scale, would involve higher level thinking. Since the length of a lesson is fixed, it is impossible to increase all the scores, and increasing part of the scores actually means decreasing the rest of them. So that analytical responses to his questions would be achieved, the teacher has to increase the frequency of his analytical questions - thus decreasing the amount of knowledge questions. In order to be able to ask analytical questions - he also has to increase the amount of analytical lecturing - even if lecturing itself gets only a low grade. The frequency of the teacher's reactions to pupils on the level of knowledge also has to decrease so that he can increase the amount of his analytical reactions.

Focusing on a specific skill in each session does increase the practice of that skill in the posttest lesson, but the lesson as a whole remains on a lower level of thinking, since inducing analytical thought cannot be practiced technically. Only if the final objective of the training is emphasized during each stage of the treatment, are the desired results achieved. The results of the treatment by the TDS reveals exactly that desired pattern of behavior mentioned: on the one hand the frequency of all activities on the level of knowledge decrease -- even those activities such as pupil response which involve a great amount of pupil participation. On the other hand, all activities on the anlytical level of thinking increase -- even analytical lecturing which does not include any participation from the pupils' side.

There is another way to combine feedback from a systematic observation system like TDS, while at the same time focusing on a specific skill as is done in microteaching. It seems that this technique might give the best results. The ure would be the following: each student would give a general lesson that be analysed with the aid of the TDS. The ratios computed from the TDS

would serve for diagnostic purpose, and make the student aware of the skills he has yet to master. After the diagnosis each student would receive treatment in the skill he needs most, and there would be focusing on that specific skill. Nevertheless, the next lesson for each student would also be analyzed by the TDS, and the supervision would again focus on the lesson as a whole and not on the specific skill practiced. This procedure should be repeated again and again, each time the TDS serves as a diagnostic system, and the skill practiced is the one in which the performance was the worst. The investigators intend to examine this combination during the next semester.

TABLE 1

F for the covariate

	lect. K	lect. A	asks K	asks A	reacts K	reacts A	pupil resp.K	pupil resp.A	G
for covariate	0.24	6.39	0.08	0.24	0.33	1.40	2.10	3.63	1.73

lect. - lectures; K - knowledge; A - analytical; Resp. - responds

* $p \leq 0.01$ { $F(1,123_{df}) = 6.85$ }

TABLE 2

Means, F's and ω^2's for the nine posttest scores

	lect. K		lect. A		asks K		asks A		reacts K		reacts A		pupil resp.K		pupil resp.A		G	
	TDS		TDS		TDS		TDS		TDS		TDS		TDS		TDS		TDS	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Yes	25.7	41.2	4.9	1.7	17.0	13.6	11.3	3.2	6.9	9.9	5.1	0.7	9.8	22.3	9.1	2.6	76	72
No	13.3	47.4	12.2	0.6	7.4	13.2	12.3	2.0	4.5	8.1	6.9	0.3	10.5	18.6	18.6	0.6	90	60
F	48.27*		34.92*		1.00		68.56*		18.46*		82.33		33.02*		70.68*		28.3*	
ω^2	0.26		0.19		—		0.23		0.11		0.38		0.20		0.32		0.07	
F	.032		5.93		16.41*		0.00		7.70*		1.33		0.7		6.38		0.7	
ω^2	-		0.03		0.10		-		0.04		-		-		0.03		-	
F	4.49		11.12		13.85*		0.93		0.22		3.71		1.4		15.68*		17.50*	
ω^2	0.02		0.06		0.08		-		-		0.01		-		0.07		0.04	

*$p \leq 0.01$ { $F(1,123) = 6.35$ }