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ABSTRACT

Utilization of learner cognitive attainment as a measure of student teacher effectiveness is employed in this study of 2,[illegible]0 secondary school students and 21 student teachers. Five conceptual research models are developed to determine the teaching skill level of the education majors through examination of their students' academic achievement. Results indicate that the student teacher's status as either an education major or a noneducation major as well as his/her overall grade point ratio significantly account for the variation in learners' performances. Time referenced variables, the quality of supervisor ratings assigned to the student teacher, and individual classroom teaching styles are also found to correlate significantly with students' cognitive attainment. (LH)

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Cognitive Attainment of Learners of Student Teachers: A Criterion for Attaining Accountable Teacher Preparation Programs

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Abstract

This investigation was conducted to determine whether learner cognitive attainment data have potential for decision-making regarding the competence of all prospective teachers completing a secondary teacher education program. Five conceptual models were developed for determining the effectiveness of student teachers in bringing about learner cognitive attainment. Structural regression equations for these models were developed to analyze the data collected for 2540 secondary school learners and 21 student teachers. Comparisons of the various regression equations yielded results indicating the professional characteristics of the student teacher namely, academic major and overall grade point ratio, significantly (F=67.69, df:2,2536) accounts for variation among learner cognitive attainment scores.

Further analyses of these data revealed that education majors produced substantially higher cognitive attainment scores among their learners than did non-education majors. Other analyses indicate that time-referenced variables (F=23.52, df:2,2534) and supervisor ratings of the planning and instructional effectiveness of student teachers (F=48.83, df:2,2532) also account for some of the variability of learner cognitive attainment values. As might be expected, positive relations were found between longer periods of time devoted to instruction and greater learner cognitive attainment. Supervisor ratings of candidates were found to have a modest positive relation with more successful learners. This finding suggests that supervisor ratings, commonly used as the primary evaluation tool in student teaching, need to be used in combination with other evaluation instruments to determine the competence of teaching candidates. One additional analysis addressed classroom behavior styles of individual student teachers (F=32.46, df:21,2511). This finding accounted for substantial variance in learner cognitive attainment in this investigation and has substantial significance for an intensive field experience if a teaching candidate's competence is based on learner cognitive attainment rather than demonstration of "teaching-process" skills.

The press for accountability in educational settings is no longer reserved for learners in public schools. Experienced teachers and teaching candidates applying for a position with the Dallas Independent School District now must pass a proficiency test before being seriously considered as a viable candidate for a teaching position in that district. According to Mitchell (1978), in a recent issue of Atlantic Monthly, this practice was initiated because of the dismal performance records of many newly minted teachers with recently acquired teaching certificates in hand. One wonders how and why this phenomenon has occurred, and what type of evaluation would allow ill-equipped individuals to attain teaching certificates. Perhaps the experience of Dallas is unique, but it does serve to emphasize the growing concern public school personnel officers and parents have regarding the capabilities of teaching candidates and the quality of teacher preparation programs responsible for preparing these individuals.

The concern about teacher preparation program quality has long been an issue of great importance. Some time back a multi-stage evaluation system was established to monitor the development and implementation of a competency based teacher education program (Denton, 1977). One stage of this evaluation system focuses on the student teaching experience where efforts have been guided by the common-sense notion that "successful teachers bring about learning in their charges." While this generalization is straightforward and easy to interpret, implementation of a plan to obtain performance data on learners is another matter. Thus, this investigation was conceived and conducted to determine whether learner cognitive attainment data have potential for decision-making regarding the competence of all prospective teachers completing a teacher preparation program.

THEORETICAL CONSIDERATIONS

A precedent for using learner cognitive attainment as a measure of teaching success dates back to the scientific management era in American schools from 1910 to 1930 (Callahan, 1962). Apparently, this interest continued for some time given the investigations by Rostker (1945), Rolfe (1945), and LaDuke (1945). These investigators collected multiple teacher and learner variables while examining teaching ability based on learner achievement. Interestingly, these investigators employed rather elaborate statistical procedures, i.e., multiple regression, to explain the effects of teacher variables on learner achievement.

More recently, Wittrock (1962) studied the impact of learner achievement gains on student teachers by telling the candidates their grades in student teaching depended on the performance of their learners. When pupil achievement of these teaching candidates were compared with pupil achievement of a similar group of student teachers who served as controls for this investigation, the learners of the experimental student teachers were found to have attained higher scores on standardized tests in social studies and English. Unfortunately, the pupils of some of the experimental student teachers expressed more dissatisfaction with their student teachers than did pupils of the control student teachers.

During the past decade or so, assessment issues in teacher education have received substantial attention, due in part to attempts to plan, develop, and implement competency based teacher education (CBTE) programs. Two major positions emanating from CBTE regarding assessment of teacher competency are: (1) procedures on the one hand which assess the process and practice of teaching candidates and (2) assessment techniques which encourage the collection of learner attainment information (consequence criteria) on the other (Weber, 1974).

Many teacher educators favor the use of process criteria for assessing the competence of a student teacher. An example of which would be the candidate's facility with creating a favorable learning set in a microteaching lesson, followed by a similar skill performance in an actual class situation. This multiple step process often is repeated for other presentation skills, such as, use of higher order questions, prompting, and providing appropriate feedback, until the usual litany of teaching skills in a CBTE program have been practiced and demonstrated by the aspiring teaching candidate.

Proponents of the process approach cite measurement problems, and economic considerations associated with obtaining learner achievement gains from standardized tests as major deterrents in using consequence criteria for assessing preservice teacher competence (Glass, 1974; Soar, 1973). Medley (1978) cites a number of alternative strategies for assessing teaching candidates, e.g., teaching tests, behavior samples, teaching exercises, classroom interaction simulations, projected problem exercises, which with the exception of the teaching tests are categorized among the process criteria approaches for candidate assessment. Interestingly this emphasis on process criteria tends to dominate the professional literature concerned with assessing the competence of preservice teachers (Kay, 1978; Pottinger, 1978; Tikunoff & Ward, 1978). Thus, teacher educators who have labored with the issues of assessing teaching competence in terms of consequence criteria (learner attainment) have encountered resistance because this approach it is said, places the fate of the teaching candidate in the hands of their learners. Proponents of consequence criteria on the other hand indicate that process criteria alone simply do not yield adequate evidence that candidates have the necessary teaching competencies to succeed in the classroom (Brinkerhoff, 1978; Denton & Norris, 1979).

Further, teacher educators espousing the latter position, find support for competence based on achievement from the vigorous research activity on teacher effectiveness. In this area of interest, effectiveness is frequently defined in terms of the classroom teacher's ability to produce higher than predicted learner gains on standardized tests. This criterion for teacher effectiveness is commonly cited in investigations (Brophy & Evertson, 1976; Stallings & Kaskowitz, 1974; Good & Grouws, 1977) and reviews of research on the topic (Dunkin & Biddle, 1974; Good, 1979; Rosenshine, 1976; Rosenshine & Furst, 1971). Thus, teacher educators embracing the notion of including learner attainment data in decisions regarding the competence of pre-service teachers have a sound body of empirical evidence to support their position regarding learner achievement data and decisions regarding teaching competence.

Perhaps an approach which integrates learner cognitive attainment data with systematic classroom observations is the optimal assessment strategy for the preparation of teachers. McNeil and Popham (1973, pp. 233-234) have derived such a strategy which involves contract plans based on learner cognitive gain. With little or no modification, this contract plan can serve as a strategy for assessing a student teacher's competence. This approach is based on the notion that the objectives of the curricular plan must be agreed on before teacher competency can be assessed. Supervisors and the teaching candidate must agree on the appropriateness of stated performance objectives for the learners. Further, agreement is reached before instruction begins regarding what evidence will be used to determine whether the teaching has resulted in learner attainment of the performance objectives. Data are subsequently collected to determine whether learners have achieved the stated objectives as well as whether unintended outcomed have emerged. The evaluation plan need not exclude the use of observational systems in the assessment of instruction, rather this plan recommends their use as means for establishing descriptive records of the teaching act.

One significant advantage of the contract plan for assessing teacher competence is that it allows student teachers in conjunction with their supervisors to establish outcomes and standards that are most appropriate for their learners. Prior learning, dynamics of the classroom, and classroom environment can be taken into account in establishing the instructional plan on which the student teacher is to be held accountable (McNeil & Popham, 1973). To this end the following research questions were posed.

1. Should teacher preparation program decisions regarding the qualifications of a teaching candidate be influenced by the degree to which academic characterisitics of student teachers relate to learner cognitive attainment on a single instructional unit when the influence of prior cognitive attainment of those learners is removed?

2. Should student teaching guidelines provided by the teacher education program be affected if the period of instruction provided by teaching candidate influences learner cognitive attainment on a single unit when the effects of prior cognitive attainment of learners and academic characteristics of student teachers are removed?

3. Should teacher preparation program decisions regarding the competence of a teaching candidate be influenced by the degree to which university supervisor ratings of the student teacher's planning and instructional effectiveness relate to learner cognitive attainment on a single unit when the effects of prior learner cognitive attainment, characteristics of student teachers and instructional time are removed?

4. Should teacher preparation decisions regarding program quality be influenced if the behavior of individual student teachers affect learner cognitive attainment on a single instructional unit when the effects of prior learner attainment, student teacher academic characteristics, supervisor ratings, and time on instruction are removed.

ORGANIZATION OF INVESTIGATION

Program Description

This investigation was conducted under the auspices of an educational curriculum and instruction department at a Land Grant University. The teacher preparation program which participated in the investigation is a competency based program for secondary level teachers fashioned around a diagnostic prescriptive model of instruction (Armstrong, Denton, Savage, 1978). This model conceptualizes teaching as a series of events requiring five distinct sets of instructional skills, that is: Specifying Performance Objectives, Diagnosing Learners, Selecting Instructional Strategies, Interacting with Learners, and Evaluating the Effectiveness of Instruction.

Specifying Performance Objectives - The decisions inherent in this element of the instructional model are instrumental in determining whether the entire instructional process can be successful in producing student learning. Restated, this idea becomes performance objectives determine the direction and focus of instruction. When performance objectives are selected and sequenced according to a logical plan, teachers are in a position of leadership and can justify their program to responsible critics.

Diagnosing Learners - Teachers need information regarding a learner's readiness to begin a proposed new instructional sequence. Bypassing this step in an effort to save instructional time is false economy, since the result may well be frustrated, bored and unmotivated learners. When adequate diagnostic information is available, instructional plans can be developed that meet the informational and emotional needs of the learners.

Selecting Instructional Strategies - In selecting instructional strategies teachers should structure activities that are consistent with the identified performance objectives, the entry levels of the learners, and the events of instruction espoused by Gagne' (1970). In a sense, selecting instructional strategies is analogous to generating directional research hypotheses. A strategy is created from a wide range of possible approaches which, in the teacher's mind, will likely bring about learner attainment of the performance objectives. The appropriateness of this strategy is "tested" during the implementation and evaluation phases of instruction.

Interacting with Learners - This component represents the "doing" phase of the instructional model. The elegance of the instructional plan becomes unimportant if the timing and continuity of the classroom activities are interrupted creating disorder and predictable management problems. Thus, learning how to interact with learners is, perhaps, the most difficult set of skills for new teachers to attain. Mastering these skills requires considerable practice in actual classroom settings, and serves to justify the emphasis on student teaching experiences in teacher preparation programs.

Evaluating the Effectiveness of Instruction - This component serves to gather evidence during and after the teaching of an instructional plan to determine whether the plan "worked." Evaluation should prompt a review of each component in the instructional model. Representative questions to illustrate this review include: Were the performance objectives appropriate? Were the pretests really diagnostic tools? Did the instructional strategies incorporate the events of instruction? Was classroom management sufficient to maintain a favorable learning environment? Were the evaluation tools valid for assessing learner growth and program effectiveness?

This model provides a framework that encourages the development of individual teaching styles. Individualized styles are encouraged because evaluation of instruction is based on learner attainment of performance objectives. Given this operating principle, teachers in preparation are free to choose procedures from their own repertoires that they believe will result in high levels of learner performance. Further, teacher responsibility is well served by this model. This responsibility comes not because of the teaching candidate's adherence to a set of "ideal role behaviors," but rather in adapting instructional practice, as necessary, to help learners achieve performance objectives that have been selected.

A full semester-full day student teaching program with twelve semester hours being awarded for successful completion of the course is the culminating experience in this preparation program. During this experience, each student teacher is required to develop and implement two instructional units each of approximately two weeks duration. The instructional units are to include: performance objectives, a diagnostic pretest to determine whether prerequisite knowledges and skills are present, instructional strategies addressed to each performance objective, and criterion-referenced instruments. These units must be deemed acceptable and appropriate by both the classroom supervising teacher and the university supervisor prior to implementation.

Evaluation of student teachers in this program includes supervisor ratings based on in-class observations and instructional materials produced by the student teacher. Generally, six supervisor ratings are completed during a semester. These ratings are recorded on an <u>Evaluation Profile</u> instrument. It may be of significance that the final evaluation for each student teacher recorded on this instrument represents a consensus rating resulting from a three-way conference between the student teacher, classroom supervisor and university supervisor. In addition, a <u>Curriculum Context Checklist</u> for rating the components of each instructional unit is completed by the university supervisor. Two of these forms are completed during the course of the field experience.

Student teachers are also requested to contribute to the formative evaluation process by completing <u>weekly reflection sheets</u> throughout the semester. Further, summative procedures are conducted by student teachers at the conclusion of each unit, where summaries of learner performances are recorded on <u>Summary Evaluation of Unit forms</u>. These self-evaluation experiences are consistent with the final component of the diagnostic-prescriptive model of instruction.

Only one type of data was collected for this investigation which ordinarily is not collected during student teaching, that being, criterion referenced learner attainment data. In this investigation, student teachers retained the unit test responses of learners after providing feedback to the learners regarding their performance. These data were subsequently used to develop a criterion-referenced summary on each learner. This summary is a record of each learner regarding his/her individual performance with respect to each performance objective included in the unit. In addition, pretest and posttest scores were recorded for each learner on the summary. The objective attainment data expressed as the percentage of objectives attained in unit two for each learner has served as the dependent variable in this investigation.

Sample

Information from 21 secondary level student teachers and 2540 learners taught by the student teachers comprised the sample for the data base of this investigation. These student teachers were supervised by one university supervisor, over the course of three semesters, i.e. Spring 1978 - 2 student teachers, Fall 1978 - 13 student teachers, Spring 1979 - 6 student teachers. The total number of secondary level student teachers numbered 184 during this period (Spring 78 - 68, Fall 78 - 64, Spring 79 - 52). The primary reason for selecting only the student teachers assigned to one university supervisor was to reduce error variance among supervisory ratings. The university supervisor has served in this role for three years and has established good relationships with classroom supervisors and building administrators in the student teaching sites represented in this project. Moreover, the supervisor is well versed on the diagnostic-prescriptive model of instruction on which the preparation program is based and has held the student teachers accountable for implementing the tenets of this model in in their teaching.

Seventeen classroom supervisors from 7 school buildings served as the "model teachers" for the student teachers. Four supervisors in this group worked with a student teacher for two of the three semesters the data were collected, while the remaining 13 classroom supervisors served in this capacity for one semester. In order to qualify as a classroom supervisor, these teachers met the following criteria: held a valid teaching certificate in the field in which they were teaching, had completed 2 full years of public school teaching experience - one of which was in the local district, agreed to serve as a classroom supervising teacher for both semesters, and agreed to attend the inservice meetings sponsored by the Brazos Valley Cooperative Teacher Education Center and other meetings sponsored by the educational curriculum and instruction department at the university.

In order to enroll in student teaching each teaching candidate in this sample had met the following criteria:

1. Attained senior standing with at least 30 semester hours completed at the university including at least six semester hours in approved professional courses.

2. Attained a minimum grade point ratio (GPR) of 2.25 based on the grade report form published by the registrar's office.

3. Completed at least 75% of the coursework required for the two 24 hour teaching fields with a minimum GPR of 2.25.

4. Admitted to the teacher education program at least one semester prior to student teaching. The components for this criterion include a statement of personal commitment, minimum grade point ratio (2.25), three letters of recommendations, successful completion of English proficiency examination, and *early field experience course (*required for EDCI majors).

5. Completed ten hours of professional education coursework (EPSY 301-3hrs., EDCI 323-3hrs, EDCI 401-7-4 hrs.).

Although the preceding criteria apply to all secondary level student teachers, the academic major does vary among teaching candidates. Education majors are required to complete a 34 semester hour sequence of professional education culminating with the 12 semester hour student teaching experience. Conversely, non-education majors seeking teacher certification are required to complete a 22 semester hour program which also includes the 12 semester hour student teaching experience. Differences in professional education coursework between these types of student teachers include, an orientation to education course (1 sem hr), an early field experience course (2 sem hrs), a logic of teaching course (3 sem hrs), an adolescent psychology course (3 sem hrs), and on educational technology course (3 sem hrs). Generally, education majors complete the total sequence of coursework over an eight semester period, compared with a three semester period for non-education majors seeking teacher certification.

The learners in this sample were assigned to the classes of 17 classroom supervisors during the three semester period these data were collected. These learners attended one of the following five rural school districts, namely:

B . . .(A.D.A. = 8412)
C . . .(A.D.A. = 1303)
C.S.. .(A.D.A. = 2898)
H . . .(A.D.A. = 1592)
N . . .(A.D.A. = 1937)

Instrumentation

A variety of scales and criterion-referenced instruments mentioned in the preceding section were used in obtaining measures of the various independent variables and the dependent variable in this investigation. The following briefly describes these instruments. An Evaluation Profile was employed to obtain the independent variable, instructional effectiveness of the student teacher as perceived by the university supervisor. This instrument is completed on a biweekly basis by the university supervisor. The scale, consists of twenty-eight Likert type items divided into two categories, i.e., instructional competencies (21 items), and personal and professional competencies (7 items). Supervisory ratings for the items under the heading, instructional competencies, are summed together to provide the values for the instructional effectiveness variable. Each item on the scale is referenced to a performance objective in the student teaching program. Further, the instructional skills addressed on this instrument are compatible with the skills and knowledges stressed in the diagnostic-prescriptive model of instruction, on which this program is based. The supervisor has the choice of marking one of five categories ranging from excellent = 1, to inadequate = 5. If the skill is not observed or not applicable to the classroom situation the supervisor has the option of marking N/A. The alpha coefficient, α=.94 determined for this instrument suggests a high degree of internal consistency among responses to the various items.

A second rating scale, the <u>Curriculum Context Checklist</u>, is used to provide university supervisor ratings of the curricular units developed by the student teacher. Values from this scale provide data for the variable, planning effectiveness of the student teacher. This instrument contains a 5 choice scale identical to the scale of the evaluation profiles. Individual items of this instrument identify components of the curriculum unit, e.g., general goals, focusing generalizations, concept list, diagnostic component. Values for the planning effectiveness variable are determined by summing together the component ratings registered for each item on this checklist.

Teaching candidates contribute to the data base by completing two instruments which serve formative evaluation functions for the candidate and provide time ordered data for programatic research. One of these instruments, the Weekly Reflection Sheet request the student teacher to estimate the percent of time s/he has spent during the preceding week observing, planning, assisting, team teaching, and/or assuming full responsibility. In addition the candidates assess their morale and provide a written rationale for the rating. These instruments are submitted to the university supervisor at the end of each week throughout the semester.

The second instrument, Summary Evaluation of Unit, is completed by the teaching candidate immediately after completing the instruction associated with each unit. This form requires an estimate of the achievement level and socioeconomic level of the learners in addition to the actual number of class periods required to teach the unit. Perhaps the most significant information collected among all data is recorded on this form by the student teacher; this data being achievement information (learner attainment of individual unit objectives, pretest scores, and unit posttest scores). Criterion-referenced tests developed by the student teacher are used to provide these learner attainment data. These instruments, unique for each unit and each student teacher, represent a strength yet potential limitation in the design of this investigation. As a strength the student teacher, with guidance from classroom and university supervisors, develops tests related directly to the outcomes established for the performance objectives in each unit. Prior learning, extenuating classroom situations, and the abilities of the learners are taken into account in establishing both the objectives and the corresponding criterion tests. Under these conditions, the cognitive attainment measure indeed should sample the behavior called for by the performance objectives of the unit.

A potential limitation of candidate-developed criterion-referenced tests stems primarily from the lack of information on the reliability and validity of the respective instruments. Conventional reliability procedures appropriate for norm-referenced tests are not determined on the various criterion-referenced tests because the function of these tests (to determine an examinee's level of functioning with respect to a stated criterion) is not consistent with the function of norm-referenced tests (determine an individual's performance with respect to the performance of others in the group) (Millman, 1974). Thus, although we are concerned, we are not unduly alarmed by the absence of these values. Validity of criterion-referenced instruments on the other hand, can be assessed by determining the logical relation of the performance objectives and the individual test items. Fortunately, this validity check was conducted by the classroom and unversity supervisors on each candidate's test before the instrument was administered to the learners.

While the preceding remarks are reasonable, we do realize measurement concerns regarding the equivalence of the 21 criterion-referenced tests have not been addressed. Certainly no claim can be made that all of these instruments were designed to measure attainment of identical content; however, it was possible to determine whether the levels of cognitive functioning (knowledge and application) addressed in the tests were nearly uniform. Table 1 (Appendix) presents a summary of characteristics for unit two tests developed by the student teachers. In nearly all instances, a preponderance of objective type test items designed to measure the knowledge level of functioning occurred. Application level test items occurred on five examinations, but invariably these questions represented only a small portion of items on the examination. This finding isn't too surprising, since lower level objectives are more reliably measured by objective type test items. Further, the candidates in this investigation tended to require extensive products, such as, term papers and comprehensive laboratory reports when higher order cognitive objectives were included in the units.

STATISTICAL DESIGN

Conceptual Regression Models

During the past decade, substantial interest has centered on the development of conceptual models for documenting the educational process. Typically, these models have been constructed to explain an individual's educational achievement in terms of the following factors: individual and family characteristics, peer group influences, genetic endowments, school resources, and study attitudes (Barro, 1970; Hanushek, 1972; Magoon, 1979).

One difficulty encountered with the early conceptual models for explaining educational achievement was the selection of an appropriate statistical model. Multiple regression techniques, which were relied on for similar model building in agriculture and economics, often yielded inconsistent estimates when applied to empirical data from the schools. One reason for these unstable estimates is the high interrelationships among educational process variables, which is known as the multicollinearity problem in statistical analysis. A solution to this problem is to combine The variables which are highly interrelated. This approach combined with a system of equations can lead to fairly accurate parameter estimates among the independent variables (Cooley and Lohnes, 1976; Murnane, 1975).

These procedures were employed to develop a system of five linear structural equations to address the research questions for this investigation. Each structural equation takes the form of a regression model to illustrate the estimation requirements for the variables being considered. These models and a corresponding legend are presented in Figure 1.

model 1: $Y_2 = b_1Y_1 + E(1)$

model 2: $Y_2 = b_1Y_1 + [b_2P_1 + b_3P_2] + E(2)$

model 3: $Y_2 = b_1Y_1 + [b_2P_1 + b_3P_2] + [b_4T_1 + b_5T_2] + E(3)$

model 4: $Y_2 = b_1Y_1 + [b_2P_1 + b_3P_2] + [b_4T_1 + b_5T_2] + [b_6S_1 + b_7S_2] + E(4)$

model 5: $Y_2 = b_1Y_1 + [b_2P_1 + b_3P_2] + [b_4T_1 + b_5T_2] [b_6S_1 + b_7S_2] + \sum_{i=1}^{21} c_iC_i + E(5)$

Y_2 = Learner cognitive attainment on the second unit developed and taught by a student teacher. (Percentage of objectives attained in unit 2)

Y_1 = Learner cognitive attainment on the initial unit developed and taught by a student teacher. (Percentage of objectives attained in unit 1)

b_i = Least squares weights associated with the initial seven variables.

$E_{(i)}$ = The error-of-prediction vector for model i.

P_1 = Overall grade point ratio for university coursework completed by student teacher.

P_2 = Undergraduate major of student teacher. One if the student teacher was an education major, zero otherwise.

T_1 = Prior solo teaching time of student teacher.

T_2 = Opportunity to learn time provided by student teacher.

S_1 = University supervisor quality ratings of second instructional unit prepared by student teacher.

S_2 = University supervisor quality ratings regarding instructional effectiveness of student teacher during the teaching of the second unit.

C_i = 1 if the learner was assigned to student teacher i, zero otherwise.

c_i = Least squares weight associated with each C_i.

Figure 1

Five Regression Models for Assessing Factors which Influence Cognitive Attainment of Learners

In model 1, learner cognitive attainment on a second unit developed and implemented by a student teacher depends on the learner's prior cognitive attainment (performance on the initial unit taught by the student teacher). Inherent in this regression model is the assumption that the effect of an instructional unit is independent of the student teacher's academic background, her/his planning and instructional skills, and the time allowed for instruction. Justification for the inclusion of model 1 in the system of equations developed for this investigation, is strongly stated by Bloom (1976, p 68), where he affirms that cognitive entry behavior can account for as much as 50% of the variance on related cognitive achievement measures over subsequent learning tasks.

Model 2 presents learner cognitive attainment on a second instructional unit taught by a student teacher as a function of the learner's prior cognitive attainment and the student teacher's academic background. Underlying this model is the assumption that the effect of a specific instructional unit is influenced by the professional preparation, i.e., collegiate grade point ratio and academic major, of the student teacher. The collegiate grade point ratio is based on a four point grading scale and computed from all coursework completed by the teaching candidate. The academic major of the teaching candidate is a categorical variable with two classifications, namely; education major, non-education major. Justification for the presence of these variables in model 2 is based on assumed positive relations among earned grades, quantity of coursework and knowledge of the student teacher. Knowledge of the teacher and the subject being taught have been shown to influence the achievement of learners (Coleman, 1975; Denton & McNamara, in press).

Model 3 presents learner cognitive attainment as a function of the aforementioned variables (prior attainment of learner, student teacher background) and two measures of time (prior solo teaching time of the student teacher and opportunity to learn time). The assumption underlying Model 3 is that the effect of instruction in unit two depends in part on prior instructional time and the time allotted for instruction in the second unit as well as the student teacher's professional background and the cognitive entry behavior of learners.

Both of these time referenced variables were determined in the same manner, that is, the number of instructional periods devoted to the unit were multiplied by the length of the instructional periods expressed in minutes. The value for prior-solo-teaching-time was determined for the first unit developed and implemented by the student teacher while the opportunity-to-learn variable was determined with values from the second unit taught by the student teacher. These time-based variables were included in this model because of the theoretical considerations of time in the oft-cited model of school learning by John Carroll (1963). Further, recent literature on teacher effectiveness indicates time-on-task of both teacher and learner is correlated with classroom achievement (Good, 1979; Medley, 1977; Stallings, 1977).

In model 4, learner cognitive attainment depends on the planning and instructional skills of the student teacher as perceived by the university supervisor as well as all of the independent variables included in model 3. The assumption behind model 4 is that the effect of instruction in unit two depends on the planning and instructional skills of the student teacher in addition to prior instructional time, opportunity to learn time and the student teacher's professional background. Supervisor ratings were included in this model because of the general acceptance of this type of evaluative procedure in assessing the competence of student teachers, (Bennie, 1972; Henry & Beasley 1972). If supervisor ratings do accurately reflect the teaching candidate's planning and instructional skills, then these variables should account for some of the variance in learner cognitive attainment. As noted earlier, planning effectiveness of the student teacher was determined by summing together the unit 2 component ratings on the curriculum context checklist. Similarly, the instructional skills variable was obtained by summing the final supervisor ratings across all 21 items dealing with instructional competencies on the Evaluation Profile instrument.

Finally, model 5 combines all of the predictors presented in model 4 with the influence on learner variability accounted for by the classroom behavior of individual student teachers. This model permits the determination of whether individual teaching candidates' instructional behavior have a different effect on learner attainment when prior learner attainment, instructional time, professional characteristics of the candidates and supervisory ratings of instructional and planning effectiveness are held constant. Operationally, model 5 clusters the variables under consideration in model 4 into 21 groups, then analyzes their relationship to one another. The grouping process is accomplished by creating an array of classificatory variables(dummy variables) each of which represents a student teacher and the learners assigned to her/him. Precedence for examining the influence of individual teachers on cognitive attainment exists in the literature on program evaluation (Denton & McNamara, in press) and educational policy research (Murnane, 1975).

The unit of analysis selected for each of these regression models was the learner rather then the student teacher. This decision was made to permit maximum variation of the dependent variable to be taken into account by the various models developed for this investigation. Further, regression model 5 (figure 1) simply would not have been possible had the data been organized with the student teacher as the unit of analysis. Since the focus of the investigation is the <u>process of assessing the competence of a student teacher</u>, <u>not</u> assessing the <u>student teachers</u> per se, the arguments given for teachers as the unit of analysis in teacher effectiveness research do not automatically apply to this investigation.

Statistical Analysis

These five regression models were analyzed and tests of significance were performed to statistically address each of the research questions. The expressions used for these tests are presented in figure 2. These expressions permit us to examine the contribution of a subset of variables (M) to the explained variation in learner cognitive attainment while holding constant the contribution of variables previously introduced into the regression equation. This process is illustrated in the following descriptions of the various tests for the four research questions of this investigation.

Research question 1, which addresses the academic characteristics of student teachers, is tested by comparing regression models 1 and 2. If the observations are consistent with our expectations, the coefficient of determination or explanatory power (R^2) of model 2 should be larger than the coefficient of determination (R^2) for model 1. The increased explanatory power of model 2 then is attributed to the professional background of the student teacher after the influence of prior cognitive attainment of learners has been taken into account.

Generalized Expression

$$F = \frac{[R^2_{i+1} - R^2_i]/M}{1 - R^2_{i+1} \;/\; N - K - 1}$$

Q1: $$F = \frac{R^2_2 - R^2_1 \;/2}{1 - R^2_2 \;/\; 2536}$$

Q2: $$F = \frac{R^2_3 - R^2_2 \;/2}{1 - R^2_3 \;/2534}$$

Q3: $$F = \frac{R^2_4 - R^2_3 \;/2}{1 - R^2_4 \;/2532}$$

Q4: $$F = \frac{R^2_5 - R^2_4 \;/21}{1 - R^2_5 \;/2511}$$

Q_i = research questions 1 - 4.

R^2_{i+1} = coefficient of determination for model (i + 1)=variance accounted for by model (i + 1).

N = number of learners in model (i + 1)=(2540 learners in all models).

K = total number of independent variables in model (i + 1) = (3 to 28).

M = number of additional independent variables in model (i + 1) which were not included in model (i) = (2 or 21).

Figure 2

Generalized Equation and Corresponding Significance Test Expression (F - ratios) for Research Questions 1 - 4.

To test research question 2, which emphasizes instructional time, a comparison of models 2 and 3 is made. If the observations are consistent with our expectation, then model 3 should provide a significant increase in explanatory power over that of model 2. These two models differ due to the contribution of time based variables in explaining the variance among learner cognitive attainment values. The F-test for this comparison determines whether the variance in learner cognitive attainment accounted for by the time referenced variables is significant when the influence of prior learner attainment and characteristics of the student teacher are held constant.

The process is repeated to test research question 3, which focuses on the planning and instructional effectiveness of the student teacher. To test this question a comparison of models 3 and 4 is made. Again, if the observations are consistent with our expectations regarding this research question, then the explanatory power of model 4 should exceed the explanatory power of model 3 due to the planning and instructional effectiveness of the student teacher. Stated another way a significant F-value for this comparison will indicate that teaching skills of the student teacher do influence learner cognitive attainment, even when the influence of learner prior attainment, professional characteristics of the student teacher and instructional time are taken into account.

Similarly, the final research question (question 4) is tested by comparing models 4 and 5. If classroom behaviors of individual student teachers influence cognitive attainment among their learners in a distinctive fashion, then the explanatory power of model 5 should be significantly greater than the explanatory power of model 4. A significant F-value resulting from this comparison will indicate that classroom behaviors of individual student teachers do influence learner cognitive attainment when learners of each student teacher are clustered and compared while holding constant the influence of the variables considered in model 4.

FINDINGS

The analysis associated with research question 1 yielded a F value ($F = 67.69$, df:2,2536) which is statistically significant ($p < .01$). This result indicates the professional characteristics of the student teacher which were included in this analysis explains approximately 4% of the variance in learner cognitive attainment which is not explained by prior attainment on a preceding unit of instruction. The characteristics considered in these procedures were whether the candidate was an education major and the overall grade point ratio of the candidate. The college major variable was determined to correlate modestly with cognitive attainment ($r_{pbi} = .23$), while the overall grade point ratio of the candidate was found to correlate only slightly with the criterion variable ($r = .13$). Further examination of the data revealed that learners of education-majors attained higher average cognitive attainment values ($\bar{x} = 69.0$) than learners of non-education majors ($\bar{x} = 58.9$). These values were somewhat surprising because cognitive attainment means associated with unit one for the two groups of learners were nearly equivalent, 67.6 and 67.3 for learners of education majors and non-majors, respectively. Moreover, grade point ratios over all college coursework completed by the teaching candidates were found to differ only slightly between education-majors (GPR = 3.00) and non-majors (GPR = 2.89). Other factors which potentially influenced the difference in learner cognitive attainment between these groups of student teachers will be presented subsequently.

The statistical comparison for research question 2 produced comparable results. The result of this comparison ($F = 23.52$, df:2,2534; $p < .01$) indicates the explanatory power (1.4 percent of the variance) of the time-referenced variables, prior solo teaching time, opportunity to learn time provided by the student teacher in the second unit, together account for slight but statistically significant differences in learner cognitive attainment on the second unit. Examining these data from the perspective of the quantity of time allotted for instruction by teaching candidates who were education majors and those who were non-majors revealed: the average prior-solo teaching time for edutation-majors was 621.4 minutes and 657.0 minutes for non-majors; and the opportunity-to-learn-time averages were 547.1 minutes and 407.9 minutes for majors and non-majors, respectively. While the values for prior-solo teaching time are comparable, the values for the instructional time devoted to unit two were more disparate. These findings are consistent with teacher-effectiveness research, since learners of education-majors who attained higher cognitive values were provided with a greater amount of direct instruction.

The third analysis was addressed to research question 3, where the coefficients of determination for models 4 and 3 were compared. The resulting F value for this comparison ($F = 48.83$, df:2,2532, $p < .01$) indicates the explanatory power (2.8% of the variance) of the university supervisor's ratings is statistically significant. This finding indicates the perceptions of the university supervisor regarding the planning and instructional competence of the student teacher do predict to some degree, learner cognitive attainment when prior cognitive attainment, professional characteristics of the student teacher, and measures of instructional time are held constant. The zero order correlations for the planning and instructional effectiveness ratings with learner cognitive attainment are .08 and -.06 respectively. Further, instructional and planning effectiveness averages from supervisor ratings were determined to be 27 and 25 for education majors, and 29 and 27 for non-majors. Due to instrument scaling, higher or better ratings were designated with lower numerical values, thus 27 represents a slightly higher rating of instructional effectiveness than does the value 29. However, these similar mean values between the majors and non-majors combined with the low zero order correlations (.08 and -.06), and the diminutive explanatory power value (2.8%) raise validity questions about the practice of using supervisor ratings as the sole measure for awarding the grade in student teaching.

Analysis of data associated with research question 4 provided yet another significant statistical finding ($F = 32.46$, df:21,2511, $p < .01$). In contrast to the preceding results however, the variance on learner cognitive attainment accounted for by the variables under review, behavior of individual student teacher, was substantial (15.5%). Descriptive summaries on each variable in model 5 were not determined, yet it is clear from the inferential values that substantial differences among these variables do occur across different student teachers.

A summary of the inferential tests for the research questions are presented in table 2. Additional statistical summaries for each model are presented in tables 3 - 7 (Appendix).

Table 2

Summary of Analyses For Research Questions 1-4

	Research Questions			
Test Legend	1	2	3	4
N	2540	2540	2540	2540
K	3	5	7	28
M	2	2	2	21
R^2 from model 1	.191			
R^2 from model 2	.232	.232		
R^2 from model 3		.246	.246	
R^2 from model 4			.274	.274
R^2 from model 5				.429
$R^2_{i+1} - R^2_i$	.041	.014	.028	.155
F Statistic	*F(2,2536)	*F(2,2534)	*F(2,2532)	*F(21,2511)
	67.69	23.52	48.83	32.46

*$\alpha < .01$

DISCUSSION

While there are a variety of means and ends for determining the competence of a student teacher, the criterion variable used in this investigation, cognitive attainment of learners, places special emphasis on the results of the teaching candidate's teaching skills. To many teacher educators, this approach places the fate of teaching candidates in the hands of their learners who may not be motivated or possess the prerequisite cognitive skills to succeed. Conversely, the contract plan described by McNeil and Popham (1973) which was incorporated into the design of this investigation enables the teacher to account for the entry levels and dispositions of the learners in the development of a "learning contract." This point and counter-point represent only one aspect of the multifaceted process of assessing a student teacher's competence. While this professional issue regarding how to assess a teaching candidate's competence is far from being a closed concern, this investigation has assumed learner cognitive attainment to be the basis for assessing teaching candidate competence. Given this assumption, we have examined learner cognitive attainment in terms of variables commonly assessed either before or during the student teaching experience.

Research question 1 addressed the effect of academic characteristics of student teachers on learner cognitive attainment in a single instructional unit. The results of this investigation indicate the teaching candidate's academic major and overall grade point ratio do relate to the performance of learners. Although these characteristics were treated together in the analysis, it is interesting that academic characteristics of teaching candidates do explain some variation in learner cognitive performance in a single instructional unit, when prior learner performance is held constant. This finding is consistent with research reported by Denton and McNamara (in press) which indicates professional characteristics of a teacher, i.e., classroom experience, workshop participation, knowledge of content, do explain sufficient variation in learner cognitive attainment to be statistically significant.

Collectively, these findings provide a modest empirical justification for teacher education admission requirements which specify grade point requirements, since the relation between learner cognitive attainment and teaching candidate grade point ratio was positive. That is, the higher the student teacher's collegiate GPR, the higher the cognitive attainment of learners in a single instructional unit. However, one must remember this characteristic was linked with the major of the teaching candidate to produce the explanatory power reported for academic characteristics of the candidate.

The influence on learner cognitive attainment regarding whether the teaching candidate was an education major or in certification seeking student (non-education major) was also addressed in research question one. The difference in performance of learners associated with the major of the student teacher reported in this investigation has not been reported in the professional literature. Since, the characteristics were linked in the analysis, these observations are offered as areas for further research, but the observed relation in this investigation was that learners of education majors attained higher cognitive attainment values on a single instructional unit than their peers who were instructed by student teachers who were non-education majors. Perhaps this finding was an artifact of the sample and cannot be replicated, but since each group contained more than 1000 learners, these findings may well be stable. If this observation can be replicated and observed under more stringent conditions, perhaps justification will result for greater emphasis on educational theory and practice in teacher preparation programs.

The block of time referenced variables addressed in research question 2, prior solo teaching time and opportunity-to-learn time, accounts for a small but sufficient amount of variance regarding learner cognitive attainment to be statistically significant. This result corresponds to the current literature on teacher effectiveness which underscores the importance of time-on-task on learner achievement (Good, 1979; Medley, 1977; Stallings, 1977). As noted in the findings, the greater the instructional time devoted to the unit the greater the cognitive attainment of learners. While not specifically addressed in the literature, prior solo teaching time was included in this block of variables since the amount of previous instructional time in student teaching should affect the competence of the student teacher. This conjecture has merit if for no other reason than for the candidate gaining confidence and establishing a routine for managing the classroom during instruction. Further, data for these time based variables were obtained readily and easily from the student teacher's instructional plans and confirmed in the Summary Evaluation of Unit forms completed by the student teacher.

While the explanatory power of these variables is small, it is interesting that such global measures of instructional time account for enough variance in learner cognitive attainment to be statistically significant. Since these time measures did contribute to the explanatory power of the model, it is plausible that other time-based measures such as, student teacher planning time, student teacher time-on-instruction, and weeks of student teaching may be fruitful extensions of this research.

Similarly, values for the planning and instructional competence of the student teacher, the block of variables for research question 3, were readily obtained from the final evaluations of the university supervisor. Since the practice of evaluating the student teacher on the basis of supervisor ratings is so common, it is comforting to find these ratings do account for enough variance regarding the cognitive attainment of learners to be statistically significant. On the other hand, an explanatory power of 2.8% of the variance fails to inspire a great deal of confidence in university supervisor ratings as a sole criterion for awarding a grade or certifying the teaching competence of a student teacher. Perhaps emphasis on observation data which provides frequencies of instructional procedures coupled with supervisory ratings would enhance the explanatory power of these ratings. Further, perceptional data from learners of student teachers on the instructional competence of the student teacher might be combined with supervisor ratings to enhance the explanatory power of these values. In any event, the practice of using university supervisor ratings as the only criteria for "grading" the student teacher is not supported by the results of this investigation.

The final research question addressed the effect of teaching behaviors of the teaching candidate on learner cognitive attainment in a single instructional unit. The finding was that a substantial portion of variation (15.5%) among learner cognitive attainment values can be explained by examining the performance of learners taught by a particular student teacher. This finding is compatible with values reported by Denton & McNamara (in press) and Murnane (1975) when pupil achievement data sets were partitioned by classroom assignment then compared. It is not unreasonable or unlikely to expect that instructional behavior patterns of individual student teachers in this investigation were different. Further, it is possible these varying instructional behaviors among teaching candidates would result in cognitive attainment fluctuations across groups of learners. The analysis related to this question confirms these conjectures.

If we return to the assessment issues addressed at the beginning of this paper, the findings to question 4 can be interpreted differently. On the one hand, if the teaching candidate has successfully demonstrated mastery of the necessary and essential instructional skills identified for a preparation program, the observed variation of cognitive attainment among learners across different student teachers could be dismissed as an artifact of the abilities and backgrounds of the learners. The observed variation regarding learner attainment would be expected because the learners represent many different backgrounds and cognitive abilities. The fact that prior cognitive attainment was taken into account in this investigation would not explain variation due to other unspecified characteristics of the learners. Given this approach to preservice teacher assessment there would be no need to explain the variation in learner performance as a function of the teaching candidate's instructional skills, since characteristics of the learners overshadow the influence of the teacher's instructional behavior.

Conversely, if the alternate position to preservice teacher assessment is taken, namely, that learner cognitive attainment is the criterion variable for determining a student teacher's competence, then the finding for research question 4 indicates the preparation program had unequal effects on different teaching candidates. There are many conjectures about the source of this variation; for example, other academic characteristics of student teachers besides overall grade point ratio and academic major of the candidate may directly influence this variation in instructional behaviors of teaching candidates. However, it is also possible that components of the secondary teacher preparation program are not adequately preparing the candidates to carry out the classroom responsibilities of a teacher. Assuming this latter explanation has merit, the use of learner attainment data for preservice teacher assessment then serves dual functions. This approach provides direct evidence concerning the teaching candidate's ability to bring about demonstrated growth of secondary learners, while providing summative evalution data for the preparation program.

In closing, the results of this investigation underscore the importance of collecting multiple sources of data on each teaching candidate. Certainly other variables not addressed in this investigation (Classroom observation summaries, learner perceptions of the student teacher's competence, classroom supervisor ratings, unit pretest scores) and transformations of the variables considered in this investigation may increase the explanatory power of a regression model on learner cognitive attainment and should be considered in future researches.

Further, this investigation has demonstrated that it is feasible to implement a McNeil-Popham type of contract plan in an ongoing student teaching program. In essence, the McNeil-Popham plan becomes a management system for implementing a student teaching program which collects cognitive attainment data from learners of student teachers. This plan has great potential not only for preparing teachers who are "accountable" for producing learner growth but for evaluating and improving existing teacher prepartion programs as well.

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APPENDIX

Table 1

Summary of Characteristics of Unit Two Tests
Developed and Implemented by Student Teachers

Student Teacher	Number of obj addressed on test	Number of test items	Cognitive level addressed by test items
1	11	25	knowledge
2	7	50	knowledge
3	5	100	knowledge
4	2	25	(1)knowledge/ (1) application*
5	4	44	knowledge
6	2	26	knowledge
7	3	40	knowledge
8	15	31	knowledge
9	5	29	knowledge
10	7	67	knowledge
11	5	33	knowledge
12	6	28	(5)knowledge/ (1) application*
13	7	52	knowledge
14	5	40	knowledge
15	8	27	knowledge
16	5	28	(3)knowledge/ (2) application*
17	3	23	knowledge
18	8	73	knowledge
19	5	24	(2)knowledge/ (3) application*
20	1	11	knowledge
21	2	21	(1)knowledge/ (1) application*

* Number in parentheses represents the number of objectives of each type represented on the test.

Ledger

Variable Ledger for tables 3 - 7

Y_1 = Learner cognitive attainment on the initial unit taught by the student teacher

P_1 = Overall grade point ratio of student teacher

P_2 = Undergraduate major of student teacher

T_1 = Prior solo teaching time of student teacher

T_2 = Opportunity to learn time by student teacher

S_1 = Planning effectiveness of student teacher

S_2 = Instructional effectiveness of student teacher

C_i = Student teacher identification

Table 3

Statistical Summary of Regression Equation for Model 1.

Multiple R	.44	Analysis of Variance	DF	MS	F
R^2	.19	Regression	1	463021	599.1
Std. Error	27.80	Residual	2538	772	

Variable		B	BETA	STD ERROR B	F
Y_1		.48	.44	.02	599.1
intercept	32.42				

Table 4

Statistical Summary of Regression Equation for Model 2

Multiple R	.48	Analysis of Variance	DF	MS	F
R^2	.23	Regression	3	188012	256.3
Std. Error	27.08	Residual	2536	733	

Variable		B	BETA	STD ERROR B	F
Y_1		.49	.44	.02	599.7
P_1		-6.70	-.08	1.59	17.7
T_2		13.11	.21	1.13	133.8
intercept	43.68				

Table 5

Statistical Summary of Regression Equation for Model 3

Multiple R	.50	Analysis of Variance	DF	MS	F
R^2	.25	Regression	5	119092	165.0
Std. Error	26.87	Residual	2534	721	

Variable	B	BETA	STD ERROR B	F
Y_1	.52	.47	.02	604.2
P_1	-9.62	-.12	1.65	33.9
P_2	14.48	.23	1.16	156.9
T_1	.02	.11	.00	36.7
T_2	.00	.03	.00	3.8
Intercept 38.19				

Table 6

Statistical Summary of Regression Equation for Model 4

Multiple R	.52	Analysis of Variance	DF	MS	F
R^2	.27	Regression	7	9489.1	136.5
Std. Error	26.37	Residual	2532	695.1	

Variable	B	BETA	STD ERROR B	F
Y_1	.52	.48	.02	640.05
P_1	-8.22	-.10	1.66	24.50
P_2	17.19	.27	1.17	216.95
T_1	.02	.09	.00	27.57
T_2	.00	.05	.00	7.83
S_1	.01	.02	.01	1.59
S_2	.34	.18	.03	97.60
Intercept 21.96				

Table 7

Statistical Summary of Regression Equation for Model 5

		Analysis of Variance	DF	MS	F
Multiple R	.66				
R^2	.43		28	37151	67.39
Std. Error	23.48		2511	551	

Variable	B	BETA	STD/ERROR B	F
Y_1	.60	.54	.02	899.2
P_1	36.55	.44	8.56	18.2
P_2	43.44	.68	3.81	129.3
T_1	.07	.44	.02	9.3
T_2	.00	.00	.00	0.0
S_1	.50	.77	.12	16.3
S_2	-.94	-.48	.26	13.0
C_1	-.30	-.00	8.84	0.0
C_2	-9.65	-.06	4.72	4.2
C_3	19.17	.12	7.09	7.3
C_4	84.58	.45	8.54	98.1
C_5	51.06	.33	4.64	120.9
C_6	-13.77	-.07	20.56	0.5
C_7	-68.51	-.35	25.86	7.0
C_8	115.54	.81	18.18	40.4
C_9	2.93	.02	3.32	0.8
C_{10}	.57	.00	3.56	0.0
C_{11}	78.42	.48	6.16	161.9
C_{12}	17.36	.12	2.79	38.6
C_{13}	10.04	.07	3.15	10.2
C_{14}	94.90	.41	14.74	41.4
C_{15}	43.93	.35	5.53	63.1
C_{16}	-84.97	.25	22.37	14.4
C_{17}	86.38	.29	16.36	27.9
C_{18}	36.59	.23	5.39	46.1
C_{19}	-54.81	-.18	16.09	11.6
C_{20}	- 6.68	-.04	4.25	2.5
C_{21}	39.96	.27	4.55	77.3
Intercept	-163.76			