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I am submitting herewith a dissertation written by Joseph K. Semak entitled "Use of the Critical Incident Method in Developing An Instrument for Evaluating Students in Medical Laboratory Programs." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Education, with a major in Vocational-Technical Education.

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USE OF THE CRITICAL INCIDENT METHOD IN DEVELOPING AN INSTRUMENT FOR EVALUATING STUDENTS IN MEDICAL LABORATORY PROGRAMS

A Dissertation

Presented for the

Doctor of Education

Degree

The University of Tennessee, Knoxville

Joseph K. Semak

June 1979

ACKNOWLEDGMENTS

I wish to express my gratitude and appreciaiton to those who made this study become a reality. First and foremost I wish to thank my wife Virginia Mull Semak for her confidence and support as well as the many hours she spent typing and revising drafts. Secondly, I wish to thank my children Susan Marie, Joseph Andrew and Jud Semak for their patience, prayers and concern for an undertaking they did not understand.

Thanks are most certainly due to my Chairman Dr. Roger W. Haskell for his guidance and direction of the study and my Committee, Professor Joe L. Reed for his personal concern and support, Dr. C. M. Achilles for his insight and evaluation of technical detail, Dr. Robert K. Roney for his organizational ability, and Dr. Sandra W. Miller for her technical communication ability. Additionally, I wish to thank Don Broach, Applied Computer Analyst, of the University of Tennessee Computer Center, whose assistance save me many hours of work. Many others contributed to the completion of this study. I apologize for being unable to list them all.

ABSTRACT

Evaluation of the clinical performance of students is extremely important in all areas of the health field. The purpose of this study was to develop an instrument for evaluating students in the clinical portion of medical laboratory training. The reliability and validity of this instrument were established.

Data for the development of the instrument was obtained through response to mailed inquiry sent to 350 Program Directors/Educational Coordinators of Medical Technologist (MT), Medical Laboratory Technician (MLT)/Clinical Laboratory Assistant (CLA) Programs accredited by the American Medical Association. Thirty-four percent responded. These represented 37 states. The developed instrument was then utilized in five programs (two MT Programs, two MLT Programs and one CLA Program). The Program Director/Educational Coordinator and one instructor of each of the participating programs provided additional information relative to reliability and validity of the instrument.

The data for the development of the instrument was treated according to the approach recommended by Herbert and Attridge. Coefficients of observer agreement were calculated using Scott's Pi. Factor analysis was used to determine suitability of categories used. A least square

regression analysis was conducted to test the degree of relationship between subjective instructor evaluation and ratio of effective to ineffective observed incidents recommended by Whitlock for summative evaluation. It was found that the relationship of instructor rating and effective/ineffective ratio is based more on an agreement of importance and correct effective/ineffective classification than on the exact categorizing of the observed incidents. Further, the recording of effective and ineffective behavior of students during clinical practice could be used in an objective manner to assign grades.

Selected recommendations from the study were:

1. The present study should be refined and replicated in other selected vocational areas which have an internship, externship, practicum or co-op as an integral component of their educational program.

2. The perceptions of clinical faculty regarding their dual roles as staff technologists and educators should be statistically analyzed. The clinical/faculty member is the key person in clinical evaluation of students.

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CHAPTER I

INTRODUCTION

I. GENERAL INTRODUCTION

Students in training to be health care professionals obtain practical experiences related to their programs in one or more ways. These experiences may be (1) laboratory experience in a hospital-based, dental or other laboratory, (2) field experience in a State or local health agency, a community health center or hospital or a variety of other grass-roots locales; and/or (3) clinical experience involving patient care in a hospital (both inpatient and outpatient services), a private practice setting or other health care facility (Moore et al., 1972). Common use has designated this required practical experience as clinical experience.

Evaluation of both performance during the clinical experience and knowledge of subject matter is essential in the health field. Evaluation of clinical performance is more representative of the evaluation used to determine job success than is evaluation of performance in the subject matter area (Merson, 1975; Norman, 1976). It is, therefore, viewed as the more important dimension in the assessment of student learning (Litwack et al., 1972). Emphatically stated, "Evaluation of the learners' clinical practice is

a critical element in professional educational programs" (Reilly, 1975, p. 163).

Clinical performance includes knowledge, technical skills, interpersonal skills, and habits and attitudes as categories (Irby, 1975). It is a complex process which represents a composite of cognitive, affective, psychomotor and perceptual behaviors. Clinical performance involves the student's application of course content and the learning of skills. Furthermore, in clinical performance, learning to be a skilled practitioner is a cumulative process (Long, 1976; Rines, 1963).

Evaluation in the clinical area is one of the most difficult tasks faced by health educators. Variability of the clinical experiences adds to the difficulty of evaluating the clinical performance of a student (Mays, 1973). Faculty ratings of student clinical performances are generally contaminated by errors; they often have a low overall reliability and validity (Herzberg et al., 1960). Although evaluative judgments are the basis for important decisions, they are far too often based on hunches, impressions, rumors, and even prejudices (Wilhelms, 1967). As a consequence of the failure of ratings of clinical performance to provide at least reliable results, the whole area of performance evaluation comes into disrepute (Herzberg et al., 1960). Recently the courts have challenged the use of teacher or

institution-prepared tests where the use of such tests has an important impact on an individual's future (Tractenberg & Jacoby, 1977). Although these tests have been challenged in the elementary grades, the point is well taken by all who are involved in doing any level of student evaluation. An educational problem can become a legal one.

There is a need to improve the clinical evaluation of students (Wilson, 1976). Kern and Mickelson (1971) state:

> The objective evaluation of clinical experience is always a matter of difficulty whatever the profession. . . . Supervisors of clinical experience have long felt the need for an evaluative procedure which is valid, reliable, practical to administer, and yields data which permit the evaluation of the student and the professional program designed to prepare him. (p. 540)

Evaluation in terms of behavioral objectives has been encouraged for 40 years. More recently, evaluation based on observable, measurable behavior change has been used (Hecht, 1974). Identifying the most important behaviors which are critical and basing evaluation on them are of special import. Wood (1972) observes:

> In this situation [clinical experience] the student is learning behavioral more than intellectual skills. Achievement of clinical experience objectives is poorly measured by written or oral tests. (p. 336)

Some tools that have been used for evaluation are rating scales, checklists, critical incidents and simulation. Attempts have been made to use these singly and in combination

(Graham, 1971). Rating scales and checklists are difficult to design because of the difficulty of identifying useful criteria to compose the scales or lists (Ebel, 1970). Simulation on the other hand is considerably complex and expensive to use. Furst (1958) notes:

> Natural situations often have the advantage of revealing directly the behavior in question and so are to be preferred to less direct approaches. By preserving the real-life complexity of the situation, they are less likely to distort the behavior under observation and hence are more likely to get at the real thing. (p. 196)

The critical incident technique uses direct observation in natural situations. It has served successfully as a means of developing performance criteria for a wide variety of tasks including those of Air Corps officers, air route traffic controllers, government research personnel, teachers, dentists, nurses, industrial hourly workers, industrial supervisors, bookkeepers, life insurance agency heads and sales clerks (Herzberg et al., 1960).

II. STATEMENT OF THE PROBLEM

Although nursing, medicine, dentistry and physical therapy have made advances in the area of clinical evaluation, the medical laboratory has yet to produce much advancement in this vital area. No valid and reliable instrument could be found for the evaluation of medical laboratory students during the clinical experience portion of their professional education.

III. PURPOSE OF THE STUDY

Evaluation of the clinical performance of students is extremely important in all areas of the health field including the medical laboratory. Observation instruments based on critical incidents and utilized in a natural setting are an effective means of approaching clinical evaluation. The potential of such a systematic observation instrument for usefulness in educational training is enormous. Reliability and validity are as important for observation instruments as for any other kind of measure, but are more difficult to accomplish (Anderson et al., 1975).

The purpose of this study was to develop an instrument for evaluating students in the clinical portion of medical laboratory training. The reliability and validity of this instrument were established.

IV. RESEARCH OBJECTIVES

The primary objective was to develop an instrument for evaluating students in the clinical portion of medical laboratory training. In order to accomplish this, the following enabling objectives were established:

1. Identification of types of behavior which were to be designated as successful and unsuccessful when exhibited by medical laboratory students during their clinical training.

2. Use of this information to prepare an instrument which could be used to evaluate medical laboratory students during their clinical training.

3. Establishment of the validity and reliability of this instrument.

4. Comparisons of the importance and organization of subcategories of the developed instrument with a rating of items derived from these subcategories.

5. Determination if, and to what extent, there was a relationship between the subjective instructor grading and the ratio of effective to ineffective behaviors noted using the developed instrument.

V. ASSUMPTIONS

It was assumed that observers were honest and that critical incidents could be remembered for at least one month. Further, it was assumed that recalled incidents could be relied on to provide adequate data for satisfactory first approximation of critical incidents (Flanagan, 1954).

It was also assumed that medical laboratory instructional personnel could provide a medical laboratory profession orientation to value judgments. Most health professionals who become educators retain their original medical orientations.

It was further assumed that the psychophysical law described the relationship between the natural logarithm of the ratio value of effective to ineffective incidents observed of students while in clinical practice (LN-ratio) and the mean subjective score assigned to the student's performance by clinical instructors (LN-score). The natural logarithm of the intercept is represented by LN. The formula representing the relationship is: LN (score value) = LN + LN (ratio) (Whitlock, 1963). Additionally, it was assumed that there was no difference in results using performance specimens or critical incidents (Bostock, 1964; Gootnick, 1971). Lastly it was assumed that categories for organizing critical incidents could be derived from the literature (Addersson & Nilsson, 1964).

VI. SCOPE AND LIMITATIONS

A stratified convenience sample was used for trial of the instrument. This sample was limited to two Medical Laboratory Technologist Programs, two Medical Laboratory Technician Programs and two Certified Laboratory Assistant Programs. These represented a variety of settings.

VII. DEFINITION OF TERMS

For the purpose of the study, the following terms were defined:

Clinical Laboratory Assistant (CLA)

A Clinical Laboratory Assistant is a medical laboratory worker who performs routine uncomplicated tests in the clinical laboratory. This worker must be able to use common instruments and requires the direction of a qualified physician and/or medical technologist.

Clinical Training

Clinical training is a structured clinical laboratory experience in a hospital-based laboratory conducted as part of an educational program for the professional preparation of medical laboratory personnel.

Critical Incident

A critical incident is an incident occurring in a situation where the purpose or intent of the act seems fairly clear to the observer and where its consequences are sufficiently definite to leave little doubt concerning its effects.

Effective Incident

An effective incident is an incident viewed as positive, helpful or desirable by the rater.

Incident

An incident is any observable human activity that is sufficiently complete in itself to permit inferences and predictions to be made about the person performing the act.

Ineffective Incident

An ineffective incident is an incident viewed as negative, harmful or undesirable by a rater.

Medical Laboratory Technician (MLT)

A Medical Laboratory Technician is a medical laboratory worker who performs all of the routine tests in the clinical laboratory. This worker must be able to correct errors by use of preset strategies, monitor quality control programs within predetermined parameters, maintain instruments and be capable of working under minimum supervision.

Medical Technologist (MT)

A Medical Technologist is a medical laboratory worker who performs or supervises all tests in the clinical laboratory. This worker must be able to correct errors, establish quality control programs, design or modify procedures and be capable of independent action.

Performance Specimen

A performance specimen is an incident of relevant performance which is uncommonly effective or uncommonly ineffective.

Psychophysical Law

The psychophysical law is a law which states that apparent or subjective magnitude grows as a power function of sensory stimulus intensity. It is mathematically stated: $Y = kx^n$, where x is the number of specimens observed; y is

the results of evaluations of performance; k is a constant depending on units of measure used; n is the natural logarithm exponent.

Psychophysics

Psychophysics is a branch of psychology concerned with the relationship between physical and psychological magnitudes.

VIII. IMPORTANCE OF THE STUDY

The development of a valid and reliable observational instrument for the evaluation of medical laboratory students during their clinical training will provide a mechanism for assessing student progress and providing feedback to students. This feedback is helpful in enabling students to maintain their strengths and eliminate their weaknesses, thus preparing them to become more competent professionals. Such an instrument can assist in assigning grades. Evaluation of clinical experiences across programs will be possible on an objective basis. Another use of the results of this study will be the development of a process which could serve as a model for the development of similar instruments in other professions which have a clinical component.

IX. NATURE AND SOURCES OF DATA

An updated list of accredited educational programs for medical technologists (MT), medical laboratory technicians

(MLT) and certified laboratory assistants (CLA) was obtained from the Department of Allied Health Evaluation, Division of Educational Standards and Evaluation, American Medical Association. This list was an updated list of that published in the Allied Medical Education Directory, 6th Edition (undated) and the brochure entitled Education for Allied Health Careers, and was current as of November 28, 1977. The list contained 656 Medical Technologist, 66 Medical Laboratory Technician, and 127 Certified Laboratory Assistant Programs. A random stratified sample (with replacement) of programs was drawn. The Program Directors/Educational Coordinators supplied the critical incidents used to develop the instrument. The sample consisted of 270 Medical Technologist, 26 Medical Laboratory Technician and 54 Certified Laboratory Assistant Programs (See Chapter III, Methodology, p. 33 - 40).

The trial of the instrument was conducted in two Medical Technologist Programs, two Medical Laboratory Technician, and two Certified Laboratory Technician Programs. These represented a variety of geographical settings (See Chapter III, Methodology, p. 33).

X. ORGANIZATION OF THE STUDY

The study consists of five chapters. The following chapter format was used:

Chapter I - Introduction.

Chapter II - Review of related literature and research.

Chapter III - Methodology.

Chapter IV - Analysis of data.

Chapter V - Summary, findings, conclusions, and recommendations.

CHAPTER II

REVIEW OF RELATED LITERATURE AND RESEARCH

I. INTRODUCTION

The purpose of this study was to develop an instrument for evaluating students in the clinical portion of medical laboratory training and to establish the reliability and validity of this instrument. This chapter presents a review of related literature and research which concentrates on evaluation studies which have placed emphasis on the critical incident technique. The three basic areas pertinent to this study are: (1) critical incident technique, (2) reliability and validity of systematic observation instruments and (3) summative evaluation.

The first part of the chapter presents information and methods related to the use of the critical incident technique. Literature dealing with the critical incident technique is essential since it is the method used in this study for the development of an evaluative instrument. Literature and studies not directly related to the critical incident technique but pertinent to clinical evaluation in the health field are also included. The second section presents literature pertaining to reliability and validity of systematic observation instruments to help clarify the

the expectations of reliability and validity for such instruments. The last section focuses on summative evaluation. Since grade assignment is a major concern, it was important to review this latter section to understand the relationship of observation and gross evaluation judgment.

II. CRITICAL INCIDENT TECHNIQUE

The critical incident technique is an outgrowth of studies conducted in the Aviation Psychology Program of the United States Army Air Forces in World War II. It was used in 1941 to develop procedures for selection and classification of aircrews. Since then its application has grown to include measures of typical performance (criteria), measures of proficiency (standard samples), training and others (Flanagan, 1954). It has been used to determine the critical elements for the development of the Clinical Performance Examination for nursing used by the New York Board of Regents in its external degree program (Lenburg, 1976).

The procedure for using the critical incident technique has four main steps. Step one, General Aims, is a brief authoritative statement of simply stated objectives with which most people in the field would agree. Step two, Plans and Specifications, is a definitive statement of the place, persons, conditions, and activities to be observed; the relevance of these to the general aim; the criticalness

of an observation, i.e. that which makes a significant contribution positively or negatively to the general aim of the activity; and, the persons to make the observation. Step three is the Collection of the Data. Step four, Analysis of Data, is the formulation of categories within a frame of reference to include general behaviors (Fivars & Gosnell, 1966; Flanagan, 1954).

In a critique of the use of the critical incident technique, Burns (1956) maintained that as a technique it cannot and does not evaluate or provide the criteria for evaluation. He stated:

> The assignment of value of course, necessarily presupposes that the criteria of value already exist in our concepts; thus, when we say a certain behavior is successful or unsuccessful, we are not so much describing the behavior as we are comparing the behavior against our preexisting criteria of success and then issuing a report that the behavior under observation fulfills the demands of our criteria. This is quite evidently a value-judgment. (p. 74)

Flanagan (1947) himself recognized the value question. He stated:

> . . . scientific procedures cannot be used to establish values. Society and the individual must decide on the nature of the activities for which the individual is to be trained and they must also define the type of behavior which is to be designated as 'successful' with respect to that activity.
>
> Educational objectives must be developed in the community and cooperatively with commercial, industrial and governmental organizations. (p. 140-141)

It appears that Burns missed the point; it is not that the technique is inappropriate for determining criteria for evaluation, but that the value judgment is supplied by the observer in the initial gathering of the data. Selection and training of the observer then become of extreme importance.

The supervisor is in the position to be the most competent judge of the effectiveness of the worker's performance under his/her supervision (Flanagan, 1952). A successful study reported by Nagay used personnel of the Civil Aeronautics Administration to collect critical incidents. They had no previous psychological training, but were collecting incidents in their own technical area (Flanagan, 1954). The results were as satisfactory as those obtained by using psychologists to obtain data in other studies. It appears that technical knowledge in the area of observation may be an adequate substitute for psychological training with respect to the effective collection of critical incidents.

Flanagan (1954) reported that if observers were motivated to observe detail at the time of an incident, memory was reliable for recent incidents. These recalled incidents provided adequate data for defining the universe of critical incidents relative to a given area. Hardin (1954) indicated that reliability was higher if a report

was made soon after the occurrence of an incident. In another study research workers were found to remember important actions of their assistants quite well for as long as a month (Flanagan, 1952). Time evidently is a factor, but a number of variables precludes placing a definitive cutoff for using recalled incidents.

In collecting critical incident data, single interview, group interview and questionnaires have been among the techniques used. The questionnaire enables the researcher to utilize a wider geographic sample. Kosy (1959) reported problems relating to the understanding of the instructions by the observer and his/her motivation to report incidents that are usable. Andersson and Nilsson (1964) studied reliability and validity of the critical incident technique and found that the data collected were not influenced by methods of collection. No significant difference was found whether single or group interview or questionnaire was used. The number of responses from questionnaires was lower (24 percent return) than that obtained by other methods.

> In situations where the observers are motivated to read the instructions carefully and answer conscientiously, this technique (questionnaire) seems to give results which are not essentially different from those obtained by the interview method. (Flanagan, 1954, p. 343)

Weislogel (1951) used the questionnaire technique successfully in a study of Life Insurance Agency Heads. His

questionnaire contained brief background information, space for writing incidents and instructions to include (a) specific circumstance or situation, (b) behavior of person being evaluated; (c) if behavior was outstanding, why; or, (d) if behavior was ineffective, what should have been done.

Category formulation is apparently one of the problems in successfully using the critical incident technique. Fivars and Gosnell (1966) and Barnes (1960) recommended help from experts in the development of classifications. Kessel (1956) analyzed 50 incidents in his study of the requirements for secondary school business teachers. From these 50 incidents, he formed tentative categories that were well defined and nonoverlapping. These categories adequately represented the universe of critical incidents submitted. Flanagan (1954) recommended submitting tentative categories to others for review. This procedure was followed by Calhoun (1960).

In a study of staff nursing behaviors, 2,065 incidents were collected. After 1,480 were classified, no new categories were needed (Gorham, 1962). Andersson and Nilsson (1964) found that after two-thirds of their 1,846 critical incidents were classified, 95 percent of all subcategories appeared. The total number of incidents is consistent with Flanagan's (1954) observation that for semiskilled and skilled jobs between 1,000 and 2,000 incidents seem to cover

the critical behaviors. Adequate coverage has been achieved when the addition of 100 critical incidents to the sample adds only two or three critical behaviors (Flanagan, 1954; Weinstein, 1975). This is the criterion generally used to determine the adequacy of incident collection. A consistency or reliability check by two independent judges after the final categories are arrived at is recommended (Barnes, 1960; Gorham, 1961; Jung, 1971; Kessel, 1956; Kosy, 1959).

Classification is a problem because of its subjective nature. A number of valid approaches to classification organization can often be used. Therefore, the rationale for a particular approach should be developed (Corbally, 1956). The number of categories into which behaviors are to be coded should not be too large. Few studies have used more than 10 (Medley & Mitzel, 1963; Symonds, 1951). The subjective nature of classification and the necessity of using a limited number of categories are part of the reason for the difficulty in developing a single-category system.

A caution is offered by Blum and Fitzpatrick (1965) on category formation. The use of simple interpretation on incident frequency in category formation must be resisted since all relevant sampling variances are not usually controlled in a study (Blum & Fitzpatrick, 1965).

Many researchers using the critical incident technique have identified the salient feature in the behaviors reported

and derived a rough classification scheme to facilitate the ordering of data. This is identical with the procedure recommended by Jansen (1960) for category formulation. In an analysis of the contents of company training literature Andersson and Nilsson (1965) found that the contents of this literature served to identify categories of critical incidents which were consistent with categories derived by other methods. It seems possible that tentative categories might be taken from the literature. Categories for evaluation of bench skills of medical laboratory workers were developed by clinical instructors. In reporting these categories Anna (1977) listed major subheadings as clerical, technical procedural, technical observation, technical reporting, technical judgment, and technical care. In evaluating behavior traits of medical technology students, Bobek (1972) used the categories of technical competence, knowledge and personal attributes or qualities and behavioral traits. The latter contained subcategories of initiative, cooperation, ability to deal with patients, and professional relationships (Bobek, 1972).

In a factor analytic study of criteria for evaluating student clinicians in speech pathology, two dimensions were observed; they were technical skills and interpersonal relationship factors and had a total of 18 variables. This study was designed to determine significant criteria used

in university training programs to evaluate student clinicians enrolled in clinical practice. A total of 152 supervisors in 53 American Speech and Hearing Association (ASHA) programs used 40 criteria to evaluate 207 clinicians engaged in speech and language therapy. The criteria were obtained from 25 programs which were randomly selected from a list of all ASHA approved programs (Oration, 1976).

Technical skills and interpersonal relations were again two main categories used in evaluating radiological students. These categories were determined from evaluation forms commonly used in radiologic training programs (Gurley & Blair, 1975).

A Veteran's Administration pamphlet on Evaluation and Performance contains the following statement:

> Performance requirements describe the quantity, quality, timeliness, and the manner of performance necessary to accomplish a job satisfactorily. (Government Publication, 1966, p. 8)

The elements noted in this pamphlet plus the common major categories of technical skills and interpersonal relationships noted in other studies appear to offer a guide for possible categories and subcategories of behavior.

There is a distinct lack of information on trial usage of developed critical incident instruments for evaluation purposes. Sims (1976) reported that previous studies using the critical incident technique in nursing

tended to concentrate on single hospitals. He surmised that a great deal of contact between staff and researchers is required to gain commitment to use the critical instrument technique. Only one study was found involving health professionals which used a critical incident evaluation instrument. The subjects in that study were nursing students. The researchers reported that ideally there should be observations of many students by many instructors (Flanagan, Gosnell & Fivars, 1963). Since there is variability of experience in the clinical training of allied health students, there is added difficulty in evaluating their clinical performance. Multiple observations by many instructors do appear advisable although the difficulties of achieving this in actual practice must be recognized. The need for multiple observations by multiple observers was also noted by Mays (1973) in evaluating physical therapy students. Mays further emphasized that raters need to apply the same standards in order to pool ratings.

A Performance Record Program was developed in the Delco-Remy Division of General Motors using the critical incident technique. In a trial of this instrument, about one-fourth of the employees evaluated had neither effective nor ineffective incidents recorded. The work of these employees was viewed as satisfactory (Flanagan & Burns, 1955). The absence of entries in a given category with sustained

observation for several weeks is sufficient to show that a student is neither outstanding nor unsatisfactory in this category (Flanagan et al., 1976).

III. RELIABILITY AND VALIDITY OF SYSTEMATIC OBSERVATION INSTRUMENTS

Observable criteria are necessary for evaluation of professional training. A recent nursing graduate reflected:

> Many student nurses believe that all that is important is to score the pass mark in any examination be it written or practical. They give little or no thought to other aspects of their assessment which make for the production of an acceptable useful member of the profession. (Umuna, 1975, p. 29)

How is one to determine the acceptable, useful member of the profession? Ladd (1977) provided some insight:

> The best evaluation of the resident consists of the day-to-day observation of how he handles the problems presented to him and whether or not he is able to develop successful professional relationships with physicians involved in direct patient care. (p. 16)

The development of criterion-referenced tests is based on the assumption that the behavior domain which the test is to represent can be explicitly defined. In a paper presented at the National Conference for Evaluating Competence in the Health Professions, Loveland (1976) pointed out that when the behavior domain is complex, very extensive, or not easily subject to explicit definition, the task is indeed formidable.

Performance tests assess complex behaviors in realistic situations. This type of assessment has impressive face validity and credibility in occupational programs because it generally relates very closely to a job situation (Erickson & Wentling, 1976). Whitlock (1960) goes even further: "The use of the term validity with respect to a criterion measure is inappropriate: the proper term is relevance" (p. 4). The relevance of a criterion measure refers to the amount of systematic variance common to the criterion measure and the ultimate criterion (Anderson, 1975; Fitzpatrick & Morrison, 1971; Whitlock, 1960). Since this ultimate criterion is almost never available, the question of relevance is one of judgment (Herbert & Attridge, 1975; Whitlock, 1960). However, the instrument items must be as low in the degree of observer inference required as the complexity of behavior under study will permit (Herbert & Attridge, 1975). In contrast Medley and Mitzel (1963) viewed the validity of measurements of behavior as depending on fulfilling three conditions: (1) a representative sample of the behaviors to be measured must be observed, (2) an accurate record of the observed behaviors must be obtained, and (3) the records must be so scored as to reflect faithfully differences in behavior.

If one accepts the former view that validity (relevance) refers to the amount of systematic variance common to the

criterion measure, then the critical incident possesses validity itself. Further, if it proves comparable to scales logically derived, it establishes their validity as well. The collections of critical incidents provide a realistic basis for the evaluation technique. Although not a measuring instrument, they may be used in check sheets or rating scales (Mayhew, 1956).

A major problem appears to be the difficulty in verifying the reliability of the critical incident instrument. Reliability is always a measure of consistency. In systematic observation one must be concerned not only with the consistency of recording of data within and among observers, but also with the stability of the behavior being recorded (Anderson, 1975). Thorndike stated:

> The reliability of observation of behavior is influenced by preciseness of definition of the behavior to be observed, the simplicity of the behavior, the degree to which the behavior is overt, the amount of aid provided by instruments, and the extent of the opportunities for observing the behavior. Efforts to improve the reliability of observation should be directed at these factors. (Thorndike, 1949, p. 129)

While Thorndike stressed the qualities of an instrument, Medley and Mitzel (1963) stressed the qualities of the observer.

The most stringent definition of reliability in classroom observation is based on the concept that the

mean differences of repeated measures obtained within classrooms will be smaller than the mean differences between and among classrooms (Anderson, 1975; Medley & Mitzel, 1963). Medley and Mitzel (1963) maintained that (1) a coefficient of observer agreement, the correlation between the scores of different observers made at the same time, told something about the objectivity of an observational technique; (2) the stability coefficient, the correlation between scores made by the same observer at different times, indicated the consistency of the behavior from time to time; and (3) the reliability coefficient, the correlation between scores based on observations made by different observers at different times, suggested accuracy of measurements. Anderson noted that consistency of recording and consistency of behavior both enter into such a reliability measure, which may be derived from a repeated-measures analysis of variance. However, few investigators have reported such data, most choosing instead to report a measure of observer agreement (Anderson, 1975). This practice was noted in the report of Jung (1974) using the critical incident technique for evaluating a program for learning in accordance with need, and Keys (1964) using a modified critical incident technique to evaluate performance of nurses in a hospital.

On the other hand, Stanley (1971) pointed out that criterion-reference measures are not intended to discriminate

among persons, but to discriminate each person's score from a fixed score. Thus, criterion-referenced tests can give reliable information even though the classically defined reliability coefficient of these tests equal zero. Such measuring instruments involve logical and empirical as well as statistical operations (Stanley, 1971). Thorndike (1949) noted that because of the numerous factors involved in the observation of behaviors in complex job situations, the reliability of objective scores obtained may be quite low. He viewed this problem as quite critical for this type of criterion. Whitlock (1960) stated:

> The fundamental consideration in criterion development is relevance and the other important consideration is reliability. In any criterion measure where relevance is accepted, the best mathematical expression of its validity is its reliability coefficient. (p. 4)

Fitzpatrick and Morrison (1971), however, observed that:

> It generally would be agreed by those with experience in the matter that the more closely one tries to simulate a real criterion situation the less reliable will be one's measurement of the performance. The dilemma of simulation is that increasing fidelity and comprehensiveness appear at least in a general way to be associated, on the other hand, with decreasing control and thus reliability. (p. 240)

They further noted that if reliability becomes extreme, the relevance i.e., close to actual job performance, is illusory since it cannot be measured. Relevance, reliability and cost must be weighed. Relevance, however, is the prime

means to the end of appropriate evaluation (Fitzpatrick & Morrison, 1971).

A different approach to reliability of observational measures was taken by Herbert and Attridge (1975). They stated:

> . . . reliability, in the measurement-theoretic sense, is a property of measures obtained through the application of a system, not a property of an instrument, nor of a system, nor of a record, nor of observers, though qualitites of each of these constrain the reliability of measures obtained. (p. 14)

They did not ignore the more traditional approaches of establishing reliability. They recommended that the report of an observational instrument contain a discussion of which reliability measures were selected and why. Potential users of a system or instrument could then decide for themselves the reliability of the scores obtained and make decisions about its value for them (Herbert & Attridge, 1975).

IV. SUMMATIVE EVALUATION

The clinical experience record for nursing students was developed by Flanagan, Machese and Tuska (1960) and was based on the critical incident technique. The developers indicated that it was not intended as a rating instrument. It was described as a formative evaluation instrument concered with student development. HEW Secretary Joseph A. Califano noted:

> Even the best programs of basic skills testing will be worthless - unless we connect them with programs designed to remedy the shortcomings and capitalize on the achievements test uncover. (American Council on Education, 1977, p. 4)

The clinical experience record basically provides the mechanism to address the concerns Secretary Califano voiced. Jarrett (1977), however, addressed a continuing concern:

> Unfortunately, we still think of exams more as devices for reward and punishment than as diagnosis in the interest of continuing education. (p. 237)

The same probably holds true for observational evaluation. There is still a felt need to assign a grade. As Scriven (1974) noted ". . . good formative evaluation normally involves giving the best possible simulation of a summative evaluation" (p. 9). Flanagan (1952) admitted that with the critical incident instrument a summary is necessary and the simplest type numerical score is preferred whenever appropriate. The simplest method of obtaining a final score for each individual consists of computing the difference between the number of effective and ineffective behaviors exhibited. However, a profile of scores has actually proved more useful (Weislogel & Schwarz, 1955).

A more useful approach to determining a final score has been defined. Stevens (1960) observed:

> On more than a score of sensory continuum it has now been shown that apparent, or subjective magnitude grows as a power function of stimulus intensity. . . . (p. 227)

On this premise Whitlock (1963) examined evaluations based on observation of performance specimens: i.e., incidents of relevant performance which at the time of observation were classed as uncommonly effective or ineffective. He found that this psychophysical law ($Y = K X$) described the relationship between the number of specimens observed (X) and the resulting evaluations of performance (Y). Further, it has been established that customary correlation procedures were appropriate if both the observation values and the evaluation values were converted to logarithms (Whitlock, 1963). Thus, in the performance area, the stimulus is the observation of performance specimens and the response is an overall evaluation of performance. The response magnitudes may be recorded on any of a number of evaluative continua such as poor to excellent or A to F (Whitlock, 1967).

The psychophysical law was found to define the relationship between the observation of performance specimens and the formation of gross evaluation judgments in the area of department chairman evaluation in secondary schools (Gootnick, 1971). Similarly, it defined the relationship between the ratio of effective to ineffective performance specimens and supervisor ratings in the area of machining personnel evaluation (Bostock, 1964). Gootnick (1971) used a modified critical incident technique in his study.

Bostock (1964) found that there was no significant difference when he adjusted his sample from performance specimens to simple critical incidents.

Rating studies have been conducted involving a large number of apprentice linemen, industrial executives, first-line supervisors and classroom teachers. In each case the stimulus values (effective/ineffective ratio) were related to the subjective ratings by a power function. The average rating made by nursing supervisors in evaluating 124 nurses in a hospital was consistent with their recorded observations (Whitlock, 1967). Thus, it appears that this technique could be used together with a critical incident evaluation form for assigning grades in clinical evaluation of students in health professions.

V. SUMMARY

Studies have used the critical incident technique or have addressed various aspects related to using this technique. Few studies have addressed implementation of an instrument developed by using this technique or the establishment of reliability and validity of systematic observation instruments. There are, however, numerous writings on the establishment of reliability and validity of systematic observational instruments. Several studies based on the psychophysical law show the relationship between

observation of performance and the formation of evaluative judgments.

The first section of this review discussed the critical incident technique. This technique has four main steps: (1) a statement of objectives which have general professional acceptance, (2) a statement of the place, persons, conditions, and activities to be observed, (3) collection of data, and (4) formulation of categories in which to classify observed behaviors. The literature review indicated that the collection of data was subjected to the greatest variety of approaches. Instrument trial appears to be the area least addressed in studies and consequently is least reported in the literature.

The second section of the review focused on reliability and validity of systematic observation instruments. The literature emphasized the inverse relationship between relevance and reliability.

The final section of the review concentrated on the psychophysical law and its relationship to evaluation. Research in this area has been conducted with a variety of groups.

CHAPTER III

METHODOLOGY

The purpose of this study was to develop and establish the reliability and validity of an instrument for evaluating students in the clinical portion of medical laboratory training. This chapter presents the methodology of the study. There are two sections. Section one, Development of the Instrument, covers the following topics: the sample, instrument, data collection, treatment of data, and summary. Section two, Trial of the Instrument, covers the following topics: the sample, instrument instructions, data collection, treatment of data, and summary.

I. DEVELOPMENT OF THE INSTRUMENT

The development of the instrument involved gathering of incidents which medical laboratory students had performed while participating in clinical training. An incident was considered admissible if the observer judged that it made a significant positive or negative contribution to the student's advancement as a developing professional. The elements of the instrument development follow.

A. The Sample. The criteria for selecting the sample used in the study centered on medical laboratory educational programs accredited by the American Medical Association and

its collaborating medical specialty and allied health organizations. An update of the list of such programs as published in the Allied Medical Education Directory 6th Edition and the brochure entitled, Education for Allied Health Careers were obtained from Department of Allied Health Evaluation, Division of Educational Standards and Evaluation, American Medical Association. These lists included 656 Medical Technologist Programs (MT), 66 Medical Laboratory Technician Programs (MLT), and 127 Clinical Laboratory Assistant Programs (CLA). For the purpose of the study, the researcher considered MLT & CLA Programs as one category for several reasons. First, the trend nationally is to consider only two levels of medical laboratory workers, technicians and technologists. Second, several CLA Programs were in the process or had completed the conversion to MLT Programs. Third, the number of CLA and MLT Programs was small when compared individually to the number of MT Programs.

Based on the literature (e.g. Flanagan, 1954; Weinstein, 1975), the researcher decided that sufficient data would be collected when the addition of 100 critical incidents to the sample added only two or three new critical behaviors. This would permit the use of the empirical stability test (Parten, 1966). However, in order to arrive at a properly drawn and arrived at sample, the researcher decided to

use a random stratified sample (with replacement) of programs totaling 350. This sample selection procedure was based on the work of Burstein (1971) and Parten (1966) and statistically significant at the 95 percent confidence level. This resulted in a sample of 270 MT Programs and 80 combined MLT and CLA Programs selected from a table of random numbers.

B. The Instrument. An initial inquiry requesting incidents (Appendix A) was developed in order to gather the data relative to critical behavior of medical laboratory students (Finkle, 1950). The inquiry contained a letter of support from the Assistant Director of the Department of Allied Health Evaluation, Division of Educational Standards and Evaluation, American Medical Association, brief background information and instructions for submitting incidents. The instructions requested (1) the reporting of specific circumstance or situation, (2) the actions of the student involved and an explanation of why the incident was outstanding, if effective, or (3) an explanation of what should have been done, if ineffective.

C. Data Collection. Inquiries (Appendix A) requesting three effective and three ineffective incidents were sent to 350 Program Directors. Based on the initial response, a form was developed for gathering samples of effective and ineffective incidents (Appendix B). Examples of the requested information were also provided along with a promise to

provide a copy of the developed instrument upon completion of the study. The second inquiry was sent by mail to Program Directors/Educational Coordinators of the original 350 programs approximately four weeks later. In this inquiry the respondents were asked to identify only one effective and one ineffective incident.

D. Treatment of Data. The salient features of the reported behavior of each complete critical incident received were analyzed and recorded. The first 50 incidents were classified according to a tentative category list suggested from the literature (Anna, 1977; Bobek, 1972; Oration, 1976; Gurley & Blair, 1975; Government publication, 1966). The resulting classification was revised and all incidents classified until no more than two or three new critical behaviors appeared per hundred incidents. An observational instrument was developed from this classification. (Appendix C).

E. Summary. An explanation of the procedure involved in developing the instrument was the main purpose of Section I, Chapter III. Critical incidents were collected from program directors and educational coordinators of AMA accredited MT, MLT and CLA programs by mail survey. The collected incidents were categorized and developed into an observational instrument.

II. TRIAL OF THE INSTRUMENT

Previous use of critical incident instruments tended to concentrate on single institutions. This study attempted to increase the generalizability of the instrument by using multiple institutions at different levels and in several differing geographic locations. The lack of information in the literature on trial usage of developed critical incident instruments for evaluation purposes precluded any prescriptive course of action. The literature, however, did note the necessity of commitment on the part of the staff in using such an instrument (Sims, 1976).

A. The Sample. A stratified convenience sample was used for trial of the instrument. This sample consisted of six programs: two Medical Technologist Programs (MT), one in Alabama and one in Georgia; two Medical Laboratory Technician Programs (MLT), one in Georgia and one in Tennessee; and two Certified Laboratory Assistant Programs (CLA), one in North Carolina and one in Tennessee. Selection was based on reasonable travel distance for the researcher and an interest in the instrument which Program Directors/ Educational Coordinators indicated in unsolicited correspondence.

B. The Instrument Instructions. Faculty members at the researcher's institution evaluated the clarity of the

instrument instructions. Instructions were then modified to insure ease of utilization of the developed instrument by clinical faculty.

C. Data Collection. Three of the six cooperating programs were visited. The researcher met with the faculty of each of these programs and discussed the instructions and the instrument. The faculty indicated the written instructions were clear. No problems were evident from the discussion. The remaining programs were contacted by mail through the Program Director/Educational Coordinator. The initial contact of all programs was followed up by telephone approximately one week later to insure an understanding of the requirement and to verify the progress being made.

Each Program Director/Educational Coordinator of the cooperating programs was provided with evaluation forms (Appendix C) and instructions for using the observational instrument (Appendix D). Each Program Director/Educational Coordinator was requested to have at least two clinical instructors use the instrument to evaluate each student over a three to six week period (Appendix E). As part of the evaluation each Program Director/Educational Coordinator was requested to have the clinical instructors rate the student on a five-point grading scale: Excellent (A), Above Average (B), Average (C), Below Average (D), and Poor (F), using their current system for evaluation.

Each Program Director/Educaitonal Coordinator plus one additional instructor in the program was provided a set of 50 critical incidents to classify according to the system used in the instrument. The incidents provided were selected at random from positive and negative incidents received during the formulation of the instrument. Half of the incidents were selected from positive incidents and half were selected from negative incidents. These positive and negative incidents were used to determine rater agreement. The Program Directors/Educational Coordinators and instructors were also asked to rate positive and negative items derived from the instrument classification system on a five-point scale on the basis of their importance to student development (Appendix E). This information was used to determine actual importance of items and was subjected to factor analysis for comparison with categories and subcategories on the developed instrument.

A least squares regression analysis was conducted to test the degree of relationship between the five point instructor rating and the effective incident to ineffective incident ratio. The fit assumed the model LN (score value) = LN + LN (ratio value). LN (score value) is the natural logarithm of 4-0 (A, B, C, D, F) subjective ratings of students by clinical instructors. LN is the natural logarithm of the intercept in a straight line equation.

LN (rater value) is the natural logarithm of the effective versus ineffective incident ratio as determined by observation using the developed evaluation instrument.

The coefficient of observer agreements was calculated by a formula proposed by Scott (1955) and referred to by Medley and Mitzel (1963). The data used were supplied by the six Program Directors/Educational Coordinators and six instructors of cooperating programs classifying the 50 incidents provided them.

D. Treatment of Data. Factor analysis is a statistical technique used to determine correlation between responses to items and then to group these items into the number of groups specified by the researcher. Factor analysis was applied to ratings of items derived from the instrument classification system to determine the agreement of major categories derived by this analysis with the major categories of the classification used in the instrument.

E. Summary. An explanation of the procedure involved in the trial of the instrument was the main purpose of Section II, Chapter III. Data were collected from Program Directors/Educational Coordinators and clinical faculty of six AMA accredited programs. The data were analyzed by statistical methods.

CHAPTER IV

ANALYSIS OF DATA

The purpose of this study was to develop an instrument for evaluating students in the clinical portion of medical laboratory training and to establish the reliability and validity of this instrument. This chapter presents the analysis of data related to (1) development of the instrument, and (2) trial of the instrument, (3) observations ancillary to conducting the study, and (4) summary. Statistical procedures were used to describe and analyze the following enabling objectives of this study, which were:

1. Identification of types of behavior which were to be designated as successful and unsuccessful when exhibited by medical laboratory students during their clinical training.

2. Use of this information to prepare an instrument which could be used to evaluate medical laboratory students during their clinical training.

3. Establishment of the validity and reliability of this instrument.

4. Comparisons of the importance and degree of logical organization of subcategories of the developed instrument with a rating of items derived from these subcategories, and

5. Determination if, and to what extent, there was a relationship between the subjective instructor grading and

the ratio of effective to ineffective behaviors noted using the developed instrument. Each enabling objective will be restated immediately preceding the data analysis related to that objective.

I. DEVELOPMENT OF THE INSTRUMENT

The sample for this study consisted of 350 Program Officials. Clinical Coordinators/Program Directors of 80 Medical Laboratory Technician (MLT) and Clinical Laboratory Assistant (CLA) Programs and 270 Medical Technologist (MT) Programs made up the reference group from which responses were sought.

Table 1 represents the reference group of Clinical Coordinators/Program Directors of MLT/CLA and MT Programs and their response rate in providing critical incidents. Eighty Clinical Coordinator/Program Directors of CLA/MLT Programs were contacted and 31 (39 percent) responded. Similarly, 270 Clinical Coordinator/Program Directors of MT Programs were contacts; 87 (32 percent) responded. Thus of the 350 individuals who were contacted, 118 responded, in an overall return of 34 percent.

Table 2 represents the reference group of Clinical Coordinators/Program Directors of MLT/CLA and MT Programs selected and their response rate by geographic distribution in providing critical incidents. No MLT/CLA Programs were available for selection from Alaska, California, Hawaii,

TABLE 1

SAMPLE RESPONSE OF REFERENCE GROUP OF CLINICAL COORDINATORS/PROGRAM DIRECTORS CONTACTED TO PROVIDE CRITICAL INCIDENTS

Programs	Surveyed	Respondents	Percent Response
CLA/MLT	80	31	39
MT	270	87	32
TOTAL	350	118	34

TABLE 2

DISTRIBUTION OF RETURNS BY STATE OF REFERENCE GROUP OF CLINICAL COORDINATORS/PROGRAM DIRECTORS OF PROGRAMS SELECTED AND THEIR RESPONSE RATE IN PROVIDING CRITICAL INCIDENTS

	Surveyed			Responses			% Response		
STATE	MLT/CLA	MT	Total	MLT/CLA	MT	Total	% MLT/CLA	% MT	% Total
AL	0	7	7	0	3	3		43	43
AS	X	X	X	X	X	X	X	X	X
AZ	2	4	6	2	4	6	100	100	100
AK	4	6	10	3	2	5	75	33	50
CA	X	20	20	X	5	5	X	25	25
CO	1	6	7	1	3	4	100	50	57
CT	3	3	6	1	0	1	33	0	17
DE	1	1	2	1	0	1	100	0	50
FL	2	7	9	1	3	4	50	43	44
GA	5	5	10	3	3	6	60	60	60
HA	X	2	2	X	0	0	X	0	0
ID	X	1	1	X	0	0	X	0	0
IL	3	14	17	1	1	2	33	7	12
IN	3	9	12	1	5	6	33	56	50
IA	1	8	9	0	6	6	0	75	67
KS	0	1	1	0	1	1	--	100	100
KY	0	4	4	0	2	2	--	50	50
LA	X	6	6	X	0	0	X	0	0
ME	X	2	2	X	2	2	X	100	100
MD	1	4	5	1	2	3	100	50	60
MA	2	12	14	1	3	4	50	25	29
MI	2	10	12	0	3	3	0	30	25
MN	4	9	13	3	1	4	75	11	31
MS	0	4	4	0	1	1	--	25	25
MO	1	7	8	0	2	2	0	29	25
MT	0	1	1	0	1	1	--	100	100
NB	X	3	3	X	2	2	X	67	67
NV	X	0	0	X	0	0	X	--	--
NH	0	3	3	0	0	0	--	0	0
NJ	9	5	14	4	1	5	44	20	36
NM	0	1	1	0	0	0	--	0	0
NY	1	10	11	0	2	2	0	20	18
NC	4	6	10	1	1	2	25	17	20
ND	X	2	2	X	0	0	X	0	0
OH	5	21	26	1	4	5	20	19	19
OK	0	6	6	0	2	2	--	33	33
OR	1	1	2	0	0	0	0	0	0
PA	4	19	23	1	7	8	25	37	35
RI	X	4	4	X	1	1	X	25	25
SC	1	3	4	1	1	2	100	33	50
SD	4	0	4	2	0	2	50	--	50
TN	2	3	5	0	3	3	0	100	60
TX	4	14	18	0	3	3	0	21	17
UT	0	2	2	0	1	1	--	50	50
VA	5	4	9	0	0	0	0	0	0
VE	0	0	0	0	0	0	--	--	--
WA	X	2	2	X	1	1	X	50	50
WV	2	0	2	0	0	0	0	--	0
WI	3	7	10	2	3	5	67	43	50
WY	X	0	0	X	0	0	X	--	--
D.C.	0	1	1	0	0	0	--	0	0
MISC.		--	--		1				
TOTAL	80	270	350	31	87	118	39	32	34

X no programs available

O no programs selected

Idaho, Louisiana, Missouri, Nebraska, Nevada, North Dakota, Rhode Island, Washington and Wyoming. No MT programs were available for selection from Alaska. Of those available for selection and selected, no returns were received from Hawaii, Idaho, Louisiana, New Hampshire, New Mexico, North Dakota, Oregon, Virginia, West Virginia and Washington, D.C. No programs were selected from Nevada, Vermont and Wyoming. The rate of response varied from a low of 12 percent (Illinois) to a high of 100 percent (Arizona, Kansas, Missouri and Montana). The response rate from the more populous states was in general lower than that of less populous states. MLT/CLA Programs had a higher rate (39 percent) than MT Programs (32 percent).

Enabling Objective 1: Identification of types of behavior which were to be designated as successful and unsuccessful when exhibited by medical laboratory students during their clinical training.

Enabling Objective 2: Use of this information to prepare an instrument which could be used to evaluate medical laboratory students during their clinical training.

Table 3 reports the distribution of incidents obtained from respondents as classified according to the observational instrument developed from these categories. All

TABLE 3

DISTRIBUTION OF INCIDENTS COLLECTED AND CATEGORIZED ACCORDING TO THE DEVELOPED INSTRUMENT

Abbreviated Incident Categories	Effective actual no. reported			Ineffective actual no. reported			Effective as % of column			Ineffective as % of column		
	MLT/CLA	MT	Total	MLT/CLA	MT	Total	MLT/CLA	MT	Total	MLT/CLA	MT	Total
I. Technical, Performance, Observation & Reporting	12	47	59	21	59	80	40	36	37	72	51	56
Inconsistent Lab Results	6	22	28	6	10	16	20	17	18	21	9	11
Unexpected Test Values	2	15	17	1	7	8	7	12	11	3	6	6
Procedure	2	5	7	6	25	31	17	4	4	21	22	22
Error	2	5	7	8	17	25	7	4	4	28	15	17
II. Dependability and Adaptability	15	81	96	5	47	52	50	62	60	17	41	36
Extra Duties	15	55	70	2	27	29	50	42	44	7	23	20
Assignment Change	0	2	2	2	5	7	0	2	1	7	4	5
New Procedure	0	15	15	0	8	8	0	12	9	0	7	6
Accepted Criticism	0	3	3	0	3	3	0	2	2	0	3	2
Work Priorities	0	6	6	1	4	5	0	5	4	3	3	3
III. Relations with Co-Workers and Patients	3	2	5	2	8	10	10	2	3	7	7	7
Difficult Situation	2	1	3	1	5	6	7	1	2	3	4	4
Consideration of Patient	1	1	2	1	3	4	3	1	1	3	3	3
IV. Professional Ethics and Appearnace	0	0	0	1	1	2	0	0	0	3	1	1
Confidential Information	0	0	0	1	0	1	0	0	0	0	0	<1
Grooming and Dress	0	0	0	0	1	1	0	0	0	3	1	<1
TOTAL	30	130	160	29	115	144	100	100	100	100	100	100

instrument categories were identified after 95 incidents were received. These incidents represented 31 percent of the total of 304 incidents received.

The distribution of incidents among categories by program level (MT and MLT/CLA) showed no effective incidents reported by either group under the Professional Ethics and Appearance category. Ineffective incidents appeared under this category in both program levels. The greatest differences in major categories between program levels were in ineffective incidents under the Technical, Performance, Observation and Reporting category (MLT/CLA 72 percent, MT 51 percent); and the Dependability and Adaptability category (MLT/CLA 17 percent, MT 41 percent).

II. TRIAL OF THE INSTRUMENT

The sample utilized for this portion of the study consisted of students and clinical instructors in clinical practice at participating programs (2 MT Programs, 2 MLT Programs and 2 CLA Programs) from June 1978 through September 1978. Table 4 presents the distribution of responses from institutions whose clinical instructors used the trial instrument to evaluate their students during actual clinical experiences. Thirty-four students were available for evaluation. Two evaluations were requested per student. At least one usable evaluation was completed

on 20 of the 34 students or 59 percent. There were 18 unusable evaluations; 12 of these were unusable because no subjective grade was given and 6 of these were unusable because incidents were not specified. The instrument was used properly in evaluating 29 of the 34 students or 85 percent. However, the lack of a subjective grade reduced the number available for analysis.

TABLE 4

RESPONSE FROM PARTICIPATING INSTITUTIONS UTILIZING THE DEVELOPED INSTRUMENT

Program	MT	MLT/CLA	Total
Number of evaluations completed	15	27	42
Number of students evaluated	13	21	34
Number of evaluations usable	5	19	24
Number of students represented by Usable Evaluations	4	16	20

In summary, the number of evaluations requested was 68. Only 42 evaluations (62 percent) were completed. Of these, 24 were usable. These represented 20 students.

Enabling Objective 3: Establishment of the validity and reliability of this instrument.

Content validity is demonstrated by the source of the data in gathering the incidents for the instrument, Tables 2 and 3, pages 44 and 46. Objective 5, in part, addresses the aspect of concurrent validity.

The problem of reliability was addressed through observer agreement in the classification of incidents. Fifty incidents (Appendix F) were randomly selected from those received in developing the instrument. The sample for this portion of the study consisted of one Program Director/ Educational Coordinator and one instructor from each of two Medical Technologist Programs, two Medical Laboratory Technician programs and two Certified Laboratory Assistant programs for a total of 12 respondents. Response was 100 percent.

Observer agreement was determined for nominal scale coding by randomly pairing respondents into two groups and using Scott's Pi. The result was $\pi = .41$ for specific classification and $\pi = .84$ for effective or ineffective incidents. Both are significant at the .05 level.

Enabling Objective 4: Comparisons of the importance and organization of subcategories of the developed instrument with a rating of items derived from these subcategories.

The sample for this portion of the study consisted of one Program Director/Educational Coordinator and one instructor from two Medical Technologist programs, two Medical Laboratory Technician programs and two Certified Laboratory Assistant programs for a total of 12 possible respondents. Eleven, or 92 percent responded.

Respondents rated positive and negative items derived from the instrument on a five-point scale to (1) determine the importance of these items and (2) compare the organization of these items in the instrument with the organization of these items based on factor analysis (Appendix E).

Tables 5 and 6 present the mean judgments and standard deviations of respondents for all positive and negative items. The mean for positive items was 1.7132 with a standard deviation of 0.5872 (Table 5); the mean for negative items was 1.8531 with a standard deviation of 0.8186 (Table 6). Item D "Admitted error or limitation and took correct, appropriate action" and Item O "Failed to notice unexpected test values before reporting or noticed unexpected test values but reported without checking" both had a mean of 1.0000 with a standard deviation of 0.0000. These items were the only ones which all respondents viewed as extremely important.

Factor analysis was used to detect patterns in the items. Classical-factor analysis with principal factoring with iteration was used from the Statistical Package for Social Sciences (SPSS) program. Items D and O were omitted from this analysis since their inclusion would prohibit utilization of this program. Since the correlation matrix was singular and could not be inverted and squared, multiple correlations could not be found. Initial estimates of communalities were based on inferred factors.

TABLE 5

MEANS AND STANDARD DEVIATIONS OF RATINGS OF POSITIVE ITEMS DERIVED FROM INSTRUMENT

	Positive Items	Mean	Standard Deviation
A.	Noticed inconsistency in lab results and took appropriate corrective action	1.1818	0.0445
B.	Checked unexpected test values before reporting	1.0909	0.3015
C.	Followed procedure (administrative, technical, or reporting)	1.3636	0.6742
D.	Admitted error or limitations and took correct, appropriate action	1.0000	0.0000
E.	Assumed or requested extra duties or responsibilities voluntarily within limits of capability	2.0909	0.3015
F.	Cooperated willingly with assignment or schedule change	2.1818	0.8739
G.	Learned new procedure or skill quickly	2.4545	0.9342
H.	Accepted criticism normally and applied it as constructive, positive information	2.0909	0.8312
I.	Adjusted work to priorities	1.4545	0.8202
J.	Handled difficult situation tactfully	2.2727	0.6467
K.	Showed consideration of patient	1.3636	0.6742
L.	Maintained confidentiality of information	1.3636	0.5045
M.	Groomed and dressed in accordance with safety and laboratory requirements	2.3636	1.0269
	Overall	1.7132	0.5872

TABLE 6

MEANS AND STANDARD DEVIATIONS OF RATINGS OF NEGATIVE ITEMS DERIVED FROM INSTRUMENT

	Negative Items	Mean	Standard Deviation
N.	Failed to notice inconsistency in lab results or noticed an inconsistency and did not take appropriate corrective action	1.2727	0.4671
O.	Failed to notice unexpected test values but reported without checking	1.0000	0.0000
P.	Failed to follow procedure (administrative, technical, or reporting)	1.4545	0.8208
Q.	Failed to recognize or admit error (limitation) or admitted error (limitation) but took inappropriate action	1.3636	0.6742
R.	Assumed extra duties (responsibilities) beyond limits of capability or failed to assume required duties or responsibilities	1.9091	1.1362
S.	Failed to cooperate with assignment or schedule change	2.5455	1.2933
T.	Failed or refused to learn new procedure or skill after repeated efforts and assistance	1.7273	0.6467
U.	Reacted negatively to criticism and failed to apply it constructively	2.2727	0.9045
V.	Unable to set appropriate priorities in a work setting	1.8181	0.7508
W.	Handled difficult situation in a tactless manner	2.7273	1.1037
X.	Was inconsiderate of authority, patient, or co-workers	1.9091	0.9439
Y.	Failed to maintain confidentiality of information	1.5455	0.6876
Z.	Groomed and dressed in such a manner as to violate laboratory requirements or rules of safety	2.5455	1.2136
	Overall	1.8531	.8186

Five factors were observed:

Factor I items	F H I J L S U V W Y
Factor II items	C G P Q R T Z
Factor III items	B E K X
Factor IV items	A F N
Factor V item	M

The importance of all subcategories used in the instrument was reinforced. Second, the more positive and negative subcategories that were opposites appeared in the same factor indicating that one set of descriptions was adequate. The major categories under which subcategories were organized, however, differed from that of the original instrument.

Twenty-six items derived from the developed instrument were rated on a five-point scale relative to their importance in student development. One positive item, "Admitted error or limitations and took correct, appropriate action," was rated as an extremely helpful student behavior; it had a mean value of 1 and a standard deviation of zero. Little variation was noted in the item, "Noticed inconsistency in lab results and took appropriate corrective action." This item had a mean of 1.1818 and a standard deviation of 0.0445. Items concerning grooming, quickness in learning, assignment or schedule change, and accepting criticism positively,

had means of 1.3636, 2.5455, 2.1818, 2.0909 and standard deviations of 1.0269, 0.9342, 0.8739, and 0.8312 respectively.

One negative item, "Failed to notice unexpected test values before reporting or noticed unexpected test values but reported without checking," was rated as an extremely harmful student behavior; it had a mean value of 1 and a standard deviation of zero. Items concerning grooming, assignment or schedule change, assuming extra duties, and tactfulness had means of 2.5455, 2.5455, 1.9091 and 2.7273 and standard deviations of 1.2126, 1.2933, 1.1362 and 1.1037, respectively. The overall mean of positive items was 1.7132 with a standard deviation of 0.5872. The overall mean of negative items was 1.8531 with a standard deviation of 0.8186.

Factor analysis of positive and negative instrument items revealed five distinct factors or categories. These categories differ from those identified in the literature and on which the developed instrument was organized. Factor 1 determined by Factor Analysis included positive and negative elements concerning cooperation with sceduling, criticism, work priorities, tact and confidentiality of information. Factor II included positive and negative elements of procedure and learning skill as well as negative elements—appearance,

judgment of capabilities and admission of error/limitations. The positive element of admission of error/limitations had been omitted from this analysis because of lack of variance, but appears to belong in this factor.

Factor III included positive and negative elements of consideration of patients as well as positive elements of accurate reporting and judgment of capabilities. The negative element of accurate reporting had been omitted from this analysis because of lack of variance, but appears to belong in this factor. Factor IV included positive and negative elements of accurate, informed observation as well as the positive factor, cooperation in scheduling. Factor V provided only the positive element of grooming.[1]

Only one element was complex, that is, it appeared as an element in two factors. The positive element related to cooperation with scheduling appeared in Factor I and Factor IV.

Factor analysis presented a picture somewhat different from that established by the literature. It identified five major factors or categories. Factor I as identified by factor analysis presented environmental elements within

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[1]Grooming is considered important in clinical practice because of patient contact. Safety and health aspects of grooming are of primary importance.

the clinical laboratory. Factors such as reactions to schedule change, work priorities, criticism, situations requiring tact as well as maintaining confidentiality of information have a direct bearing on the internal environment of the laboratory.

Factor II presented the administrative/technical aspect of laboratory operations. Elements of following procedures and technical learning skills were included within this cluster. The positive element of admission of error/limitation was omitted from this analysis. Its inclusion here seems desirable along with its negative counterpart. It appears that the negative element of appearance and judgment of capabilities were included here. They may well be interpreted as violation of administrative rules.

Factor III presented those elements which affect the laboratory's external image. Since the laboratory's primary function is that of producing reliable data and its consciousness of the relation of those data to patient welfare, the element of consideration of patient welfare as well as the positive element of accurate reporting seem consistent with that function and consciousness. The negative element accurate reporting was deleted from this analysis because of lack of variance in judgment regarding importance of this item, but appears best placed under this

factor. The positive element of judgment of capabilities also appears in this factor, while its negative aspect appeared in Factor II.

Factor IV presents a higher order of technical ability on a personal level. It contains the positive and negative elements of accurate informed observation. This factor also includes the positive element of cooperation in scheduling. The cooperative effort was emphasized here as this element also appeared in Factor I where it could be viewed as compliant with environmental elements within the clinical laboratory.

Factor V presented only one element which appeared to be miscellaneous. It contained only the positive element of grooming. There were no positive incidents of this element reported in the critical incidents received in the development of the observational instrument.

Enabling Objective 5: Determination if, and to what extent, there was a relationship between the subjective instrument grading and the ratio of effective to ineffective behaviors rated using the developed instrument.

The sample for this portion of the study consisted of 24 usable evaluations of students during their actual clinical experiences (Table 4, p. 48). A regression analysis was performed. The Statistical Package for Social Sciences

(SPSS) computer program was used. The dependent variables were natural logarithms of scores 4 through 0 representing grades A, B, C, D, and F as determined by the subjective rating of clinical instructors. The independent variable was the natural logarithm of the effective over ineffective (E/I) incident ratio as determined by observation using the developed evaluation instrument.

Table 7 presents the analysis of the overall natural logarithm of the E/I Ratio. The calculated F ratio of 7.93 was statistically significant at the .05 level. The analysis of the data indicated that a relationship existed between the natural logarithm of subjective instructor grade and ratio of effective to ineffective behaviors noted using the developed instrument. Further this relationship may be stated by the equation LN (subjective score) = .1188 + .7384 LN (E/I Ratio). The strength of this relationship is expressed by the correlation coefficient R = 0.51462 significant at the .05 level.

TABLE 7

ANALYSIS OF VARIANCE COMPONENT OF THE REGRESSION ANALYSIS OF SUBJECTIVE SCORES TO E/I RATIO

Source	DF	SS	MS	F
Regression	1	0.10868	0.10868	7.92510*
Residual	22	0.30168	0.01371	

*$F_{.95}(1,22) = 4.30$, $p<.05$

III. OBSERVATIONS ANCILLARY TO CONDUCTING THE STUDY

Motivation of the sample populations must be carefully analyzed. In this study the inclusion of a support document from an apparent referent group possibly had a negative effect on the initial inquiry. The researcher subsequently learned that some possible respondents had strong negative feelings toward that group.

The method of contact with Program Directors/Clinical Coordinators made little difference in the outcome in terms of response to the components of the instrument trial. Program Directors/Clinical Coordinators of one MT Program and two MLT/CLA Programs were met in person by the researcher and one MT Program Director and two MLT/CLA Program Directors were contacted by phone. A high return of other information was obtained on the rating of items and classification of items relative to the developed instrument. This indicates a good response on the part of these individuals. With respect to the successful use of the instrument by clinical instructors, a great deal of contact (Sims, 1976) or a close relationship of the contact people to the clinical instructor is absolutely essential. The use of Program Directors/ Educational Coordinators as a substitute for direct researcher contact with clinical personnel seemed to be effective only if the relationship of these individuals to clinical faculty

is close. This study found that considerable cooperation was obtained from the Program Directors/Educational Coordinators. When they were relied on to provide information from their clinical instructors, however, the effectiveness of this cooperation was reduced considerably. Effectiveness varied considerably between programs.

Multiple observations by multiple raters would be an excellent method of establishing reliability using an analysis of variance. This is recommended as ideal by Anderson (1975). This view is supported by Flanagan, Gosnell and Fivars (1973) studying nurses and Mays (1973) with respect to physical therapists. Although this is the ideal, this researcher was not able to use this method in his study.

Sims (1976) noted that single hospitals were generally used in previous studies using the critical incident technique in evaluating student nurse performance. This suggests that serious problems are encountered as one attemptes to expand such a study to multiple institutions covering a wide geographic region.

Trial of the instrument developed in this study was conducted in five laboratory programs. Multiple evaluations were received on only 8 of 34 students. Considering the length of time of clinical training rotations involved, it appears that longitudinal studies might be required to obtain

multiple evaluations. An alternative to logitudinal studies, in order to increase the size of the sample, would be to increase the number of participating programs. The number of students in medical laboratory programs generally ranges from 10 to 15. If the latter approach is used, one must be prepared for the difficulties involved in working with multiple institutions.

IV. SUMMARY

Four types of data appear in this chapter. First, data relative to preparation of an instrument to evaluate medical laboratory students during their clinical training are presented. These data are summarized in Table 1, p. 43, Sample Response; Table 2, p. 44, Geographic Distribution of Returns by State; and, Table 3, p. 46, Distribution of Incidents. Second, data relative to establishing validity and reliability is presented. These data are presented in the discussion which appears on pages 48 and 49. Third, data relative to subcategory organization identified through factor analysis and determined from the literature are compared. These data are presented in the discussion beginning on page 49. Fourth, data relative to determining if, and to what extent, there is a relationship between the subjective instructor grading and the ratio of effective to ineffective behaviors noted using the developed instrument are presented.

These data are summarized in Table 7. Fifth, observations ancillary to the study are presented in the discussion which appears on page 59 - 61.

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

The purpose of this study was to develop an instrument for evaluating students in the clinical portion of their medical laboratory training. The reliability and validity of this instrument were also to be established.

Program Directors/Educational Coordinators of 270 Medical Technologist (MT), 26 Medical Laboratory Technician (MLT) and 54 Certified Laboratory Assistant (CLA) Programs supplied samples of effective and ineffective incidents noted while observing their medical laboratory students during their clinical training. These effective and ineffective incidents were collected through response to inquiries mailed to 350 program officials. Samples of the materials mailed are presented in Appendices A and B. Of those contacted 118, or 34 percent, actually responded and provided a total of 304 incidents. These incidents were classified according to a tentative category list suggested from the literature. The category list was further modified upon classification of the first fifty incidents received. All incidents were than classified until no more than two or three new behaviors appeared per hundred incidents. All categories and subcategories were identified

after 95 incidents were classified. After the instrument was completed (Appendix C) all incidents received were classified according to it (Table 3, p. 46).

Six programs were selected for trial of the developed instrument. These six programs were composed of two Medical Technologist (MT), two Medical Laboratory Technician (MLT) and two Clinical Laboratory Assistant (CLA) Programs. Their respective Program Directors/Educational Coordinators were requested to have each of their current students evaluated with the developed instrument (Appendix E) by at least two clinical faculty instructors. They were sent copies of the instrument (Appendix C) and the instructions for its use (Appendix D). Clinical instructors from five of the six programs actually participated. Data collection of student evaluations using the developed instrument were through instruments completed by clinical instructors. Thirty-four students were evaluated (Table 4, p. 48).

Content validity was demonstrated by the source of the data in gathering the criteria for the instrument (Tables 2 and 3, pp. 44 and 46). To establish reliability, information on inter-observer agreement was sought. The Program Directors/Educational Coordinators and one instructor from each of the six participating programs were mailed 50 critical incidents selected by stratified random sampling from the 304 incidents received during the development

of the instrument. They were asked to classify these incidents on the basis of the developed instrument. Each of the 12 individuals contacted provided responses. The data received were analyzed using Scott's Pi as a statistical tool to determine the coefficient of rater agreements.

In order to determine the importance of subcategories and analyze the organization of these categories a list of 13 effective and 13 ineffective items (Appendix E) derived from the subcategories of the developed instrument was sent to the Program Directors/Educational Coordinators and one instructor from each of the six participating programs. They were asked to rate each item on a five-point scale to indicate its importance in terms of helpful or harmful behavior. Of the 12 individuals contacted, 11 rated the 26 items. The means and standard deviations of responses to each item were determined (Tables 5 and 6, pp. 51 and 52). These ratings were also subjected to the statistical technique of factor analysis and were compared with the major categories identified from the literature.

The relationship between the subjective instructor grading and the ratio of effective to ineffective behaviors was analyzed. Data collection of student evaluations using the developed instrument (Appendix C) was through instruments completed by the clinical instructors already cited. Thirty-four students were evaluated (Table 4, p. 48).

The clinical instructors supplied the grade (A, B, C, D or F) they felt that the student earned as well as observing student behavior for effective and ineffective incidents. Twenty-four usable evaluations were analyzed according to instructor rating score versus effective-ineffective ratio using least squares regression analysis to determine the relationship.

II. FINDINGS

The following is a report of the findings of this study. The findings are based on the analysis of data reported in Chapter IV of this study.

Findings Relative to the Development of the Instrument

The first inquiry contained all the information recommended by the literature necessary for proper response. The individuals in the sample were asked to provide six effective and six ineffective examples of student performance that they had observed which had a significant positive or negative effect on student development. Based on returns, modifications of the instrument were made. The second inquiry requested the respondent to provide 2 incidents rather than 12 incidents. The total response was 34 percent and provided sufficient critical incidents to define the area under study. This response rate is higher than that found by Andersson and Nilsson (1964) which was 24 percent.

Critical incidents were received from respondents in 37 of the 50 states. By state, the rate of response was lower for more populous states than for less populous states and higher for MLT/CLA Programs than for MT Programs.

Using the major categories found in the literature, the first 50 incidents were classified. The categories were revised and incidents were classified until only 2 or 3 new behaviors appeared per 100 incidents. All categories appeared after 95 of the 304 incidents received were classified.

The distribution of incidents among categories by program level (MT and MLT/CLA) shows no effective incidents reported by either group under the category Professional Ethics and Appearnace. Ineffective incidents appeared under this category in both program levels. The greatest differences in major categories between program levels were in ineffective incidents of the Technical, Performance, Observation and Reporting categories (MLT/CLA 72 percent, MT 51 percent); and the Dependability and Adaptability category (MLT/CLA 17 percent MT 41 percent).

The above procedure identified critical behaviors, both positive and negative, exhibited by medical laboratory students during their clinical training. Moreover, it was found to be practical to use these critical incidents to structure an observational instrument.

The use of the first fifty incidents for the formation of subcategories was found to be adequate. This experience was shared by Kessel (1956) and Calhoun (1960) in studies involving secondary school business teachers.

Using the criterion of only 2 or 3 new behaviors per 100 incidents, it was found that 95 incidents specified the universe of critical incidents. The total number of incidents received was 304. This differs somewhat from studies by Flanagan (1954), Gorham (1962) and Andersson and Nilsson (1964), each of whom utilized a higher number of incidents in defining the universe of critical incidents. The criterion, however, of adding only 2 or 3 behaviors per 100 incidents recommended by Flanagan (1954) and utilized by Weinstein (1975) was included in this study. This criterion is generally accepted as the measure of circumscribing the universe of critical incidents defining a particular area of inquiry.

Finding Related to Trial of the Instrument

Sixty-two percent of the requested evaluations were completed. Fifth-seven percent of the completed evaluations were usable. Utilization of the instrument in a clinical setting provided data for examination of the relationship between subjective scores assigned by clinical instructors and the ratio of effective to ineffective incidents observed during clinical practice.

1. Validity and Reliability. Content validity of the instrument developed in this study is demonstrated by the source of the data in gathering the criterion from critical incidents reported by Program Directors and Educational Coordinators. These critical incidents describe performance of students during their clinical laboratory training in the medical laboratory. The method of Flanagan (1954) was used to assure that the universe of behavior was specified.

Concurrent validity was established by performing a Regression Analysis utilizing the data gathered by clinical instructors evaluating students in clinical practice. The calculated F ratio of 7.93 was statistically significant at the .05 level. The analysis of data indicated that a significant relationship did exist between the natural logarithm of subjective instructor grade and the ratio of effective to ineffective behaviors noted using the instrument. This relationship is expressed by the equation:

LN (subjective score) = .1188 + .7384 LN (E/I Ratio).

The strength of this relationship is expressed by the Correlation Coefficient R = 0.51462 significant at the .05 level.

In this study the reliability of the instrument was established through interobserver agreement. Fifty incidents randomly selected from those received in developing the

instrument were classified by respondents. The data were analyzed using the statistical technique of Scott's Pi. For classification of incidents in a specific subcategory $\pi = .41$ was obtained and for classification of incidents as effective and ineffective $\pi = .84$ was obtained. Both are significant at the .05 level. Scott's Pi corrects for the number of possible categories. It indicates a 17 percent agreement among observers in placing incidents in subcategories and a 71 percent agreement among observers in placing incidents in cagegories of effective and ineffective. This finding is encouraging since a criterion-referenced test can give reliable information even though its classically defined reliability coefficient equals zero (Stanley, 1971). Thorndike (1949) likewise noted that the reliability of objective scores obtained from an experimental session in a complex job situation may be quite low. Fitzpatrick and Morrison (1971) concur with these observations.

2. Importance and organization of subcategories. Importance of the subcategories was verified by the rating of positive and negative items derived from the instrument developed in this study. Ratings were made by Program Directors/Educational Coordinators and Instructors using the instrument.

Factor analysis of these rated items revealed an orientation of the data consistent with laboratory operation

rather than with the individual as a distinct entity. The latter is the orientation identified in the literature.

3. Relationship between the subjective instructor grading and the ratio of effective to ineffective behaviors noted. A significant relationship between subjective scores assigned by clinical instructors and the ratio of effective to ineffective incidents observed during clinical practice does exist and can be described by a natural logarithm relationship. It is based more on an agreement of importance and correct effective/ineffective classification than on the exact categorizing of the observed incident.

Such a relationship provides a method of establishing a single score for evaluation. Such a single score value provides direct input into student grading by clinical faculty.

III. CONCLUSIONS

Generalizations from the findings of this research study should be applied to other populations with extreme care. To the extent that the data resulting from the research procedures used in this study were both valid and reliable, the following conclusions seem warranted.

1. The critical incident method is a suitable method for developing criteria from which to prepare an evaluation instrument to evaluate medical laboratory students during their clinical training.

2. The instrument developed in this study is valid and reliable. It provides a method for assigning a single grade as a summative evaluation of a student's clinical practice based on observed student performance.

3. All subcategories of the instrument developed in this study are important and identify areas of behavior important to success or failure of medical laboratory students in the clinical portion of their training.

4. Factor analysis provides a method for determining major categories for critical incidents which may differ from major categories derived from the literature.

Conclusions Ancillary to the Study

1. In attempting to develop an evaluative instrument of clinical performance one must seek maximum possible commitment in obtaining information especially of the open response type. Reliance on discipline identification, peer group identification or reference group identification while of some value, is not sufficient. Techniques used by business to increase response may be of value. It is difficult to address the issue of motivation; however, the more effective the researcher can be in identifying the factors involved in motivation of the target respondents, the more successful he/she will be in obtaining adequate response.

The disparity between the returns on the first and second request for effective and ineffective incidents to develop the instrument was large enough to make a small pilot mailing seem highly desirable. Because of multiple variables it is impossible to state with a great degree of certainty which factors had a major effect on the increased rate of return experienced on the second mailing.

The inclusion of a form on which to place data appeared beneficial, since a number of photocopied forms were returned. Weislogel (1951) mentions the advisability of space for writing incidents in his study of Life Insurance Agency Heads by the critical incident technique using the questionnaire approach.

2. The relationship of Program Directors/Educational Coordinators to clinical faculty is not clearly defined. In many cases both groups have primary responsibilities to different organizations which have differing expectations of the individual.

IV. RECOMMENDATIONS

To the extent that subjects in this study are representative of health professions which have a clinical component in their educational programs, the following recommendations seem warranted.

1. The instrument developed in this study should be used to evaluate students in the clinical portion of

medical laboratory training programs. Care must be taken in such use since one must be cautious in generalizing from a restricted sample of clinical training programs.

2. The critical incident method should be applied to developing observational instruments for other health professions which have a clinical component in their educational programs.

3. Factor analysis should be considered for determining major categories for critical incidents.

4. The present study should be refined and replicated. The trial of the present instrument on a tightly controlled group over a longer period of time should be attempted. Although reliability was established through an inter-rater agreement, ideally a repeated measures analysis of variance should be performed. Because of clinical rotation times, an extended period of time is necessary to insure multiple observations by more than one clinical faculty member.

5. The present instrument subcategories should be examined in light of the finding of the factor analysis for the purpose of developing an alternate observational instrument.

6. The present study should be refined and replicated in other health disciplines which have clinical components in their educational programs.

7. The present study should be refined and replicated in other selected vocational areas which have an internship,

externship, practicum or co-op as an integral component of their educational program.

8. The perceptions of clinical faculty regarding their dual roles as staff technologists and educators should be statistically analyzed. The clinical faculty member is the key person in clinical evaluation of students.

9. The relationship of the faculty of the educational institution to the cooperating clinical facilities staff serving as clinical faculty should be evaluated with respect to expectations of the administrators of educational institutions, the administrators of cooperating clinical facilities and accrediting groups.

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REFERENCES

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APPENDICES

APPENDIX A

INITIAL INQUIRY

(Letter to Program Directors
Requesting Effective and Ineffective
Behaviors of Medical Laboratory Students)

AMERICAN MEDICAL ASSOCIATION

535 NORTH DEARBORN STREET • CHICAGO, ILLINOIS 60610 • PHONE (312) 751-6000 • TWX 910-221-0300

November 11, 1977

DIVISION OF EDUCATIONAL
STANDARDS AND EVALUATION

RICHARD L. EGAN, M.D.
Director

DEPARTMENT OF ALLIED
HEALTH EVALUATION
(312) 751-6282
RALPH C. KUHLI, M.P.H.
Director

Dear Program Director:

Joseph K. Semak is attempting to develop an instrument for evaluating students during the clinical portion of their medical laboratory training. The critical incident technique constitutes his primary approach. The enclosure from Mr. Semak explains this approach and requests your participation as a contributor.

Objective evaluation of the student's performance in the clinical year has been a concern to the Committee on Allied Health Education and Accreditation for some time. We hope this study will provide a reasonable mechanism to achieve that goal. Because of our concern, and I am sure, yours also, we consider this study to be very important, and we request your cooperation in it.

As clinical instructors, you constitute a particularly important group in laboratory education and the essential group for the success of this study. Your explicit descriptions of events you see in training students are requested in the report. Again, your cooperation is solicited.

Sincerely,

John E Beckley

John E. Beckley, Ph.D.
Assistant Director
DAHE

Joseph K. Semak
3811 Peerless Rd.
Cleveland, Tennessee 37311

Dear Program Director:

One of the concerns in medical laboratory training programs has been evaluation of students during a clinical performance. For this reason, I am in the process of developing an instrument for evaluating students in the clinical portion of medical laboratory training and establishing this instrument's reliability and validity for my dissertation at The University of Tennessee at Knoxville in the Department of Vocational-Technical Education. In order to accomplish this, I need your assistance.

The technique that I am utilizing is that of critical incidents. I would be very appreciative if you would describe at least six specific circumstances or situations in which a medical laboratory student's performance was ineffective or effective. Please supply three of each. (Directions for doing so are attached.) The incidents noted should have had significant positive or negative contribution to the student's advancement as a developing professional. In order to verify the classification of these incidents for the development of an instrument, please identify at least one individual whom you consider competent in evaluating medical laboratory students in clinical practices.

I hope you will agree that this is a worthwhile project and will cooperate with me in this endeavor. If you desire any additional information or clarification, please let me know.

Sincerely,

Joe Semak
MT(ASCP) MED.

Incls.

EVALUATION OUTLINE

Each of your examples should be a factual description of an event which:

(1) you observed.

(2) involved particularly effective or ineffective performance.

(3) had a clear-cut consequence.

Effective

From your experience, think of the most recent situation in which you observed a student do something that impressed you as an outstanding example of effective professional performance.

(1) What was the situation? (Briefly describe relevant aspects of the background to the incident.)

(2) Exactly what did the student do?

(3) Why was this action particularly effective?

Ineffective

From your experience, think of the most recent situation in which you observed a student do something that exemplified inadequate or inferior professional performance.

(1) What was the situation? (Briefly describe relevant aspects of the background to the incident.)

(2) Exactly what did the student do?

(3) What more effective behavior might be expected in a situation like this?

In accordance with the policies of the University of Tennessee at Knoxville—Committee on Research Participation and HEW—the following guarantees are noted.

All replies will be held in strict confidence. Complete anonymity of individuals and institutions will be provided. I will be the only individual with access to returned data. The data will be collected, analyzed and reported as group data. At no time will individuals be identified. The main vehicle for disseminating this data is the dissertation itself. Original data will be destroyed upon completion of short term educational goal.

You have the right to withdraw from this study by not returning the information requested.

APPENDIX B

SECOND INQUIRY

(Letter to Program Directors/Educational Coordinators Requesting Effective and Ineffective Behaviors of Medical Laboratory Students)

April 14, 1978

Dear Program Director/
Educational Coordinator:

This past February I wrote you requesting that you provide me with incidents of behavior of students which contributed positively or negatively toward their development during their training. Evidently I went wrong somewhere. The response has not been very good. Perhaps I asked for too much information or did not provide enough information.

I realize that you have many demands being made on your time but please give me only fifteen minutes. I have enclosed a form complete with examples and request only one positive and one negative incident from you.

From the incidents gathered I will develop an instrument for evaluating students during the clinical portion of their training and validate it. If you would like a summary of the study and a copy of the validated instrument when it is completed, please include your name and mailing address on the attached form.

Sincerely,

Joe Semak, MT(ASCP) MED
Program Director
Medical Laboratory Technology Program

ed

Enclosure

p.s. I have enclosed a self-addressed, stamped envelope for your convenience.

EXAMPLE-EFFECTIVE PERFORMANCE

Situation: Student, upon returning from floor, discovers a tech has called in sick, and there is a pile of slips to be picked up yet.
Response: Student volunteers to go up and draw these people.
Reason why effective: Shows responsibility and willingness to help others. Student could have ignored problem and left it for others to handle.

Please fill out the following:

Situation: _____

_____

_____

Response: _____

_____

_____

Reason why effective: _____

_____

_____

****

EXAMPLE-INEFFECTIVE PERFORMANCE

Situation: After lunch the student noticed he had run the wrong patient specimen and placed the value on the daysheet. Results were not reported on the requisition.
Response: The student sent another student after the correct patient sample and reran the proper specimen.
Appropriate Behavior: The student should have informed the department instructor who could have checked to be sure nothing was reported on the phone from the daysheet. He should also have obtained the correct specimen himself.

Please fill out the following:

Situation: _____

_____

_____

Response: _____

_____

Reason why ineffective: _____

_____

(over)

My program is: (Circle) MT MLT CLA

Please recommend an individual you feel competent to review my classification of the incidents received after they are catalogued.

Name Recommended

Address

****

_____ I would like a copy of the completed validated instrument.

_____ I would like a copy of the summary report.

Name

Address

APPENDIX C

OBSERVATIONAL INSTRUMENT

OBSERVATIONAL INSTRUMENT

CATEGORIES	DATE	E	I	WHAT HAPPENED
I. TECHNICAL PERFORMANCE, OBSERVATION AND REPORTING				
A. Noticed inconsistency in lab results and took appropriate corrective action.				
B. Checked unexpected test values before reporting.				
C. Followed procedure (administrative, technical, or reporting).				
D. Admitted error or limitations and took correct, appropriate action.				
II. DEPENDABILITY AND ADAPTABILITY				
A. Assumed or requested extra duties or responsibilities voluntarily within limits of capability.				
B. Cooperated willingly with assignment or schedule change.				
C. Learned new procedure or skill quickly.				
D. Accepted criticism normally and applied it as constructive, positive information.				
E. Adjusted work to priorities.				
III. RELATIONS WITH CO-WORKERS AND PATIENTS				
A. Handled difficult situation tactfully.				
B. Showed consideration of patient.				
IV. PROFESSIONAL ETHICS AND APPEARANCE				
A. Maintained confidentiality of information.				
B. Groomed and dressed in accordance with safety and laboratory requirements.				

SUMMARY	I				II					III		IV		TOTAL	E/I
	A	B	C	D	A	B	C	D	E	A	B	A	B		
Effective															
Ineffective															

I would assign this student an overall grade of:
(circle one) A B C D F

Student Ident. _____
Evaluator Ident. _____
Program Ident. _____

APPENDIX D

INSTRUCTIONS FOR USE OF INSTRUMENT

(Letter to Clinical Instructors)

CLEVELAND STATE COMMUNITY COLLEGE
CLEVELAND, TENNESSEE 37311

Division of Career Education
(615) 472-7141

June 7, 1978

Dear Clinical Instructor:

As you assume your role in the instruction of students in the medical laboratory, additional demands are made upon your time. I have long been impressed with the contributions that individuals in your position have made to the educational process and feel that you have a significant role to play in evaluating the students you help train. Your professional judgment is important in the evaluation process of these students. In the past there has been no system for documenting the reasons for that judgment.

In order to document your judgments, I have developed an observational instrument which will require a minimum of your time to use. As with any new instrument its validity and reliability must be established. It is here that I need your assistance. I request that you use it in evaluating your students for six weeks.

The instrument contains four major categories and thirteen subcategories which have been determined from important incidents involving students submitted to me by fellow medical technologists. These technologists were asked to supply behaviors they had observed in students which were important positive or negative contributions to the students development as a laboratory professional.

The basis for using this instrument is simply to record the incidents which you observe in your students which have an important positive or negative effect on the student's development and identifying them according to the classifications. This can be done at the completion of each day within five minutes. For example, you observe that on 5/3/78, Student A, upon returning from collection rounds, discovers that a technician has called in sick, and there is a pile of slips to be picked up yet. Student A volunteers to go up and draw these people. Student A shows responsibility and willingness to help others. On 5/5/78, you observe that Student A, upon returning from lunch noticed that he had run a test on the wrong patient specimen and placed the value on the daysheet. Results were not reported on the requisition. Student A sent another student after the correct patient sample and reran the proper specimen. Student A should have informed the department

(Continued on Back of Page)

instructor who would have checked to be sure nothing was reported on the phone from the daysheet and obtained the correct specimen himself.

You simply enter the following on the observational instrument.

DATE	E	I	WHAT HAPPENED
5/3	IIA		Assisted in extra blood pick-up.
5/5		ID	Run wrong patient.

Student Ident. Student A

This evaluation form serves two purposes. One, it provides information on a student which may be used to counsel the student in areas needing improvement or correction, and points out areas in which behavior should be encouraged. Two, it provides a means of objectifying and quantifying behavior as supportive information for grading.

Thank you for your cooperation.

Sincerely,

Joseph K. Semak, MT (ASCP)
Director, Allied Health Department

APPENDIX E

LETTER TO PROGRAM DIRECTORS/CLINICAL COORDINATORS

POSITIVE AND NEGATIVE ITEMS DERIVED FROM THE DEVELOPED INSTRUMENT

CLEVELAND STATE COMMUNITY COLLEGE
CLEVELAND, TENNESSEE 37311

Division of Career Education
(615) 472-7141

June 6, 1978

Dear Program Director and/or Clinical Coordinator:

Thank you for your interest in my study. Besides using my instrument in your clinical facility (each student being evaluated by at least two clinical faculty instructors), I need some additional information for you.

In order to determine the proper sequences of items in the evaluation instrument, please rate the items on a 1 - 5 scale as indicated on the attached forms. This will help to either verify the intuitive classification or allow the instrument to be appropriately modified.

I have also included 50 incidents which I have collected from programs throughout the country. It is important from the standpoint of the reliability of the instrument that different observers would arrive at a similar classification from these incidents. In order to establish this, I would like for you to classify them as to category and effectiveness according to the instrument.

Thank you for your time and cooperation.

Sincerely,

Joseph K. Semak, MT (ASCP)
Director, Allied Health Department

Rate each of the following 1-5. One is extremely helpful, 5 is not especially helpful behavior in a student's development as a laboratory professional.

Circle the appropriate number:

A.	Noticed inconsistency in lab results and took appropriate corrective action	1	2	3	4	5
B.	Checked unexpected test values before reporting	1	2	3	4	5
C.	Followed procedure (administrative, technical, or reporting)	1	2	3	4	5
D.	Admitted error or limitations and took correct, appropriate action	1	2	3	4	5
E.	Assumed or requested extra duties or responsibilities voluntarily within limits of capability	1	2	3	4	5
F.	Cooperated willingly with assignment or schedule change	1	2	3	4	5
G.	Learned new procedure or skill quickly	1	2	3	4	5
H.	Accepted criticism normally and applied it as constructive, positive information	1	2	3	4	5
I.	Adjusted work to priorities	1	2	3	4	5
J.	Handled difficult situation tactfully	1	2	3	4	5
K.	Showed consideration of patient	1	2	3	4	5
L.	Maintained confidentiality of information	1	2	3	4	5
M.	Groomed and dressed in accordance with safety and laboratory requirements	1	2	3	4	5

Rate each of the following 1-5. One is extremely harmful, five are not especially harmful behavior in a student's development as a laboratory professional.

Circle the appropriate number.

N.	Failed to notice inconsistency in lab results or noticed an inconsistency and did not take appropriate corrective action	1	2	3	4	5
O.	Failed to notice unexpected test values before reporting or noticed unexpected test values but reported without checking	1	2	3	4	5
P.	Failed to follow procedure (administrative, technical, or reporting)	1	2	3	4	5
Q.	Failed to recognize or admit error (limitation) or admitted error (limitation) but took inappropriate action	1	2	3	4	5
R.	Assumed extra duties (responsibilities) beyond limits of capability or failed to assume required duties or responsibilities	1	2	3	4	5
S.	Failed to cooperate with assignment or schedule change	1	2	3	4	5
T.	Failed or refused to learn new procedure or skill after repeated efforts and assistance	1	2	3	4	5
U.	Reacted negatively to criticism and failed to apply it constructively	1	2	3	4	5
V.	Unable to set appropriate priorities in a work setting	1	2	3	4	5
W.	Handled difficult situation in a tactless manner	1	2	3	4	5
X.	Was inconsiderate of authority, patient, or co-workers	1	2	3	4	5
Y.	Failed to maintain confidentiality of information	1	2	3	4	5
Z.	Groomed and dressed in such a manner as to violate laboratory requirements or rules of safety	1	2	3	4	5

APPENDIX F

INCIDENTS RANDOMLY SELECTED FROM THOSE RECEIVED DURING THE DEVELOPMENT OF THE INSTRUMENT AND CATEGORIZATION SHEET FOR CRITICAL INCIDENTS

1. I am the bench instructor in Hematology. In our department we have a Coulter S Sr. for our main working instrument and a Coulter F, micro hematocrit centrifuge and a hemoglobinometer as backup instruments. Everyday we perform quality control on both the working and back-up instruments. As part of student's training, it is required that they perform efficiently and reproducibly tests done by manual and semimanual techniques. Thus, as their training progresses, they assume the responsibility of performing quality control on the back up equipment.

I can recall particularly one specific student that I had both an ineffective and effective experience. After a rather lengthly training period of showing the student the manual techniques on the Coulter F and the other back up equipment, I had instructed the student that the next day and all the other days remaining in her rotation in hematology she would be responsible for the QC on the back up equipment. On the average, most of the students need some guidance on their technique. But this girl would get discouraged and frustrated to the point where she would swear she wouldn't do quality control because it wouldn't work for her. Sometimes she would leave for lunch and still not have it done. I tried to explain to her that what was needed was some patience and to try it again. We had some hectic moments. She would come to me all the time and tell me it would not work. I told her to check various things that would influence the results she was getting and try it again. Once she said that it was no use to re-do it because it would not work anyway and she left. Thinking that something might be functionally wrong with the equipment, I did the QC then. It worked perfectly. I made her try to do it everyday and finally repetition paid off and she was performing back up QC with increasing speed. She felt that she had accomplished what she thought, "a very trying and difficult procedure."

This experience paid off very well, as near the end of the rotation the Coulter S Sr. broke down and we had to perform everything "back up." She was a real asset, as she could work with the Coulter F, etc. With an expert technique and reproducibility. Thank God she was there to step in and help us. We needed her extra pair of hands.

2. Situation: Coagulation and Hematology were working with a very small staff over lunch break and two techs

off for the day. I was the only tech working in coag for the day. When I went to lunch another tech was asked to go to recovery room for the heart work-up when the surgery was over. (Our coag. lab has a very extensive pre- and post-op coag. panel for heart surgeries.) The heart patient went to recovery room however the other techs were tied up and couldn't leave. The intern that had rotated through coag. but was now working in Special Hematology volunteered to get the work-up. This action was particularly effective because it enabled the coag. work to be done on the patient without any great delay. These post-op results are crutial and must be done super stat for the welfare of the patient.

3. The MLT student was in his last few days of his blood bank rotation and was performing a crossmatch on his own.

The student put the wrong unit number on the blood bank crossmatch slip and put the slip on the bag of blood. Also, the number of the unit was written wrong in the log book.

The results of this was that the crossmatch had to be repeated on the patient before the blood could be handed out. Since the student had previously made this error and been made aware of it, he should be this time in his training have been more conscientious of his work, so no errors such as this would occur.

4. A student went to a patient's room to obtain a number of blood samples for "stat" Hematology and Chemistry work. She attempted one venipuncture but did not obtain enough blood. While looking for a good place to try a second time the physician came into the room and began examining the patient. (The patient was about 20 years old, extremely ill with acute pancreatis, family members were present). The physician noted the student's searching and stepped in saying he would try to draw the blood for her. He began drawing the patient just above the palm of the hand, in the wrist area which we always teach students as a poor area to attempt because of all the cords present. She accidently "blurted" out, "No, don't stick there," which resulted in a big incident report filed by the physician. He said it looked very bad when she questioned his technique in front of the patient and his family.

She did not intentionally do this, but felt frustrated that he stepped in when she was sure she could have gotten sufficient, additional blood had he left her on her own. She stated that she never had anyone take over her duties like that before and just was taken totally by surprise.

5. The student was involved in doing a Heinz body stain and questioned Heinz bodies versus Howell-Jolly bodies.

The student was asking if you could see Howell-Jolly bodies on a Wrights stain. He was not thinking at all because at this point in time he was and should have been reporting out Howell-Jolly bodies on routine differentials.

This was ineffective and more could be expected in that the "student should have been putting the pieces together" and should have been able to answer his own question, based on his previous experience.

6. The situation involved the use of the aggregometer for platelet aggregation. This entails making several dilutions of various aggregating agents. This is all specified in the procedure manual. However, recently Dr. Mazza wished to have some modifications of this procedure.

The student was able to take the original procedure and modify the concentrations of the aggregating agents according to Dr. Mazza's specifications, and then to perform the aggregation studies without further ado!

This action was effective because the student did not require time consuming step by step explanation of the situation or the procedure, as well as the modifications, which is more than some techs can handle.

7. During lunch hour when most of the staff was at lunch, an MT student and a tech were left in the department. The student took a phone call which was an order for fresh blood for surgery. The tech was busy with another task.

The student took it upon himself, with no orders from the tech to call a donor, have her come up and started the screening and drawing procedure.

This action was effective because it prevented the completing of the order for fresh blood from being delayed for any length of time. Had the student not gone ahead on his own, the donor probably would not have gotten called til the tech responsible for that section returned from lunch, or til the tech present in the department finished the task she was doing.

8. Situation:

On entering the bacteriology lab one afternoon, I noticed a student eating candy which had spilled onto the work bench.

Student Performance:

After explaining to her the seriousness of her actions, the student immediately threw away the remaining candy.

Behavior:

The student should have had the common sense to realize that NO eating should be done in a bacteriology lab where numerous pathogens are worked with daily. It is especially hazardous to eat food which has been placed on the work counter.

9. Situation:

While running simultaneous CO_2-Cl determinations on the Auto Analyzer, the student attached the wrong reagent line. Instead of attaching the CO_2-free air line to the appropriate line, the student attached it to the line open to the atmosphere that pulls air into an IM solution of NaOH to absorb out CO_2. The result of this action caused suppressors to pop from the pressure, IM NaOH was expelled all over the manifold, and a black precipitate formed in the line.

Student Performance:

The student panicked and called the clinical instructor. The student was content to simply observe the instructor troubleshoot and fix the instrument.

Behavior:

Obviously there was an unexpected reaction occurring.

a. Student should have traced back all reagent lines to insure all lines were attached to the proper reagent bottle.

b. Student should have referred to the AutoAnalyzer manual to insure all lines were attached to the proper connection on each reagent bottle. The error would have been picked up here.

c. Student should have noticed when he wiped the manifold the liquid was extremely soapy. A definite clue leading the student to the IM NaOH reagent bottle.

d. Student should have put all lines back in water, cleaned the manifold, changed all tubings that were indicated, and proceeded from there.

All of these actions the student could have performed on his own under the supervision of the clinical instructor.

10. Situation:

Was expanding case study material for future use with students. This enables them to gain an integrated a approach to the laboratory's efforts in patient health care.

Student Performance:

Student did a complete case study involving a history of patient, correlation of all relevant clinical and laboratory findings, and an explanation of how these findings confirmed patient's disease state. The student also explored additional testing possibilities which could have been used in diagnosis.

Action:

This demonstrated a good working knowledge of the physician's approach to diagnosis and the tools he used to make the diagnosis. It demonstrated his ability to correlate the material learned this year which is of a magnitude greater in ability than is expected in most student settings.

11. Situation:

Differential media results were being recorded, and the proper interpretation of the reactions would be necessary for further testing in order to ID the organism.
Results of dextrose (open)—No change.
Results of dextrose (closed)—Acid
Results of TSI—Alkaline/No change
(with growth visible)

Student Performance:

With the following results the student interpreted the organism as a fermenter instead of realizing that the OF dextrose closed tube was probably contaminated and set up the follow-up media as if the organism was a fermenter instead of repeating the above tests or assuming that the organism was a nonfermenter from the TSI and of dextrose open.

The student should have realized that the results did not correlate, and should have at least brought it to someone's attention.

12. All working technologist had gone to lunch leaving a student to shutdown a chemistry analyzer. The student was instructed to push the "shutdown" button when the machines audible alarm sounded in approximately five minutes. The student had not yet been instructed in the operation of the analyzer and had little knowledge of it.

When the alarm had not sounded in exactly five minutes, the student phoned for help assuming that the machine had malfunctioned. Before the student could explain the full nature of her crisis, the alarm sounded.

The student was instructed that the alarm would sound in "approximately" five minutes, not exactly five minutes. The student may have been more patient or ask what she should do in the event that she should have a problem.

13. Situation:

While rotating through the Blood Bank Department, the student discovered a positive antibody screen on a

patient scheduled for surgery the following day. Since it was near quitting time, the antibody identification test, donor typing, and crossmatch would have been performed by afternoon shift personnel.

Student Performance:

The student pursued the antibody identity investigation and continued testing until the antibody was identified; the donor units typed for the corresponding antigen; and the crossmatch was performed. The student stayed two hours on his own time to complete the work-up. When questioned the next day about staying late, the student responded that he wanted to stay and felt it was a good learning experience.

Action:

This action was particularly effective to the student because of the learning experience; to the clinical instructor because the student displayed qualities of a good future blood bank technologist and showed interest in the patient's welfare; to the department because the afternoon shift workload was lessened by not having to spend the time involved in antibody identification studies.

14. Technicians working in the phlebotomy area failed to report to work. There was a large amount of blood to be drawn from patients within the house, as well as the clinic area. This student had already worked through a rotation in the phlebotomy area and was very proficient in the art of blood drawing.

Upon request by the Educational Coordinator, the student applied her skill in blood letting and in so doing, assumed some of the burden which otherwise would have fallen on the shoulders of the working technologist.

This action was effective not only because it freed the technologist to perform other work, but also because it allowed the student to assume responsibility not normally given to her.

15. Situation:

One day our Hematology Department was extremely busy for different reasons. The two students in the Department were dismissed to study in the classroom or library, as was normally allowed at that time of day. Both students were well aware of the situation in the Department. I am sure they also realized the advantage of having been given time to study. Studies which are not completed during the time spent at the hospital are expected to be finished by the students on their own time.

Student Performance:

One student came back to the Department on her own initiative giving up that precious free time, to assist the Department toward completion of required work.

Action:

This impressed me as an outstanding example of effective professional performance because it demonstrated to me that the student had the following qualities:

a. Initiative
b. Sensitivity to the needs of the Department
c. Willingness to share the responsibilities of the Department
d. Willingness to put the needs of the Department in a higher priority than her own needs.

16. Situation:

The student is performing partial thromboplastin times (ptt) and prothrombin times (pt). The normal ptt range is 23-35 seconds. The student's results on a patient's sample are within the normal range for the pt. The ptt result is 10 seconds.

Student behavior:

The student reports the pt and ptt results to the physician.

The ptt result is an unreasonably short time. Since the pt was normal, the specimen collected was probably satisfactory. The ptt should be repeated.

If the value is still short, a commercial control should be used to check if the reagents and equipment are functioning properly.

17. Situation:

The student is operating the coulter Senior. He obtains the following results: white blood cell=2.0×10^3, red blood cell count=1.8×10^6 hematocrit=10%, hemoglobin=3.3. The blood is from a person being admitted to the hospital for eye surgery. The student has previously made a wedge smear from this blood.

Student behavior:

The student reports the results to the physician.

The values are abnormally low for all parameters. This would not be expected for a patient of this type. A hematocrit of 10% should yield a thin watery looking wedge blood smear. These results could occur if the student had not put the sampling tip far enough into the blood and therefore has sampled blood and air. To check for a possible error the sample should be run through the coulter Senior again. If the values are still low, a commercial control should be used to check the functioning of the coulter Senior. If the coulter is functioning properly, the patient's physician should be contacted. If the physician questions the validity of the results, a new specimen should be requested.

18. Situation:

The student is performing zeta sedimentation ratios on a group of bloods which were drawn from healthy hospital employees. These results will be used to establish a normal range for a new zetafuge. The previous normal range was 41-61%. Three samples have zeta sedimentation ratios of 75%.

Student behavior:

The student questions these results and repeats the test. The values for these samples are now 52%. He checks the previous calculation of the zeta sedimentation ratio and finds that he had miscalculated the values.

The student has shown that he is aware of the previous normal values and that a new zetafuge should not drastically change the normal value range. He has taken an appropriate course of action to discover if an error had been made.

19. Situation:

The student is performing a microscopic examination of urine sediment. He sees many yeast, some of which are in the budding form. He questions whether some of the nonbudding forms are red blood cells.

Student behavior:

The student checks the previously performed dipstick results and finds that the dipstick test for blood was negative. He then questions the supervisor to find out if there is something that can be added to the sediment to lyse the red blood cells, and thus distinguish them from yeast.

The student has realized the possibility of confusing red blood cells and yeast. He has correctly referred to the dipstick results for possible confirmation of the presence of blood. He understands that the dipstick detects only free hemoglobin (not intact red blood cells), and therefore asks his supervisor for another method to distinguish red blood cells from yeast.

20. What was the situation?

Students are taught the operation of basic laboratory equipment early in their year of training. This situation concerned the use of a micro-hematocrit centrifuge.

What did the student do?

The student failed to place the screw-type lid on the centrifuge before closing the top. As a result, the micro-hematocrit tubes broke and tiny pieces of glass surrounded the area, also another worker was using a computer nearby and glass fragments landed on the computer.

What makes this dangerous?

Anyone could place a hand on the table and the pieces of glass could penetrate the skin. This can cause ugly problems. Not only does the glass penetrate the skin, but the patients blood also. Despite our

efforts to clean the area, I am sure since the glass fragments were so small, we were unable to get them all.

The student should have paid more attention to what she was doing. An extra second of thinking would have prevented this situation. Again, students should always double check their work.

21. Situation:

The student is performing partial thromboplastin times. He has been told that the upper limit of normal is 35 seconds. Three patient samples in a row have values of approximately 70 seconds.

Student behavior:

The student questions whether or not there is something wrong with the reagent or equipment. He performs a partial thromboplastin time on a commercial control and the values are within the acceptable limits. He then questions his supervisor as to whether or not these patients are receiving heparin.

This action clearly shows the student's understanding of the partial thromboplastin time procedure. He has used this understanding to take the initiative to avoid reporting out results which may be erroneous.

22. What was the situation?

In our institution, platelets counts are performed according to the Brecher-Cronkite method—hemocytometer using a phase microscope. The student was in her first two weeks rotation of a four week period in the Hematology Department. Previously, in the student lab the student had counted platelet counts using hemocytometer.

What did the student do?

She completed the platelet count—with the following numbers for her two sides—140, 178. For the final results, she averaged the two numbers to be 117 (or a platelet count of 117,000.)

a. By applying some 'common sense' and judgment, she would have caught her own mistake. Numbers 140, 178 cannot average to a 117.
b. Any student should always check—at least twice or maybe a third time—any math problem—no matter how simple it may seem to be.

23. Situation:

The students are taught basic laboratory techniques very early in the program. This is done in a student laboratory. They spend approximately five months in the student laboratory. This situation deals with the misreading of a micro-hematocrit using a circular reader. This situation was during the first two weeks' rotation in the Hematology Department. It is a policy in the department that any leukemia patient with a high WBC have a manual hemoglobin and hematocrit performed.

What did the student do?

The student was reading a micro-hematocrit using a circular reader. Instead of reading to the right of the scale (resulting in a lower value), the student read to the left of the scale (giving a higher value than the S value). The difference was 4 vol. % from the S value. Knowing the micro value was probably lower or the same as the S, I asked the student to repeat the test. He had misread the hematocrit reading.

1. Always (double or triple check) any work performed-have a system of check and balances regarding work.
2. If expected results are not obtained repeat the test.

24. Situation:

A student received a stool specimen for O & P examination. The color and consistency of the specimen were unusual.

Response:

The student noted that the color and consistency were unusual and promptly took the specimen to the pathologist and asked if this was significant.

Reason why effective:

Although the student did not know the significance of this particular specimen, she did recognize the fact that it might be significant and went to a reliable source for help and further information. She shows awareness that the medical technologist should always be alert and check out unusual observations.

25. What was the situation?

The student was in his first two weeks of a four week rotation in the Hematology Department. Previously, in the student lab the student had performed numerous classic WBC counts. On this particular day in the Hema Department the student was performing a classic WBC on a patient with a high WBC count (as reported by Coulter S). The differences now were (1) 8 weeks had passed and the student had not performed a classic count. (2) The results were to be reported if:

a. the student reproduced
b. the results were comparable to the S values

What did the student do?

As he was counting the WB cells in the hemocytometer, he noted the WBC's were clumping and therefore his two sides of the hemocytometer would not agree. He asked the opinion of a technical person and because of his observation of the clumping of the WBC's—the tube of blood was checked for a clot. It was clotted and an inaccurate report was kept from leaving the Hematology Department.

We all make mistakes, but in our school of medical technology, we try to teach the students to have a "system of checks and balances" and use sound judgment. By the students' awareness of the clumping of cells and knowing the theory behind hemocytometer cell counts- an error on a patient's chart was avoided.

26. Situation:

Student is performing approximately 50 RPR's, including some maternal specimens and some cord specimens. Among the "Reactive" results are one maternal sample and one cord, but their names are different.

Response:

Student writes "Reactive" on the reports and takes no further action before handing the reports to her instructor to review before they are sent out to the charts.

Reason why ineffective:

Student was not alert in recognizing a situation which clearly indicated the possibility of a mix-up in

in specimens. She did not recheck her work before recording the results, nor did she indicate to the instructor that there was a possibility of error. (At the instructor's request, she rechecked the maternal and cord sera, and subsequently found that she had placed the "Reactive" result on one report incorrectly—the R cord belonged to the baby of the R mother.)

27. Situation:

A student was asked by the instructor to explain the effect of specific gravity upon erythrocytes in the urine. She was unable to do so.

Response:

Upon her own initiative, at the first opportunity, the student consulted references and wrote a thorough explanation of the effect of specific gravity on rbc's and presented it to her instructor.

Reason why effective:

Shows initiative in the learning process. The student demonstrated that she recognizes that the responsibility for learning is shared by the student and the instructor.

28. Situation:

A student beginning his parasitology clinical experience is performing and O & P examination on a fecal specimen. He finds Giardia and E. coli.

Response:

He immediately tells the instructor what he has found and asks her to look at the smear and confirm.

Reason why effective:

The student made a correct tentative identification. He also recognized that he had not had sufficient experience to make the identification and report the results on his own.

29. (a). Student on nearing completion of rotation in Coagulation was given unknown factor plasma for identification and quantitation. (b) Student successful fully analyzed plasma, using aged serum and adsorbed plasma to identify deficiency and ∴ quantitation of factor. (c) The action of student showed she understood the theory and procedure necessary.

30. Situation:

A student in Urinalysis measured a 24-hour urine collection and recorded the total volume. She then discarded the entire specimen.

Response:

The student immediately recognized her error and informed her instructor what she had done.

_____:

The student took quick action to admit a mistake and the instructor was able to get another collection started immediately. The student, although having made a mistake, immediately recognized it and informed her instructor. She accepted responsibility for her own action and initiated corrective action.

31. Situation:

A student concentrated a fecal specimen for O & P. Upon looking at the concentrate under the microscope, she found what she thought to be E. histolytica.

Response:

She reported out "probable E. histolytica."

_____:

Student failed to accept responsibility for following established protocal. She did not follow up her findings by making a permanent trichrome stain to identify the organism, nor did she ask the instructor to check her findings and/or given her further instructions. She did not check the procedure manual either.

32. Situation:

Following explanation of the use of the Chemstrip 6, a student is asked by the instructor to check several urine specimens by this method.

Response:

Student dips Chemstrip 6 into urine and immediately records result for occult blood.

_____:

Student ignored directions to read this part of the Chemstrip 6 at exactly 1 minute. Shows failure to follow directions.

33. (1) Student going up on floor drawing blood and working in bacti lab with media and Bunsen burners.
(2) Wearing hair long in a shag haircut. Hair falls in front of face when drawing blood and into media and almost into burner in lab.
(3) Better to pull hair back and tie out of way in lab and on floor. Patients may feel she can't see to do work, and hair in media could be agent for transmission of organisms. Hair in burner is obviously dangerous.

34. (a) Student asked for help in discerning the type of WBC on slide at microscope. (b) On looking at WBC, observed that student was looking at cells in very thin area where RBC's are mishapen-almost square. (c) Students had been taught why such areas would give distortion-should have seen this.

35. (a) After lectures and hands on experience with the two channel Auto Analyzer, the student is expected to find 10 problems and rectify them in one hour. (b) The student identified the problems easily and had all the problems solved well within the hour limit. (c) One could observe the student was at ease and understood the mechanics of the instrument. This is particularly important because instrumentation is very much a part of the clinical lab. If one understands how an instrument works his/her performance in a lab will be an asset.

36. (a) A student in doing alkaline phosphatase stain leukocytes was to stain slides in substrate mixture for 30 minutes. (b) The student stained the slides for only 30 seconds. (c) The student in question should have read the whole procedure checking to see if reagents were available and timing of each step.

37. A student setting up 10 RBC and WBC from some lavender top tube of blood to use for both precision and accuracy and to be used in connection with quality control made the proper dilution for WBC—on autodilutor (1:500). To set up the RBC from this original dilution, the knob must be turned to 1:100, thus removing 0.1 ml of 1:500→1:50,000 for RBC dilution. (b) Instead she left knob set at 1:500 for RBC dilution and consequently had a decreased RBC and couldn't understand why. (c) She should have possibly listened better to initial instructions and/or tried to solve problem before asking for help.

38. (1) Instructor who usually works with student is ill—others are very busy.
(2) Student follows objectives and schedule, asking a minimum of questions from techs, and successfully completes day's responsibilities.
(3) Shows independence and ability to work effectively without supervision. Good qualities to have in a future employee.

39. (1) Instructor usually working with student is involved in repairing instrument in different area of lab.
(2) Student does not ask questions. Does as little as possible. What he does do does not turn out. Accomplishes little and decides this is no problem—he can do it another day—but usually does not.
(3) Better action as in III-3 of Effective.

40. (1) Student has exam (preannounced) on a certain day.
(2) Student calls in sick and then wants to make up test on next day (after having had more time to study).
(3) Better not dodge tests or abuse sick days. Honestly take exam and see how well you do compared to others—not taking unfair advantage of others.

41. (a) The student rotating through blood bank was given oral directions and a demonstration on pooling platelets. The student was then observed while they pooled platelets. The next time platelets had to be pooled, the student was expected to accomplish this task individually, after being asked if he could "handle it" alone. (b) Student followed clerical procedures perfectly. He pooled the units of platelets and informed the nurse that the platelets were ready. While waiting for the R.N. to pick up the platelet, we noticed that they were leaking onto the counter top. The student had forgotten to seal the unit after pooling the platelet. Due to the error the platelet were lost due to contamination of the unit and the volume of platelets still remaining in the unit could not be determined. (c) If the student was unsure of the procedure or felt the least bit hesitant to pool the platelets, he should of asked for assistance. No one is ever penalized when asking for help. Everyone must know their own limits.

42. Situation:

A CSF was received from the emergency room for a WBC count. The student had been taught the correct procedure for this test and had performed it correctly without supervision several times previously.

Breifly, the information needed is:

A. the amount of CSF
B. the color and turbidity (if present) of the CSF; presence of xanthochromia
C. a WBC count, including a differential if more than 10 WBC/mm^3 are seen:

    1. number of WBC/mm^3
    2. % lymphocytes
    3. % polynucleated cells

Students Performance:

The student did the WBC count and the differential, but failed to record the amount of CSF, the color, the turbidity, or the presence of xanthochromia (the specimen was xanthochromic). Also, the student reported out % polynucleated cells and % mononucleated cells instead of % polynucleated cells and % lymphocytes.

Expected Behavior:

The student should have referred to the procedure manual or asked one of the Medical Technologists in the lab at the time. The CSF had to be reevaluated by one of the staff because of the incompleteness of the student's evaluation.

43. (1) Student drawing blood from outpatient. Outpatient confused, upset because wife was supposed to pick him up and is not there.
(2) Student helped find patient's wife and made sure things were straightened out before leaving the patient.
(3) Was espcially effective because helped public image of profession, promoted good will, provided service to patient.
Much better than leaving patient to figure out own problem.

44. (1) Student, upon returning from floor, discovers a tech has called in sick, and there is a pile of slips to be picked up yet.
(2) Student volunteers to go up and draw these people.
(3) Shows responsibility and willingness to help others. Student could have ignored problem and left it for others to handle.

45. The Medical Technology student in question had spent 4 1/2 weeks at the bench in our blood bank. Much of the teaching is repetitive in stressing more important aspects of working in this department. One afternoon, as I was sitting with the student at the bench, I posed hypothetical problem cases for comment. What I desired from her was an ability to correlate information already proven and decide what to do next in logical order to arrive at a satisfactory conclusion. Thus to identify the problem and be able to supply compatible blood in spite of the difficulty.

What the student did was to answer my questions with extreme rapidity and correctness. She had been able to determine what steps to take in proper order and knew in which direction to proceed. She showed tremendous correlation of information and ability to use it to its best advantage.

46. Situation:

The students in blood bank were beginning their day at 8:00 A.M. The department instructor and education coordinator decided that the department could be covered more effectively if they began at 7:00 A.M.

Response:

One student complained that it wasn't fair to require the rest of the students to come in an hour earlier than the first two students.

Appropriate Behavior:

This student should have realized that the change was ultimately for their benefit. (The reasons had been discussed with all of the students.) A more appropriate attitude would have been the realization that they would be better qualified in the department.

47. Situation:

Chemistry department—ABA enzyme procedures. After lunch the student noticed she had run the wrong patient specimen and placed the value on the daysheet. Results were not reported on the requisition.

Response:

The student sent another student after the correct patient sample and reran the proper specimen.

Appropriate Behavior:

The student should have informed the department instructor who could have checked to be sure nothing was reported on the phone from the daysheet. She should also have obtained the correct specimen herself.

48. Situation:

Chemistry department—cholesterol procedure. The abnormal control was greater than ± 2 SD. from the mean.

Response:

The student reran the same control on a few patients. The second control value was closer but still out of control. The student released the patient results (none of the patient values checked had changed changed). The department instructor caught the error and had the student follow the proper procedure.

Appropriate Behavior:

Both the same vial and new vial of control should have been rerun with a few patient specimens. When this was done, it was confirmed that the original control was in error (probably a dilution problem) and the new control showed the procedure to be in control.

49. Several employees in the department were out sick one day. Hematology and Urinalysis were very short handed and very busy. The student in urines was told to begin the morning run and yell if she needed help. She handled the department single-handedly and very competently all morning.

This action showed not only good initiative and organization on the part of the student, but it also showed that she could remain calm under pressure and completely handle a heavy workload. She was a great asset to the department.

50. Situation:

Coagulation department—platelet aggregation procedure. The patient's test was completed and showed normal aggregation responses. The control was run with ristocetin and gave no response. Unfortunately, the controls for this procedure—a coworker on no medication and assumed to be normal—are less than desirable; and such a result was entirely possible. However, the student noticed that the reagent diluent bottle was sitting beside the diluted reagent with the same colored label.

Response:

Even though the patient value was unaffected, the control was repeated—double checking to use the diluted

ristocetin reagent. The value changed and the report form was recopied correctly.

Reason:

This student understood that even though the patient's value was not affected, we must strive for total accuracy. A questionable control value does not serve to lend credence to the laboratory's work.

Please classify the attached incidents into categories as listed on the Observational Instrument:

1_____	11_____	21_____	31_____	41_____
2_____	12_____	22_____	32_____	42_____
3_____	13_____	23_____	33_____	43_____
4_____	14_____	24_____	34_____	44_____
5_____	15_____	25_____	35_____	45_____
6_____	16_____	26_____	36_____	46_____
7_____	17_____	27_____	37_____	47_____
8_____	18_____	28_____	38_____	48_____
9_____	19_____	29_____	39_____	49_____
10_____	20_____	30_____	40_____	50_____

VITA

Joseph K. Semak, son of Joseph Semak and Stephnie Krupa Semak, was born at Newark, New Jersey, in 1938. He graduated from Seton Hall Preparatory School, South Orange, New Jersey, in 1956 and Seton Hall University, South Orange, New Jersey, in 1960 with a Bachelor of Arts in Natural Science.

From 1960 to 1962, he attended Marquette University School of Dentistry. In 1962-1963, he attended the University of Pennsylvania Graduate School of Microbiology on a fellowship from Marquette University.

He joined the United States Army in 1964 attending a service school in medical laboratory technology at Walter Reed Army Medical Center in Washington, District of Columbia, from 1965 to 1966.

From 1966 to 1968 while on active duty for the United States Army, he served as Assistant Director of the Army European Blood Bank where he also supervised immunohematology reference section. From 1968 to 1969 he served in Vietnam in the capacity of Chief of Chemistry supervising chemistry section directly supporting two 1,000 bed hospitals. He was awarded The Army Commendation Medal for Meritorious Service and attained the rank of major.

From 1970 to 1972 he held civilian laboratory positions being chief technologist in a 125 bed hospital and a 450 bed hospital.

In 1972 he became coordinator of Allied Health Programs at Cleveland State Community College in Cleveland, Tennessee. Under his direction the Medical Laboratory Technology, Respiratory Therapy and Dental Laboratory Programs have achieved accreditation status. Currently he is Head of the Department of Allied Health.

He is a member of Omnicro Tau Theta, the American Society of Clinical Pathologists, the American Society for Medical Technology, and president elect of the Chattanooga Society of Medical Technology.