ED 428 090   TM 029 491

AUTHOR   Rahman, Mohammed A.; Loadman, William E.
TITLE   Determining the Multivariate Assumptions of a Four
                Dimensional Instrument Designed To Follow-up Elementary and
                Secondary Level Graduates of Multiple Teacher Education
                Institutions.
PUB DATE   1998-10-15
NOTE   14p.; Paper presented at the Annual Meeting of the
                Mid-Western Educational Research Association (Chicago, IL,
                October 1998).
PUB TYPE   Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE   MF01/PC01 Plus Postage.
DESCRIPTORS   *Elementary School Teachers; Elementary Secondary Education;
                Followup Studies; Graduates; Higher Education; *Job
                Satisfaction; *Multivariate Analysis; Program Effectiveness;
                *Secondary School Teachers; Teacher Attitudes; *Teacher
                Education; Test Construction

ABSTRACT
                Whether there is a difference in job satisfaction,
self-assessed knowledge of teaching, and ratings of the quality of teacher
education programs for graduates of elementary teacher education programs and
secondary teacher education programs was studied using the Teacher Education
Follow-up Scale of the National Database for Teacher Education Follow-up
Studies. Fourteen teacher preparation institutions participated in the
follow-up study, although not all used all 4 subscales of the followup
instrument. Sample sizes for each subscale ranged from 2,785 to 3,930.
Analyses, which included mulitivariate analysis of variance, suggest that
there is a difference between graduates of elementary teaching programs and
graduates of secondary education programs. Job satisfaction and assessment of
program quality were higher for graduates of elementary teaching preparation
programs. These results have ramifications for the use and interpretation of
data from teacher followups. (Contains two figures, three tables, and nine
references.) (SLD)

Determining the Multivariate Assumptions of a Four Dimensional Instrument Designed to Follow-up Elementary and Secondary Level Graduates of Multiple Teacher Education Institutions

Mohammed A. Rahman
William E. Loadman

The Ohio State University

Paper presented at the Annual Meeting of the Mid-western
Educational Research Association
Chicago, IL
October 15, 1998

Objective:

The National Database (NDB) for Teacher Education Follow-up Studies is a compilation of data from various teacher preparation institutions across the United States. The Teacher Education Follow-up Scale contains a total of 49 items measuring four different subscales: Knowledge of Teacher (Knowledge), Skills of Teacher (Skills), Job Satisfaction (Job Satisfaction), and Quality of the Program (Program Quality). The number of specific items for defining these subscales were 13, 22, 7 and 7 respectively. The purpose of this study was to determine whether there was a difference between graduates in an elementary teacher education program and graduates in a secondary teacher education programs with respect to their rating on job satisfaction, their rating on knowledge of teaching, their rating on skill of teaching, and their rating on quality of the program.

Literature Review:

Under the press of accountability within institutions and by accreditation agencies, there has been renewed interest in program evaluation, and follow-up studies of graduates have increased. Follow-up studies are becoming more of an essential part of the evaluation of the teacher education programs. Seventy five percent of teacher education programs use follow-up surveys to get an indication of student satisfaction, program quality and skill preparation (Ayres, 1989).

Multivariate analysis of variance (MANOVA) techniques are routinely used in a variety of disciplines such as agriculture, anthropology, biological sciences, business, econometrics, education, engineering, marketing, medicine, psychology, and sociology.

The MANOVA model is a natural generalization of univariate analysis of variance (ANOVA). That is, two or more possibly correlated dependent variables are simultaneously modeled as the linear functions of the same set of independent variables (Khattree, R., and Naik, D., 1995).

Before applying any statistical techniques, it is crucial to verify if the data at hand satisfy the underlying distributional assumptions. For most multivariate analyses, it is thus very important that the data indeed follow the multivariate normal, if not exactly at least approximately (Khattree, R., and Naik, D., 1995). There are many possibilities for departure from multivariate normality and no single procedure is likely to be robust with respect to all such departures from the multivariate assumption (Mardia, K. V., 1980). This assumption is generally checked by Chi-square Q-Q plots. Violations of this assumption have only a very small effect on the type I error rate (Rummel, 1970; Stevens, 1986).

Homogeneity of variance-covariance matrices is another important assumption for MANOVA. This is the multivariate extension of the *homogeneity of variance* assumption of univariate ANOVA. The power of the test tends to be attenuated when the homogeneity assumption is violated (Stevens, 1986). It is strongly recommended that some appropriate tests for the homogeneity of the variance-covariance matrices be applied to the data prior to performing any multivariate analysis variance (Khattree, R., and Naik, D., 1995).

Data Source and Methodology:

A total of fourteen teacher preparation institutions participated in the follow-up studies, but not all four subscales were used by these institutions. The data were collected from these participating institutions during the 1991-1997 school years. The sample sizes for four different subscales, Job Satisfaction, Knowledge, Skills, and Quality were 2785, 3788, 3925 and 3930 respectively. The range for scale values for each item on the Knowledge subscale goes from a low score of one (negative) to a high of seven (positive); the Skills subscale goes from a low score of one (negative) to a high of three (strong); the Job Satisfaction subscale goes from a low score of one (negative) to a high of seven (positive); and, the Quality subscale goes from a low of one (weak) to a high of three (strong). In order to create a unique sample size, data were used only from those institutions that provided responses to all 49 items. To take care of the missing values, a listwise deletion method was used prior to apply the analyses techniques reducing the sample size to 1498.

The following three steps were used to complete the methodology of the intended study:

Step 1: Scores were generated for four different subscales by calculating the mean of corresponding items of each subscale.

Step 2: The assumption of *multivariate normality* was assessed for the subscale scores by Chi-square plots. The assumption of *homogeneity of variance-covariance matrices* was tested by applying PROC DISCRIM in the SAS system.

Step 3: Then, the following null hypothesis was tested:

H_0: *In the population, there is no difference between graduates in an*

elementary teacher education program and graduates in a secondary

teacher education programs when they are compared simultaneously on

their rating on job satisfaction, their rating on knowledge of teaching,

their rating on skill of teaching, and their rating on quality of the

program.

Against the following alternative hypothesis:

H_a: *In the population, there is a difference between graduates in an*

elementary teacher education program and graduates in a secondary

teacher education programs when they are compared simultaneously on

their rating on job satisfaction, their rating on knowledge of teaching,

their rating on skill of teaching, and their rating on quality of the

program.

Results:

Multivariate Chi-square Q-Q plots were generated for graduates in elementary

teacher education programs (Elementary) and graduates in secondary teacher education

programs (Secondary) by using PROC IML in the SAS statistical package and shown in

Figure 1 and Figure 2. Examination of the plots indicated that most of the points are

around the 45° angle passing through the origin. Hence it can be assumed that the

observations are coming from a multivariate normal population. A test on homogeneity

of variance-covariance matrices was performed by using PROC DISCRIM in the SAS

system and the test results will be shown in Table 1. Table 1 revealed that the variance-

covariance matrices for these two groups are homogeneous.

6

Scores of the four subscales were then analyzed using a one-way MANOVA, between-groups design in the SAS system and summarized in Table 2. This was followed by four one-way ANOVAs for four different subscales (See Table 2). The analysis in Table 2 revealed a significant multivariate effect for type of teacher education programs, Wilk's $\lambda = .99$, $F (4, 1493) = 3.34$, $p < .01$. A close examination of Table 2 showed that the Elementary program with mean = 5.08 and the Secondary program with mean = 4.96 are significantly different on Job Satisfaction, $F (1, 1496) = 4.32$, $p < .05$. Table 2 also indicated that the Elementary program with mean = 5.02 and the Secondary program with mean = 4.86 are significantly different on Program Quality, $F (1, 1496) = 10.40$, $p < .01$. Additional investigation of means on each item by type of program (Elementary and Secondary) for Job Satisfaction and Program Quality subscales were generated and summarized with output from one-way ANOVAs (See Table 3). As reported in Table 3, the means on the elementary program were found to be significantly higher ($p < .05$) for two items on the Job Satisfaction Subscale, and four items on the Program Quality Subscale ($p < .05$). In general the means for the elementary graduate were higher on 12 of the 14 items (six of which were significantly different). The two items where the secondary graduates were slightly more positive than the elementary graduates were salary and authority. The item means on the Job Satisfaction subscale ranged from a low of 4.11 to a high of 5.98. The graduates indicated greater satisfaction with students colleagues interaction and only moderate satisfaction with salary, advancement and working conditions. The item means on the Program Quality subscale ranged from a low of 3.87 to a high of 5.98. The graduates indicated greater endorsement

of their mentoring, field experience and teaching experience and lower endorsement of advice from adviser and liberal arts courses.

Discussion:

Two major assumptions of MANOVA are *multivariate normality* and *homogeneity of variance-covariance matrices*. This study assessed the normality assumption by Chi-square Q-Q plots. This study also performed an appropriate test on *homogeneity of variance-covariance matrices* and found that the variance-covariance matrices are homogeneous. Therefore, the appropriateness of the MANOVA technique applied in this study is supported.

Results of the MANOVA described here suggested that there is difference between graduates in elementary teacher education programs and graduates in secondary teacher education programs when they are compared simultaneously on their rating on job satisfaction, their rating on knowledge of teaching, their rating on skill of teaching, and their rating on quality of the program. The follow-up univariate ANOVAs revealed that the differences between graduates in elementary teacher education programs and graduates in secondary teacher education programs (favoring elementary programs) were on the subscales of Job Satisfaction, and Program Quality, at least for the fourteen institutions that are contained in the database. These results have important ramifications for the use and interpretation of data from follow-up studies of graduate of teacher education programs.

```
                 Plot of DSQ*CHISQ.      Symbol used is '-'.
                 Plot of CHILINE*CHISQ.  Symbol used is '+'.
        17.5 +                                       -
             |                                     --
             |
             |                                  ---
             |                               --
   M 15.0 +                                 -
   A         |
             |
   H         |                                    +
   A         |                             -
   L         |                            --
             |                           --
   A 12.5 +                            +
   N         | .
             |                        -
   O         |                      +
             |                    -
   B         |                  --
             |                +
   I         |              --
             |            +
   S 10.0 +            --
             |        +
   D         |      --
             |     ++
             |    --
             |   ++
   S         |  --
             | ++
   Q   7.5 +  ++
   U         | --
             | ++
   A         | --
   R         | ++
             | ---
   E         | ++
             | --
             | ++
       5.0 +  --
             | +++
             | --
             | ++
             | --
             | ++
             | ---
             | +++
             | --
             | ++
       2.5 +  ---
             | ++
             | --
             | ++
             | ---
             | +++
             | --
             | ++
             | --
       0.0 +  -
             |  +
             |
           ---+------------+------------+------------+-------+--
              0            5           10           15        20
                        CHI-SQUARE QUANTILE
```
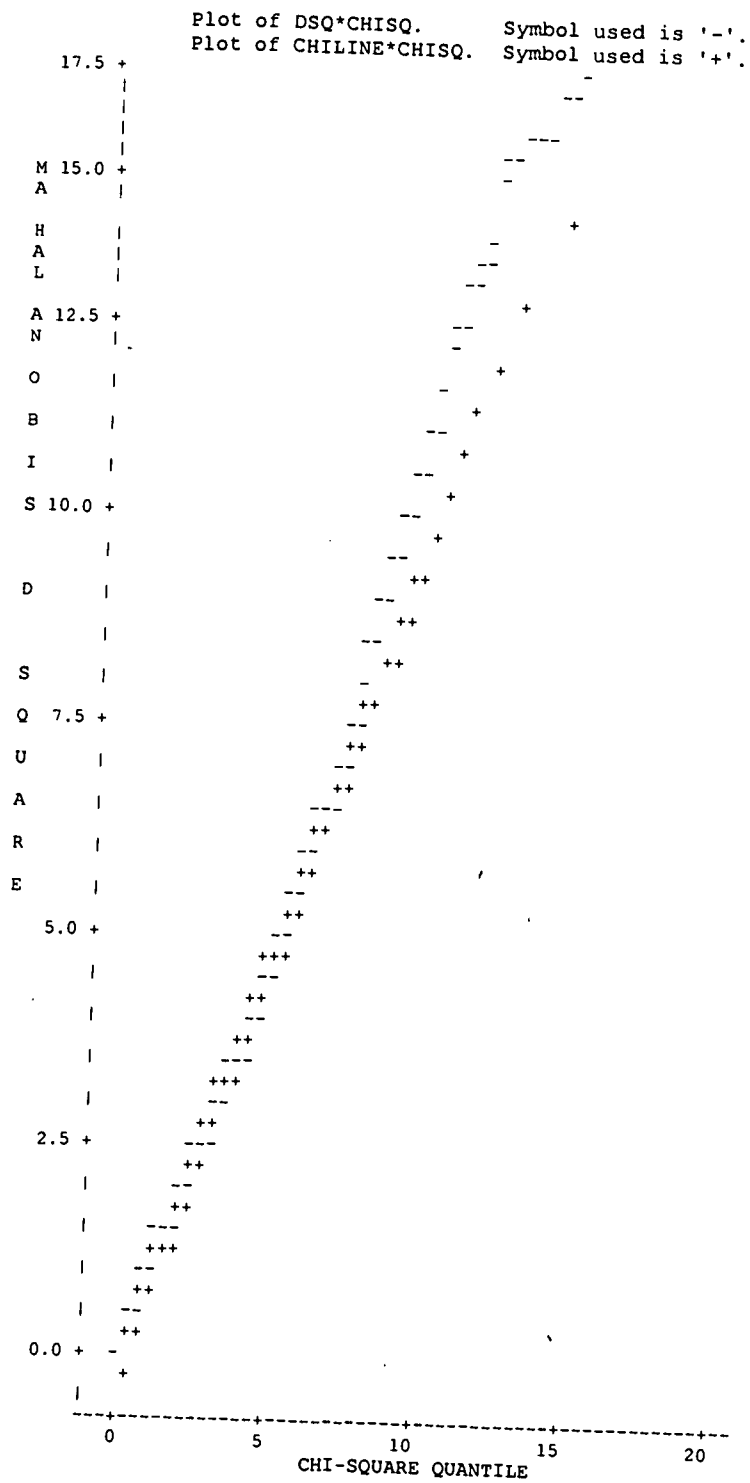
Figure 1: Chi-square Q-Q Plot for Elementary Teacher Education
          Graduates on the Four National Database Subscales of
          Knowledge, Skills, Job Satisfaction, and Program
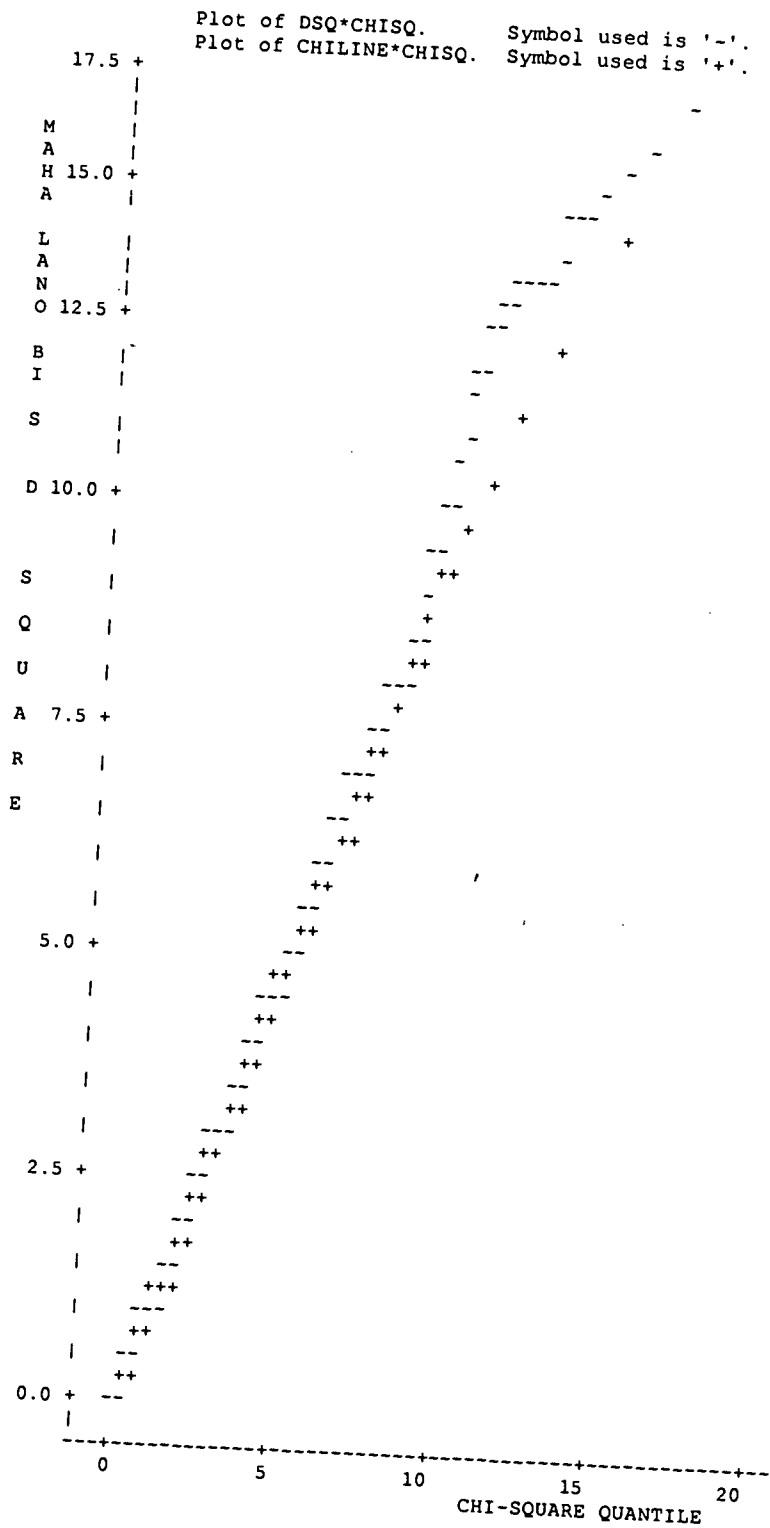   Quality.

```
                        Plot of DSQ*CHISQ.      Symbol used is '-'.
                        Plot of CHILINE*CHISQ.  Symbol used is '+'.
       17.5 +
            |
    M       |
    A       |
    H 15.0 +                                                      -
    A       |                                                 -
            |                                             -
    L       |                                        ---
    A       |                                              +
    N      .|                                      -
    O 12.5 +                                  ----
            |                                 --
    B      |`                                          +
    I       |                               --
            |                              -
    S       |                      +
            |                            -
            |                          -
    D 10.0 +                    +
            |                          --
            |                  +
    S       |                --
            |                ++
    Q       |               -
            |               +
    U       |              --
            |              ++
    A   7.5 +             +
            |            --
    R       |           ++
            |           ---
    E       |          ++
            |         --
            |         ++                    '
            |        --
            |        ++
        5.0 +       --
            |      ++
            |      ---
            |     ++
            |    --
            |    ++
            |   --
            |   ++
            |  ---
        2.5 +   ++
            |  --
            | ++
            | --
            | ++
            | --
            | +++
            | ---
            | ++
            | --
            | ++
        0.0 + --
            |
        ---+-------------+-------------+-------------+-------------+--
           0             5            10            15            20
                                  CHI-SQUARE QUANTILE
```

Figure 2: Chi-square Q-Q Plot for Secondary Teacher Education
Graduates on the Four National Database Subscales of
Knowledge, Skills, Job Satisfaction, and Program Quality.

10

Table 1: Test of Homogeneity of Covariance Matrices for
Elementary and Secondary Teacher Education
Graduates on the Four National Database Subscales
of Knowledge, Skills, Job Satisfaction, and
Program Quality.

Chi-square	DF	p
14.479	10	.152

Table 2: Multivariate and Univariate Analysis of Variance
of Elementary and Secondary Teacher Education
Graduates on the Four National Database Subscales
of Knowledge, Skills, Job Satisfaction, and
Program Quality.

Subscale	Program	Mean	F	p
Job Sat.	Elementary	5.08	4.32	.037
	Secondary	4.96		
Knowledge	Elementary	2.20	0.29	.588
	Secondary	2.19		
Skills	Elementary	2.09	0.09	.766
	Secondary	2.10		
Quality	Elementary	5.02	10.40	.001
	Secondary	4.86		

Wilks' Lamda = 0.99, F(4, 1493) = 3.34, p < .01

Table 3: Univariate Analysis of Variance of Elementary and Secondary Teacher Education Graduates on items contained within the Job Satisfaction and Program Quality Subscales.

Item	Program	Mean	F	p
Salary	Elementary	4.17	0.53	.465
	Secondary	4.23		
Advance	Elementary	4.22	1.44	.231
	Secondary	4.11		
Challeng	Elementary	5.44	10.48	.001
	Secondary	5.19		
Authorit	Elementary	4.97	1.07	.302
	Secondary	5.06		
Wkcond	Elementary	4.73	0.75	.386
	Secondary	4.66		
Colleag	Elementary	5.55	3.25	.071
	Secondary	5.41		
Students	Elementary	5.98	14.44	.000
	Secondary	5.73		
Qlibarts	Elementary	4.54	1.77	.183
	Secondary	4.62		
Qpreppgm	Elementary	4.91	11.31	.000
	Secondary	4.68		
Qfieldex	Elementary	5.16	25.46	.000
	Secondary	4.75		
Qtchexp	Elementary	5.98	5.80	.016
	Secondary	5.82		
Qmentor	Elementary	5.77	6.67	.010
	Secondary	5.58		
Qadvprof	Elementary	5.04	1.36	.244
	Secondary	4.94		
Qadvadv	Elementary	3.89	0.04	.844
	Secondary	3.87		

13

References:

Ayres, J. B. (1979, April), Follow-up Studies: Providing the Thrust for Program Improvement, Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco: CA.

Johnson, R. A. & Wichern, D. W. (1988), Applied Multivariate Statistical Analysis, Second Edition, Englewood Cliffs NJ: Prentice Hall.

Khattree, R. & Naik, D. N. (1995), Applied Multivariate Statistics with SAS Software, Cary NC: SAS Institute Inc.

Loadman, W. E., Brookhart, S. M. & Freeman, D. J. (1989, March), Developing a National Database for Pre-service Teacher Education Follow-up Studies, Paper presented at the Annual Meeting of the American Association of Colleges for Teacher Education, Anaheim: CA.

Mardia, K. V. (1980), Tests of Univariate and Multivariate Normality, Handbook of Statistics, Vol. 1: Analysis of Variance, Ed. P. R. Krishnaiah, Amsterdam: North Holland.

Rummel, R. J. (1970), Applied Factor Analysis, Evanston: North Western University Press.

SAS Institute Inc. (1989), SAS/STAT User's Guide: Version 6, Fourth Edition, Volume 1, Cary NC: SAS Institute Inc.

SAS Institute Inc. (1989), SAS/STAT User's Guide: Version 6, Fourth Edition, Volume 2, Cary NC: SAS Institute Inc.

Stevens, J. (1986), Applied Multivariate Statistics for the Social Sciences, Hillsdale NJ: Lawrence Erlbaum Associates.

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

REPRODUCTION RELEASE
(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: DETERMINING the Multivariate Assumptions of a for Dimensional Instrument Designed to Follow-up Elementary and Secondary Level Graduates of Multiple Teacher Education Institutions.

Author(s): Mohammed A. Rahman, WILLIAM E. LOADMAN

Corporate Source: The Ohio State Univ.

Publication Date: 10-15-98

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents	The sample sticker shown below will be affixed to all Level 2A documents	The sample sticker shown below will be affixed to all Level 2B documents
PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY ___Sample___ TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY ___Sample___ TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY ___Sample___ TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
1	2A	2B
Level 1 ↑	Level 2A ↑	Level 2B ↑
Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) *and* paper copy.	Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only	Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Sign here, → please

Signature:

Printed Name/Position/Title: MOHAMMED A. RAHMAN

Organization/Address: 480 Baker Systems 1971 Neil Ave Columbus, OH 43210

Telephone: (614) 688-3462
FAX: (614) 292-7081
E-Mail Address: rahman.5@osu.edu
Date: 10-15-98

(over)

III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC SOURCE):

If permission to reproduce is not granted to ERIC, or, if you wish ERIC to cite the availability of the document from another source, please provide the following information regarding the availability of the document. (ERIC will not announce a document unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selection criteria are significantly more stringent for documents that cannot be made available through EDRS.)

Publisher/Distributor:
Address:
Price:

IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS HOLDER:

If the right to grant this reproduction release is held by someone other than the addressee, please provide the appropriate name and address:

Name:
Address:

V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse:

However, if solicited by the ERIC Facility, or if making an unsolicited contribution to ERIC, return this form (and the document being contributed) to:

088 (Rev. 9/97)
PREVIOUS VERSIONS OF THIS FORM ARE OBSOLETE.