Pertanika J. Soc. Sci. & Hum. 3(2): 113-118 (1995)
ISSN: 0128-7702

An Analysis of Teaching Behaviours of Preschool Student Teachers in a Laboratory School Setting

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Keywords: student teachers, teaching behaviours, laboratory school, observation rating scales, factor analysis

ABSTRAK

Dalam kajian ini skala pemeringkatan terhadap sembilan dimensi tingkah laku mengajar 112 guru pelatih prasekolah yang telah dikenalpasti dalam kajian awal dianalisis semula dengan kaedah analisis faktor tinjauan. Tingkah laku mengajar dicerap dan direkodkan dengan alat pengukuran 'Observer Rating Scales'. Satu pola tingkah laku dapat dikenalpasti. Empat pembolehubah terpendam didapati mendasari sembilan dimensi tingkah laku mengajar yang dicerap. Pembolehubah-pembolehubah Ini adalah: (1) 'facilitating' (2) 'interpersonal' (3) 'interactive' dan (4) 'flexible'. Pembolehubah terpendam atau faktor ini berkorelasi secara positif di antara satu dengan lain. Guru pelatih prasekolah dalam kajian ini didapati memperlihatkan tingkah laku mengajar tersebut dalam situasi sekolah makmal. Saranan untuk kajian lanjutan untuk menentusahkan dapatan ini dengan menggunakan analisis faktor pengesahan dibentangkan. Maklumat dari kajian ini diharap berguna sebagai panduan bagi pendidik guru dalam penyediaan guru pra-sekolah.

ABSTRACT

In this study, the rating of nine dimensions of teaching behaviours of 112 preschool student teachers from a previous study was analysed using exploratory factor analysis. The teaching behaviours were observed and recorded using the observer rating scales. A pattern of behaviours was observed. Four latent variables were found to underlie the nine teaching behaviours. These are: (1) facilitating (2) interpersonal (3) interactive and (4) flexible. These latent variables are correlated with each other. Preschool student teachers in the study exhibited these teaching behaviours in their teaching performance in a laboratory school setting. Recommendations for future research to confirm the teaching behaviour model employing confirmatory factor analysis are presented. The findings of this study could hopefully serve as a useful guide for teacher educators in the preparation of preschool and early childhood teachers.

INTRODUCTION

Data from a previous study (Briggs and Dickerscheid 1985) were re-analysed using the factor analysis options on SAS. The data came from the ratings of teaching behaviours of 112 preschool student teachers using the observer rating scales (ORS), a 6-point rating scale with a value of 1 as low and 6 as high (McDaniel *et al.* 1974). This study was done concurrently in the laboratory schools of two higher education institutions in the Midwest USA. The observer rating scales have a "relatively high degree of construct validity" and the inter-rater reliability has been estimated to be .83 (Briggs and Dickerscheid 1985: 59).

The student teachers were observed for approximately 30 minutes. Their performance was rated by trained observers in classroom settings. All observations occurred during "free play" situations in which several classroom activities were occurring simultaneously and children were moving freely from one activity to another according to their interests.

The student teachers were rated on nine dimensions of teaching behaviours: warmth, enthusiasm, clarity, variety, individualization,

feedback, cognitive demand, freedom, and on-task activity.

Definitions of the nine behaviour dimensions (Briggs and Dickerscheid 1985) are as follows:

1. Warmth - the extent to which the teacher is relaxed and comfortable; the degree to which the teacher maintains positive interpersonal relationships with children.
2. Enthusiasm - the enthusiasm or interest level expressed by the teacher and children during nursery school activities.
3. Clarity - the clarity of communication, instructions and expectations conveyed to the children.
4. Variety - the extent to which the teacher uses a variety of materials and activities.
5. Individualization - the degree to which the teacher provides children with different levels of work suited to their particular needs, interests, and abilities, and the amount of individual assistance provided.
6. Feedback - the extent of communication to the children of information about the adequacy, acceptability, completeness or correctness of his or her response.
7. Cognitive Demand - the level of intellectual activity the teacher expects from the children.
8. Freedom - the degree to which the teacher provides arrangements which facilitate independence and individual freedom.
9. On-task Activity - the amount of child activity directed toward the accomplishment of instructional objectives.

The inter - relationship between the nine teaching behaviours of the preschool teachers was determined and the inference of the findings was made to the population of preschool teachers from which the sample was drawn. As mentioned earlier, this study was based on secondary data: it was not intended to relate the findings to the original article. Though factor analysis was used in the original study, different statistical software was used. Furthermore, only two factors were extracted in the original study. The only material that was utilized from the Briggs and Dickerscheid (1985) study was the published correlation matrix of the ratings on the nine teaching behaviours of the preschool student teachers. The emphasis of this paper is not only the interpretations of the data; equal importance is placed on creating awareness among readers of the importance of selecting an appropriate computer program and considering issues in methodology when using factor analysis as a statistical technique.

METHOD

The exploratory factor analysis technique was used to analyse the data as the investigator did not have any prior theories on the relationship between these teaching behaviours. The raw data from the ratings of 112 student teachers on nine measured variables were first reduced to a 9 x 9 correlation matrix. The upper triangular matrix without the diagonal was used. The correlation matrix showing the relationship of the measured variables is presented in Table 1.

Assuming that the common factor model holds, a maximum likelihood method of factor extraction was performed on the data set, based on the assumption that for m measured variables (MVs) there exists p latent variables (LVs) or factors that account for the variation and covariation in the measured variables. Another condition that needs to be satisfied is that $p<m$.

The Statistical Analysis System (SAS) program was used for the analysis due to its superior attributes in factor analysis procedures and options (MacCallum 1983). The maximum likelihood method of factor analysis was chosen because the investigator was not only providing a description of the relationship between the variables but also recognizing that the data came from a population. Maximum likelihood estimation provides information on whether the data could have come from a population where the common factor model also holds. This was done through hypotheses testing at each step of the maximum likelihood factor extraction method.

Starting with zero factors, that is the variables are not correlated in the population, the null hypothesis is that there is zero common factor against an alternative hypothesis that there is at least one common factor in the measured variables. At each step, the Q value at p factor hypothesized was calculated. The value of Q is obtained by dividing the Chi-square (X^2) by the respective degree of freedom at p factor. The Chi-square (X^2) value at each step is significant and the null hypothesis is rejected at most steps due to the power of the test enhanced by the large sample size involved. This problem is circumvented by using the rho statistics of the

TABLE 1
Correlation matrix of the nine measured variables

Variable	2	3	4	5	6	7	8	9
1 Warmth	.72*	.53*	.33*	.45*	.39*	.26*	.40*	.42*
2 Enthusiasm		.59*	.41*	.41*	.50*	.28*	.30*	.39*
3 Clarity			.55*	.66*	.55*	.51*	.37*	.48*
4 Variety				.49*	.36*	.37*	.51*	.45*
5 Individualization					.26*	.42*	.33*	.39*
6 Feedback						.11	.20	.39*
7 Cognitive Demand							.40*	.20
8 Freedom								.30*
9 On-task Activity								

N=112
*p < .001

Tucker-Lewis coefficient (Tucker and Lewis 1973). At each step, the appropriate values of Q at each factor are substituted in the formula. The value of the rho statistics is an indication of the goodness of fit of the model to the data.

The formula for the Tucker-Lewis coefficient is given as follows:

$$\text{rho } (r) = (Q_0 - Q_p)/(Q_0 - 1) \qquad [1]$$

where
$Q_0 = X^2$ /df at 0 factor
$Q_p = X^2$ /df at p factor.

Rho values in the mid-nineties and above are a good indication of goodness of fit at p factor solution. Concomitantly, the Chi-square value is inspected at that point. If the Chi-square (X^2) value is not significant at the conventional $p < .05$ level the appropriate number of factors are arrived at. At that point, the investigator fails to reject the null hypothesis and the solution at p factor is retained. This is a unique solution that has the maximum likelihood of producing the data we obtain. Four factors were retained by this procedure. The four factors accounted for 78% of the variance in the measured variables. A summary of the steps and the resultant rho statistics are presented in Table 2.

Using another piece of information from the printout, a four-factor model is plausible and reasonable in the data if the series of eigenvalues obtained is examined. Only the first four eigenvalues are large and significant enough to be considered of importance. The fifth and subsequent eigenvalues are very small and insignificant. This is presented in Table 3.

TABLE 2
Summary of maximum likelihood factor solution

p	X^2	df	prob.	Q	rho
0	422.52	36	.0001	11.74	-
1	91.66	27	.0001	3.39	.78
2	50.55	19	.0001	2.66	.84
3	26.98	12	.0078	2.25	.88
4.	6.99*	6	.3221	1.16	.98
5	1.60*	1	.2056	1.60	.94

* X^2 not significant at $p < .05$
Fail to reject H_0: The four factor model is plausible.

TABLE 3
Table of eigenvalues obtained in the four factor solution

	Eigenvalues
1.	8.6201*
2.	1.1834*
3.	0.5530*
4.	0.4090*
5.	0.1045
6.	-0.1280
7.	-0.1985
8.	-0.4492
9.	-0.4922

* eigenvalues retained

Heywood cases (communality values exceeding the theoretical value of 1.00) were encountered in the data when the number of factors to be retained was greater than two. The Heywood option was used to circumvent this problem.

Using the procedure of rotation, the factor matrix F is rotated in space to achieve a condition termed as simple structure (Rummel 1970), with the objective of achieving simple structure which will enhance interpretability. The rotated factor pattern is presented in Table 4 .

In deciding on the kind of rotation to be performed on the factor matrix, the Promax rotation option on the SAS factor analysis package was employed first. This is an oblique rotation method which allows the investigator to correlate the factors with each other, if they are indeed correlated. Low correlations, e.g. in the low twenties and below, could be regarded as a sign of orthogonality in the factors. Should this happen, the investigator should continue analysis using the Varimax (orthogonal) rotation option. In this data the Phi matrix indicated that the four factors were intercorrelated. The Phi matrix is presented in Table 5.

The correlations vary from 0.38 to 0.57 (Table 5). This clearly indicates that the factors are correlated with each other, implying that people who are high on Factor 1 are likely to be high on the other three factors. Using orthogonal rotation method of analysis without considering if the factors are correlated is imposing unrealistic and unnecessary restrictions on the factors trying to be uncovered. This may lead to difficulty and erroneous interpretations of the results.

The factor matrix was rotated using the Harris-Kaiser class of rotations with the HK power set to zero to check if the factors exhibited independent clusters; such clusters were not found. The Promax rotation, however, seems to provide a cleaner simple structure with better interpretability.

FINDINGS AND DISCUSSION

The four factors retained accounted for 78% of the variances in the measured variables. What is left unaccounted for is the portion contributed by the unique variances associated with each unique factor and measurement error. Teaching behaviour is very complex. It is not a unitary attribute that can be observed and singled out from a single observation of a teaching episode of any individual teacher. Different teachers exhibit different teaching behaviours depending on the kind of subjects taught, the level of the students, the teacher's personality and situation. Furthermore, what the behaviours of the teachers is the product of the interaction between the teacher presage variables and the environment, that is the teacher education curriculum that they have been exposed to. The ratings given were based on the raters' perceptions of what these teaching behaviours ought to be. However, interpretations were attempted after examining the rotated factor pattern matrix. By grouping

TABLE 4
Obliquely rotated (promax) factor matrix (F*)

Rating Scales Variable	Factor 1 FACILIT	Factor 2 INTERPE	Factor 3 INTERAC	Factor 4 FLEXIBL
Warmth	0.01	**0.99**	0.01	0.00
Enthusiasm	0.03	**0.52**	0.34	0.05
Clarity	**0.79**	-0.01	0.37	-0.09
Individualization	**0.56**	0.12	-0.02	0.15
Cognitive Demand	**0.64**	-0.02	-0.22	0.17
Freedom	0.14	0.20	-0.13	**0.50**
Variety	0.10	-0.11	0.21	**0.76**
Feedback	-0.15	0.05	**0.84**	0.01
On-Task Activity	0.05	0.15	**0.30**	0.26

FACILIT = Facilitating Behaviour
INTERPE = Interpersonal Behaviour
INTERAC = Interactive Behaviour
FLEXIBL = Flexible Behaviour

TABLE 5
Phi matrix - inter-factor correlations

	Factor 1	Factor 2	Factor 3	Factor 4
Factor 1	1.00			
Factor 2	**0.48**	1.00		
Factor 3	**0.57**	**0.48**	1.00	
Factor 4	**0.51**	**0.37**	**0.38**	1.00

Factor 1 = Facilitating behaviour
Factor 2 = Interpersonal behaviour
Factor 3 = Interactive behaviour
Factor 4 = Flexible behaviour

those measured variables with high loadings on a particular factor (latent variable), a distinct pattern emerged, indicating which variables share a common characteristic. Four latent variables were identified; given labels to designate a certain teaching behaviour. The teaching behaviours of the preschool student teachers in the study seem to be inter-related. They were named appropriately based upon their common feature and, to a degree, reflecting the cluster of teaching behaviours observed and rated. These teaching behaviours are: facilitating behaviour, interpersonal behaviour, interactive behaviour, and flexible behaviour. The teaching behaviours identified in this study are described as follows:

1. Facilitating behaviour - the measured variables designated as clarity (0.79), individualization (0.56), and cognitive demand (0.64) have high loadings on this factor. This teaching behaviour, which facilitates the learning process, is common among these measured variables.
2. Interpersonal behaviour - the measured variables designated as warmth (0.99) and enthusiasm (0.52) have high loadings on this factor. This attribute is related to the teacher's personal disposition.
3 Interactive behaviour - the measured variables designated as feedback (0.84) and on-task activity (0.30) have high loadings on this factor. This is an indication of the degree of interactivity of the student teachers with the children.
4. Flexible behaviour - the measured variables of variety (0.76) and freedom (0.50) have high loadings on this factor. This is an indication of the flexibility of the student teachers as rated by the observers.

As the sample used in the study came from a population of preschool student teachers from two institutions of higher learning in the Midwest the findings could only be generalized to this population of preschool student teachers.

Based on this investigation, the preschool student teachers exhibit these four teaching behaviours in their classroom performance as rated by the trained observers. The preschool student teachers in these institutions possess facilitating, interpersonal, interactive' and flexible teaching behaviours in varying amounts and the variances in their performance are explained by the four latent variables stated earlier.

Since these latent variables are correlated with each other, it is not possible to partition the variance of their performance between each of the latent variables identified in this investigation.

Because the common factors are correlated with each other, people who manifest the characteristic governed by one factor tend to possess the characteristics attributed to the other three factors as well. Specifically, in this study student teachers who exhibited a high degree of facilitating behaviour also tended to be highly endowed in interpersonal, interactive and flexible behaviours as well. The reverse is also true.

Most of the measured variables are good indicators of the latent variables or construct. This is clearly shown by their final communality values (h^2) in Table 6. High communality values (mid 0.30s and above) are desirable. The final communality value is the proportion of variance shared by the common factors.

Based on the findings of this study, future studies on the teaching behaviours of preschool student teachers (new data) should employ

TABLE 6
Final communality values of the measured variables

Variable	Communality (h^2)
Warmth	1.0000
Enthusiasm	0.6205
Clarity	1.0000
Variety	0.7733
Individualization	0.5186
Feedback	0.6246
Cognitive Demand	0.4042
Freedom	0.4151
On-task Activity	0.3519

confirmatory factor analysis with the following hypotheses:

1. The nine dimensions of teaching behaviour could be explained by four latent variables.
2. These four latent variables are correlated with each other.
3. The variables clarity, individualization, and cognitive demand load only on the facilitating factor; The variables warmth and enthusiasm load only on the interpersonal factor; the variables on-task activity and feedback load only on the interactive factor; and finally, the variables variety and freedom load only on the flexible factor.
4. Each variable is assumed to contain some unique variance.

Confirmatory factor analysis (Long 1983) can be done using the Linear Structural Relations (LISREL) program (Jöreskog and Sörbom 1989). This program gives measures of goodness of fit of the specified model to the data. If the hypothesized model is plausible and can be confirmed, a parsimonious path diagram (model) can be drawn to represent the relationships among the variables in the population (Zulkifli 1987, 1994, 1995). This could be used as a theoretical framework for further research and validation studies of teaching behaviours of preschool student teachers.

Other research questions that need to be addressed in future studies should include the following:

1. Do preschool teachers who possess these teaching behaviours contribute to significant learning among preschoolers?
2. Are these teaching behaviours exhibited by preschool teachers in Malaysia or other cultures? (Cross-culture validation studies)
3. Can these teaching behaviours be taught to teacher trainees.

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(Received 6 August 1994)