August 1979

To the Graduate Council:

I am submitting herewith a dissertation written by Annot Faye Littlepage entitled "The Identification of Current Competencies for Entry into the Career Phase of Medical Laboratory Technology." 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.

George W. Wiegers, Jr., Major Professor

We have read this dissertation and recommend its acceptance:

Accepted for the Council:

Vice Chancellor
Graduate Studies and Research

THE IDENTIFICATION OF CURRENT COMPETENCIES FOR ENTRY INTO THE CAREER PHASE OF MEDICAL LABORATORY TECHNOLOGY

A Dissertation

Presented for the

Doctor of Education

Degree

The University of Tennessee, Knoxville

Annot Faye Littlepage

August 1979

ACKNOWLEDGMENT

In an investigation of this type, the assistance and cooperation of many individuals are essential. The limitation of space will not permit listing everyone who contributed to the study. The researcher, however, would like to give acknowledgment to those most directly involved.

Appreciation is expressed to those colleagues and students in medical laboratory technology who participated in and made possible this study.

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ABSTRACT

The primary purpose of this study was to identify the current essential competencies for career entry level medical laboratory technologists. A second purpose was to examine the curriculum placement of the essential competencies. Educational coordinators, instructors, instructors, and students of accredited schools of medical laboratory technology participated.

The continental United States was divided into regions to ensure regional representation in the sample. The schools were stratified so that the final population (170 schools) consisted of all accredited schools approved for an enrollment of at least fifteen students. A random sample of 118 schools was drawn.

Ninety-one competency statements were included in the questionnaire. The instrument used for the collection of data was developed from professional journals, articles, and similar studies. The opinions of the educational coordinators (56), instructors (154), and students (176) were compared to determine the different levels of "Essential" and "Non-Essential." Each respondent was asked to place the essential competencies in either the "Pre-clinical" academic or the "Clinical" hospital phase of the curriculum.

From the list of ninety-one competencies included on the instrument, seventy-nine were considered essential by at least 75 percent of each of the three groups. Some of the competencies deleted were important only

a few years ago. This reflects the changing technology in the field. When the opinions of the educational coordinators were compared with those of the instructors there were no significant differences as to which of the statements were "Essential." However when the opinions of instructors were compared with those of students significant differences became apparent. Comparison of the responses from the educational coordinators and students showed few areas of difference. The same patterns were apparent in curriculum placement. The students generally responded that more of the competencies should be acquired in the "Preclinical" phase of their educational experiences.

The ratio of preclinical to clinical placement was 1 to 3 (22 competencies in preclinical, 65 competencies in clinical), this the opposite of the time allotment in the curriculum.

The following were the conclusions:

1. In general the competencies identified were essential for the education of medical laboratory technologists.

2. The essential competencies should be gained in either the academic or the hospital setting with the major portion to be acquired in the clinical training phase.

3. Some competencies should be addressed in both phases of a student's professional preparation.

4. Respondents perceived placement of the competencies in the curriculum according to their position in the educational program.

5. Competencies needed for entry into the field of medical laboratory technology change over time.

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CHAPTER I

INTRODUCTION TO THE STUDY

In sixteenth century England the physician was trained in philosophy at the university. The surgeon, trained in an apprenticeship, and the barber, trained for blood letting, made up the rest of the health care team. Medicine was practiced in a different manner. Reiser stated:

> In the seventeenth century, the physician principally used verbal and visual techniques to make a diagnosis. He listened to a patient's description of his symptoms, and observed his appearance and that of his body fluids. In the beginning of the nineteenth century physicians continued to evaluate illness in the same manner as their predecessors had done. However, the physician began increasingly to use manual techniques (1978, p. 22).

Gradually dentists, pharmacists, and nurses were added to the health care team. As the number of support personnel increased even doctors interested in performing new diagnostic techniques and using newly developed technologies left these procedures to technical specialists. This fragmentation of duties has been pronounced since the 1950's. By 1974 over 400 groups, other than physicians, were identified in the health care field (Goldstein, 1972, p. 13).

There has been no fine line dividing the different groups according to educational requirements or areas of expertise. This has begun to change over the last few years. The training of allied health personnel, medical technologists in particular, has generally changed from totally hospital based programs to university coordinated programs that include a hospital practicum. Two of the reasons for this change are the increasing costs of educational programs for the hospital and increasingly complex technology. This transition from hospital training to university or college training has been identified as one way of cutting hospital costs for patients. Kerr stated: "this trend embraces the philosophy of charging educational costs to educational institutions supported by the public tax base" (1966, p. 4). Previously this cost had been absorbed into charges for patient care by each teaching hospital.

The increased complexity of technical knowledge required in the allied health professions is reflected in the training program format. In diagnostic medicine, this has led to the development of a highly structured program. The Allied Medical Education Directory (1978, p. 238) states that the student must complete a minimum of 90 semester hours or 135 quarter hours of academic credit in an approved college or university. These credits must include hours in biology, chemistry, microbiology, and mathematics. The college experience is to be followed by a minimum of twelve months or the equivalent of field experience in an approved clinical laboratory.

One route to becoming a medical technologist consists of three years on the university campus with the fourth year of the baccalaureate degree program in the clinical facility. In the literature and related journals this format is referred to as the "3 + 1" design. Because of the limited number of clinical training spaces in the hospitals some students choose to complete the Bachelor of Arts or the Bachelor of

Science degree prior to application for admission into the clinical phase to improve their chances for admission. An alternative, found in a few schools, is a program consisting of two years of college plus two years in the clinical phase. This is called the "2 + 2" design. One advantage of this program format is that the expanding volume of clinical material can be spread over two calendar years.

A new design has recently emerged. The "integrated" design offers field experiences in the freshman year or during the following summer. Throughout the remainder of the training a particular sequence is followed. First a theoretical base is developed. A simulated laboratory experience is provided to develop a level of mastery prior to participation in clinical experiences. For this design to be functional the hospital and university must be in close proximity. An expanded time commitment is required of both the university faculty and the hospital instructional staff to coordinate the parallel components of this program.

The student who successfully completes the whole program may apply to the Board of Registry of the American Society of Clinical Pathologists to take the national examination. Individuals meeting the requirements of the Board are recognized as medical technologists or MT(ASCB). The Department of Health, Education, and Welfare also provides recognition by offering an examination. In addition some states require laboratory personnel to pass a licensing examination to work in a clinical facility. This growing trend toward state licensing and additional national examinations is one factor decreasing the number of medical technologists entering the work force. A second factor is limited clinical facilities. "In medical technology education student selection at some level is becoming necessary, as most programs have limited clinical facilities" (Youse, 1977, p. 127). These factors have emphasized the need for training programs which are relevant to the job role. This has led to a close examination and evaluation of the total curriculum.

The special report by the Carnegie Commission on Higher Education dealing with educating the members of the health care team stated

> Among the responsibilities which the universities should undertake are: to develop more effective integrated educational programs for the total health care team, and to cooperate in the development of educational programs for allied health specialties (1970, p. 91).

The response to this challenge by the universities and professional societies has directed programs for medical technologists toward a competency-based system.

I. STATEMENT OF THE PROBLEM

Modern clinical laboratories are staffed, according to AMA guidelines, by trained personnel. The knowledge and skills required by the staff change constantly as medical laboratory technology advances. This situation gives rise to changes in the educational requirements. What are the essential competencies currently needed at career entry into the role of medical technologist? There are two parts to the clinical technologist's training: the university campus and the teaching hospital. In which phase of training should each essential competency be acquired?

II. ANALYSIS OF THE PROBLEM

This study answers the following questions:

1. What are the essential competencies currently needed by an entry level medical laboratory technologist?

2. Is there a difference in the opinions of educational coordinators and instructors regarding current essential competencies?

3. Is there a difference in the opinions of instructors and students regarding current essential competencies?

4. Is there a difference in the opinions of educational coordinators and students regarding current essential competencies?

5. In which phase of training should each of the essential competencies be acquired?

6. Is there a difference in the opinions of educational coordinators and instructors as to the phase of training in which competencies should be acquired?

7. Is there a difference in the opinions of instructors and students as to the phase of training in which competencies should be acquired?

8. Is there a difference in the opinions of educational coordinators and students as to the phase of training in which competencies should be acquired?

III. IMPORTANCE OF THE STUDY

There has been a progressively greater reliance by physicians on the reports, examinations, and procedures from the medical laboratories. "The modern technology of diagnosis unquestionably provides insights into the process of disease" stated Reiser (1978, p. 158). This dependence has placed greater responsibility on laboratory personnel to perform in an efficient and skillful manner. Schools of medical technology are challenged to maintain a viable curriculum in the face of accelerated development of medical knowledge, increasingly sophisticated instrumentation, and new involved protocols. The curriculum must remain current to fulfill the needs of the students and patients.

Crowley's study on educating medical technologists recommended:

1. The number of educational opportunities must be increased to meet the demands of an expanded universe of laboratory professionals.
2. Current educational programs must be restructured to relate to specific competence requirements.
3. A system must be established that will provide the mechanism to update competence requirements and related educational programs.
4. Educational approaches must be developed to improve the efficiency and effectiveness with which education is provided (1978, p. 412).

IV. SCOPE AND DELIMITATION OF THE STUDY

The study was limited to data that could be obtained by means of a survey. An instrument was developed after a review of literature and a pilot study. This pilot study was conducted to obtain recommendations from selected medical technology instructors as to the accuracy, clarity, and structure of the competencies listed on the questionnaire.

The population for the study included only programs of clinical instruction listed as accredited in the Allied Medical Education Directory/7th edition. These programs had participated in the voluntary accreditation process as prescribed under the guidelines of the Council on Medical Education of the American Medical Association. Programs outside the continential United States were not included.

The competencies acquired after employment in a clinical facility were not included. Only the opinions of the program directors/educational coordinators, the instructors and students of the programs were included in developing the list of current essential competency statements. Pathologists, laboratory managers, and chief technologists were used as a jury of prospective employers to consider the final list of statements.

V. ASSUMPTIONS

The following basic assumptions were made for this study:

1. Survey research would yield the data required.
2. A questionnaire would aid in the identification of current essential competencies.
3. The current essential competencies needed by students in medical technology training were identifiable.
4. Students now in the clinical phase of training can provide valuable data for this study.

5. The educational coordinators or project directors in the schools of medical technology were specialists in the field.

6. The instructors in the clinical facility were specialists in the field.

7. Educational coordinators, instructors, and students were able to determine those competencies which are currently essential.

8. Educational coordinators, instructors, and students were able to determine in which phase of training a competency should be acquired.

VI. DEFINITIONS OF TERMS

AMA. The recognized abbreviation for the American Medical Association.

AMED--The Allied Medical Education Directory--lists all of the American Medical Association accredited Allied Health educational programs.

ASCP. The recognized abbreviation for the American Society of Clinical Pathologists, a specialty board within the American Medical Association which sponsors the national examination for the Board of Registry of medical technologists.

Clinical facility. A hospital or other health care institution that has an accredited program for training medical technologists.

Competency. Achievement of the knowledge, skills, and attitudes required to perform a given task (Norton and Huang, 1975, p. 22).

Educational coordinator. A qualified medical technologist who has education and experience acceptable to the National Accrediting Agency for Clinical Laboratory Sciences and to the Committee on Allied Health Education and Accreditation and who has a master's or doctoral degree and at least three years of experience in medical technology education. Medical Technologists who are certified and who are without advance degree(s) shall qualify if they have five years post-baccalaureate years of experience in medical technology education education acceptable to NAACLS and CAHEA (AMED, 1978, p. 239).

Essential. Something necessary, fundamental, or indispensable (Guralnik, 1976).

Instructor. A qualified medical technologist employed by the health care facility who must demonstrate on a continuing basis through education, certification, or experience, the ability to contribute information and/or teach skills at the medical technology (baccalaureate) level (AMED, 1978, p. 239).

Medical Laboratory Technician (MLT). The intermediate level on the laboratory career ladder. The MLT performs some complicated laboratory procedures and requires only a limited amount of supervision, but does not undertake the supervisory and educational responsibilities of the medical technologist (ASCP, 1976).

Medical Technologist (MT) / clinical laboratory scientist. A person qualified by education and experience to perform clinical laboratory procedures requiring the exercise of independent judgement and discretion, holds a B. S. or B. A. degree and has had at least twelve months training or the equivalent in an accredited school of medical technology (ASCP, 1976).

Preclinical training. The required academic course work in an accredited university program.

Student. A senior (baccalaureate degree level) or a first year graduate student in the clinical phase of an accredited medical technology program.

VII. PROCEDURES

A review of the literature resulted in the compilation of many possible aspects of training for prospective medical technologists. The important components that have led to the development of current curricula trends were: (1) the education of medical and allied health professions students; (2) survey research; (3) development of competency-based education; (4) competency-based teacher education; and (5) competencies in the allied health field.

The instrument for the survey was developed from competency statements gleaned from the literature and from colleagues. One study by members of the American Society of Medical Technologists yielded significant material. Selected statements and portions of statements from the newsletter of August 1976 and the report, "Career Entry Statements of Competence- Clinical Laboratory Sciences," were incorporated with permission. (See letter Appendix B).

The instrument was then pilot tested. This testing was to refine the statements of competency prior to mailing. The major changes in the instrument as a result of the pilot study were to include more of the statements in the "Clinical Laboratory - General" segment of the questionnaire and to delete these statements from each specialty area. In this way the number of statements was reduced.

For the purpose of the study, data were secured from a random sample of laboratory personnel involved in accredited schools of medical laboratory technology across the nation. Respondents from each school included the educational coordinator, instructors, and senior students. The final listing was examined by a jury of pathologists, chief technologists, and laboratory managers. Each was asked if he or she considered these statements the current essential competencies for new career entry level employees in the position of medical technologist.

VIII. ORGANIZATION OF THE STUDY

The main body of the study is reported in five chapters. In addition, reference materials are included in the form of a list of references and a set of appendices.

Chapter I contains an introduction to the study, statement of the problem, analysis of the problem, importance of the study, scope and delimitation of the study, assumptions, definitions of terms, and procedures. The organization of the study is also included.

Chapter II presents the results of the review of related literature. The review was conducted to obtain materials and information from other research and projects relative to the study.

Chapter III contains the procedures for collecting and analysing the data. Included are the instrumentation, the definition of the population, the selection of the sample, the collection and coding of the data, and the statistical procedures employed to analyze the data.

Chapter IV contains the essential competencies as identified by the educational coordinators, instructors and students. Additional analyses are presented regarding the placement of the essential competencies within the structure of the curriculum. The final list prepared for validation is included.

Chapter V is the concluding chapter in the study. A summary of the findings, conclusions drawn from the findings, observations, and recommendations are given.

CHAPTER II

REVIEW OF LITERATURE

I. INTRODUCTION

Five areas of literature were considered for this study. These areas were: education of medical and allied health professions students, survey research, competencies in education, competency-based teacher education, and competencies in the allied health field. To understand the dilemma in the allied health professions, some historical data proved helpful. The growth and development in these fields have depended upon the quality of medical education. Roush stated:

> The research findings of medical education research units could be applied to many professional schools. Changes in any curriculum need to be systematically evaluated. The phenomenon of "change for the sake of change" could be abandoned; change because of educational evidence can replace it (1974, p. 340).

II. EDUCATION OF MEDICAL AND ALLIED HEALTH PROFESSIONS STUDENTS

In the seventeenth century there were two ways to obtain a medical education. One group, the physicians, attended the university where they majored in philosophy. The techniques used in treatment and diagnosis relied on what the patient disclosed about his illness to the doctor. The doctor was also taught to observe the patient for signs of illness, changes in physical appearance and in behavior. The surgeon was taught in an apprenticeship situation. Anatomy was studied by dissection of animals other than man. Through the years both aspects of a physician were incorporated into one role (Reiser, 1978, p. 1).

The application of chemistry to evaluate disease developed during the 1840's. Reiser stated:

> as physicians came to recognize that a chemical evaluation of disease, like a microscopial one, required skills, experience, and apparatus they generally lacked, they were increasingly inclined to forfeit their warrant to apply these techniques and interpret their findings, and to delegate this right to other physicians and lay experts. Many of these specialists organized their work in an institution that was to be prominent in and crucial to twentieth century medical practice - the diagnostic laboratory (1978, p. 139).

Until the early 1900's physicians in the United States were trained largely by reading and apprenticeship. Medicine in the United States was held in low esteem. Conditions deteriorated until 1910 when the Flexner Report was released. At this time there were 135 medical schools. After the expose only 75 medical schools remained. The main areas of concern were: (1) the relation and interpretation of university and medical school curricula; (2) strict standards for admission and instruction; and (3) the need to provide full time faculty for hospital and laboratory (Coggeshall, 1969, p. 162). Glaser stated: "one can date the beginning of quality medical education on a significant scale in the United States to 1910" (1971, p. 19).

In 1875 at the University of Michigan in Ann Arbor the first clinical laboratory was founded. In 1908, Dr. Todd produced a Manual of Clinical Diagnosis (Coltey, 1978, p. 2). This book later became known as Todd and Sanford. It remained the laboratory bible for many years (Williams, 1971, p. 10). The first laboratory training school was established in 1922 at the University of Minnesota (Coltey, 1978, p. 2). There are now schools of Medical Technology in every state. Coggeshall (1969) stated:

> Surgery, radiology and diagnostic laboratories especially, are utilizing a veritable spawn of new devices that are profoundly altering the practice of medicine, the education of the physician, and particularly the training of nurses and technicians (p. 165).

The structure of admission and the number of students accepted into medical and allied health professions became and still is tightly controlled. Pressures have been applied to increase enrollments without loss of quality. Medical technology like medicine is facing the problem of a large group of excellent students and few clinical training spaces. Youse and Clark (1977) stated: "student selection at some level is becoming necessary, as most programs have only limited clinical facilities" (p. 127).

Some medical technology schools have developed several tools for selection criteria. Enright stated:

> The range of admission criteria used by schools of allied health includes test scores, including aptitude, achievement, intelligence and psychological tests, previous academic records, which is most represented by cumulative average; prerequisite courses that would be required for successful completion of the required course work; personal interviews; and letters of recommendation (1972, p. 154).

The Carnegie Commission in Higher Education in its special report "Higher Education and the Nation's Health Policies for Medical and Dental Education" made some applicable recommendations. The Commission asserted that:

> many of the reforms being sought by the students deserved serious consideration. They (the students) called for more carefully integrated relationships between basic science course work and clinical instruction. Also among the responsibilities which the universities should undertake were the development of more effective integrated educational programs for the total health care teams, and cooperation in development of educational programs for allied health specialties (1970, p. 91).

Education in the allied health fields must provide the students with more than just a factual background. Jason wrote:

> Education, ideally, is a form of supervised rehearsal for the part one is to play in one's career. Much as an actor needs to practice separate components of his total characterization during the early stages of rehearsal, so must the student practice manageable segments of the total role he is eventually to play. But at all times both actor and student need a clear understanding of the final total role toward which he is moving, if the rehearsal is to be productive and efficient (1970, p. 2095).

III. SURVEY RESEARCH

The survey is a useful tool for getting descriptive data which people can provide from their own experience. It is not a good method for establishing cause and effect. The researcher should state specifically and in detail the information he needs (Hayman, 1968, p. 75). Oppenheim discussed the questionnaire's advantages. These were low cost and the ability to secure information from a large sample. He suggested that (1) finalized form should be developed after thorough field testing, (2) each question should contain only one idea, and (3) loss of information may be due to ambiguous questions, coding problems, or incorrect interpretation (1966, p. 23). Questionnaires should be written with concerns for (1) language, (2) arrangement of the questions, (3) length of questionnaire, (4) form of response, and (5) organization of data (Young, 1966, p. 322).

Bushnell Study

Bushnell (1973) in his report on Project Focus, a W. K. Kellogg Foundation nationwide study, surveyed the America Community College of 1970. "The purpose of this study was to determine where community colleges are headed, how likely they are to get there and what alternative strategies ought to be considered" (p. 1). Survey instruments were mailed to selected institutions. Students, faculty, and presidents completed separate instruments. Questionnaires for the institutions provided basic data about each school. A subsample of institutions was selected from the larger sample for purposes of interviewing staff. The goals of the community colleges were then each given a rank order and a mean score. In the considered role of competencies for success three of Bushnell's comments were valid:

> (1) The concept of "organic curriculum" combines the need to develop intellectual skills with those required for entry into an occupation, examples of a successful melding process are difficult to find (p. 100).
>
> (2) The rise of service organizations, for example, has put a premium on communication skills (writing, listening, speaking and reading skills) which were not as much in demand during an earlier era with a production oriented society (p. 101).
>
> (3) Standardized achievement test scores have been found to be poor predictors of a student's performance in occupational education. Measures of verbal ability do not help predict the student's manipulative abilities (p. 111).

Even though the comments sited pertain to community colleges, the recognition that service areas such as the allied health professions may need new and additional skills was one reason for this research project. The difficulty of evaluation in clinical or manipulative areas was another area of concern when developing the survey questionnaire.

Brown Study

The B. J. Brown (1971) study concerned evaluation by supervisors and students to determine teaching effectiveness. The study included both mailed questionnaires and interviews in terms of methodology. One basic premise was that students could provide reliable information about learning and teaching situations in which they were personally involved. In defining successful behavior students and supervisors could identify both good and poor patterns of classroom teacher behavior.

The primary purpose of the Brown study was to determine if there was a relationship between student's and supervisors' evaluation of general business teachers' effectiveness. The secondary purpose was to identify qualities of characteristics of effective teachers in general business courses.

A questionnaire was administered to students in general business classes in East Tennessee high schools with the cooperation of business teachers and school counselors. Students were asked to test examples of behaviors they had observed in class that they considered good teaching and poor teaching. A total of 538 students for 21 classes were polled. Those behaviors that were mentioned repeatedly were included in the performance checklist. There were thirty-four specimens of poor behavior and thirty-four specimens of good behavior included in the final checklist.

After completing the checklist students were also asked to give the teacher a grade based on the sum of their observations.

The form used by the immediate supervisors was a collection of characteristics of an effective general business teacher as identified by a panel of eight recognized leaders in general business education. This list was developed by using the DELPHI Technique.

The population consisted of 102 high schools in East Tennessee. The sample included thirty business teachers selected from those schools. Each teacher was evaluated by their students in one general business class using the performance checklist. For the immediate superviosr the teacher chose that supervisor considered most able to evaluate teaching performance. "There was a positive relationship between the evaluation of teacher effectiveness by students and immediate supervisors" (p. 143). However, there were differences in criteria used by supervisors and students in evaluating teacher effectiveness. Brown concluded:

> Apparently, factors other than teaching experiences, such as the personality of the teacher, rapport with students, and involvement of students in a variety of activities in the classroom, play a more important part in teaching effectiveness as evaluated by immediate supervisors and students (p. 152).

The use of student observation in determining teacher effectiveness in the Brown study aided this researcher in deciding to include student observations in determination of professional preparation needs.

Harrison Study

The purposes of the Harrison (1979) study were to identify, validate, and verify evaluation criteria for secondary consumer and homemaking programs. The competencies and perceptions among teacher educators, state directors of secondary vocational programs, and state supervisors of home economics were also examined in regard to these criteria.

Harrison used a survey combined with the DELPHI technique to establish a valid list of criteria for program evaluation. Those criteria selected for the final statement were rated "Essential" by at least 80 percent of the panel of experts. Of the original 181 statements and their subparts, the panel of experts rated 147 statements and their subparts "Essential" for evaluating secondary consumer and homemaking programs (p. 28).

This study emphasized the importance of continuing evaluation in the implementation, maintenance, and quality assurance of programs. The research showed that the product as well as the educational process must be considered. The structure of the survey instrument used by Harrison aided this researcher.

IV. COMPETENCIES IN EDUCATION

In an attempt to improve instructions in higher and vocational education there has been an accelerated trend toward development of competency-based programs. Ralph Tyler wrote:

> if an educational program is to be planned and if efforts for continued improvement are to be made, it is very necessary to have some conception of the goals that are being aimed at (1949, p. 3).

Another educator Robert Mager, (1962) has said "If you're not sure where you are going, you liable to end up some place else and not even know it." Most of the early work in the area of competency-based education concerned teacher education. Projects across the nation have helped develop a broader data base for the past two decades. Those considered for this study were Cotrell, et al (1972), Houston (1972), Craig (1967), and Porreca and Stallard (1975).

Cotrell Study

This extensive study was conducted by a group of investigators at the Center for Vocational and Technical Education at Ohio State University. The director of the project, C. J. Cotrell, and two associates directors, S. A. Chase and M. J. Molnar, supervised the development of the four phase study.

The rationale for the study was that there was a growing pressure for change in vocational-technical education. Cotrell stated:

> Shortages of adequately prepared teacher education personnel, demand for more qualified vocational and technical teachers, lack of in-service education programs for teachers and other leadership personnel, and criticism of the overlap in offerings from one vocational service area to another within an institution are representative of some of the concerns and problems which have led to the need for developing and defending core and specialized curricula for vocational and technical education (1972, p. 2).

This project, "Model Curricula for Vocational and Technical Teacher Education," had two major research phases. During Phase I a career analysis was made of teaching in the various service areas. An instrument was designed from interviews and introspection techniques of analysis. The 237 performance requirements for vocational and technical teachers were identified. These performance elements were evaluated by a task force of teacher educators, state supervisors, and master teachers from the various service areas in nineteen states. To verify these elements a critical incident technique was used with an additional group of 700 teachers. "To better communicate the meaning of the performance elements, general objectives were developed as an intermediate step between performance elements and specific objectives" (1972, p. 4).

Phase II dealt with identifying the functions of teacher-coordinators of cooperative education programs. The same techniques used in Phase I were employed. Then 385 performance elements were identified. This stage was followed by an evaluation by a 300 member national task force of teacher-coordinators from the various service areas in each state. The investigators concluded:

> (1) The performance requirements as guidelines for a career-based and relevant teacher education program are the same for secondary and post-secondary teachers of in school laboratory programs in all services, and
> (2) the requirements for teacher-coordinators of cooperative programs for all services are the same (p. 5).

The remaining portions of the project dealt with Dissemination of Results and Materials, Dissemination and Feedback for a Teacher Education Seminar, and Projections for the Future. They stated:

> This project resulted in guideline materials being developed which could be helpful to teacher educators and other state leadership personnel in: (1) designing new teacher education curricula; (2) revising existing teacher education curricula; (3) evaluating teaching and teacher education activity; and (4) establishing performance based certification requirements (1977, p. 11).

This study has acted as a spring board for studies in the various service areas. As an addition outgrowth many other professional groups and associations are considering or involved in developing competency based curricula, tests, and certification.

Craig Study

While the group at Ohio State under Cotrell developed the wide base of competencies in general vocational-technical education, Craig (1967) at Cornell was considering the relationship between vocational field training and the required competencies of that particular job in the service area of agriculture. Craig sought to define those work experiences needed to learn particular required competencies in the off-farm agricultural occupations. In addition the responsibilities of both the teacher and the employer in aiding the student develop competencies and make the transition smoothly from student to functioning employee were investigated. Another facet of the problem was to identify the difficulty than an instructor might face in developing a meaningful off-farm agricultural experience program for his students. Employer's expectations for program graduates were considered as part of this problem.

To investigate these areas Craig developed a trial model for off-farm agricultural experiences. General areas of responsibilities were synthesized. He stated:

> These areas consisted of a sequence of general teacher of agriculture and agricultural business employer responsibilities which involve students during enrollment in vocational agriculture classes offering work experience (p. 14).

Important areas of teacher responsibility were: student selection, orienting students, and supervision of students. Ninety-four percent of the teachers expressed concern for the safety of the student in the work situation. By contrast only 35 percent considered wages paid to the student as very important. Experience was also more important than the possibility for advancement. The major concern that the teachers had was the competence of the employer to supervise the student and to understand the purposes and values of the work experience (p. 123). When teachers were asked to express their concerns about student performance 97 percent considered the quality of student workmanship of prime concern. The next ranking concern was the student's interest and satisfaction.

When employers were polled about their concerns and responsibilities several areas were mentioned: student selection, number of students employed, student transportation, orienting students to the business, and the hours students worked. When wages were considered the efficiency of the student was most important to the employer. Another major responsibility of the employer was the safety of the students they employed (p. 166). Ninety-eight percent of the employers were concerned that the students understood and followed safety rules, and the students used care and good judgement while at work. Craig concluded:

> there was considerable relationship between the number of teachers and employers identifying concerns and expectations and the amount of importance placed upon these items. That is, individuals who were greatly concerned or had high expectations of each other about particular items also tended to consider the same items as very important, (p. 209).

Binkley Study

Under the supervision of Harold Binkley, the staff of the Department of Agricultural Education at the University of Kentucky decided to investigate Competencies Needed by Employees in Agricultural-Supply Business - Sales and Service. The areas to which the study was limited were off-farm agricultural occupations that sold seeds, fertilizers, feeds, agricultural chemicals, and agricultural supplies (1965, p. 3). In order to develop the pilot programs, data were collected for a survey instrument. Levels of employment that were considered in each business were: manager, sales clerk, field representative, service man, bookkeeper, and handyman. Each job was related to an area within the business such as: feeds, seeds, business, fertilizers, agricultural chemicals, and general. The manager or assistant manager was interviewed. The questions asked were:

1. What does this man do?
2. What would you like him to do better than he is now doing?
3. What would you like him to do which he cannot do now? (1965, p. 3).

From these data the survey instrument was developed in which the competencies for each level were evaluated. The data were presented in tabular form. The materials were then developed as guidelines for preparing 12th grade students of vocational agriculture for jobs in agricultural-supply businesses.

American Home Economics Association Study

In 1974, seventy-one home economics professionals participated in an invitational workshop held at Ames, Iowa. The rationale for the workshop was that teachers have traditionally been focused on developing competencies in students. They stated:

> It is important to identify the bases for addressing professional abilities of all home economists as related to their roles in the education process. Although not labeled "teacher" other home economists are involved in the teaching/learning process in their professional roles in business, extension, health, welfare, research and other areas of family/community service (1974, p. 2).

The symposium entitled "Competency-Based Professional Education in Home Economics and Criteria" had the basic assumption that assessment of professional competencies was necessary to the development of a system for evaluation of educational effectiveness (p. 4). Three major guidelines were identified: competencies serve as the basis for developing instructional strategies; the pattern of attainment of competency by individuals must be adaptable to varying requirements in employment; and field experience in the primary method of competency development in home economics. It proved feasible to establish five groups of competencies: (1) Philosophical; (2) Professional Role; (3) Program Planning; (4) Educative Process; and (5) Research. The participants concluded that these areas should be considered for both professional and preprofessional levels.

Lima Study

In the study conducted by Lima (1973) at the University of South Florida, an eight member advisory board of classroom teachers of business was used. Each teacher was asked to record every classroom task performed for two weeks. Later, a five day workshop was held to develop the catalog of business education teacher competencies from this recorded data. The participants in the workshop took the lists of task statements and identified the common competencies. The statements were then grouped into six major areas of competency: (1) Planning Instruction; (2) Executing Instruction; (3) Evaluating Instruction; (4) Classroom Management/administrative Duties; (5) Human Relations; and (6) Guidance.

By comparing this set of competencies with those developed at the Ames, Iowa symposium of the American Home Economics Association (1974) a pattern of developing competencies through effective teaching included planning, execution, evaluation, and adaptation in preprofessional and professional education. In June 1975, E. Popham stated, "to convert a task into a competency, the teacher must first determine the level of ability required to perform the task" (p. 5). The conditions under which the learner performs the task must be identified. Once a competency is stated in these terms it can become a performance goal. If the student knows the performance goals of a course then what is to be learned becomes relevant (p. 6).

Porreca and Stallard Study

In 1976, A. G. Porreca and J. Stallard conducted a project at The University of Tennessee. The purpose of the study was to verify common affective domain competencies of students in vocational-technical areas. Also this study attempted to validate, through the DELPHI technique, common affective domain competencies of students among the vocational areas of agriculture, business and office, distributive and industrial education. The procedure involved review of publications for development of a list of common affective domain competencies for the various service areas. These competencies were then verified by submission to a sample drawn from all the areas. The sample consisted of 191 persons that were employed, employers, or educators in that service area. The affective domain competencies were then validated by state level directors of vocational education to determine the degree of commonality. Forty-eight State Directors of Vocational Education participated. With this sample the DELPHI technique consisting of two probes was used. Of the 111 statements, the samples rated 110 statements above the 69 percent level. This showed that there was agreement among the state level directors of vocational education, and with employees, employers, secondary and area school vocational teachers as to what are the common needed affective domain competencies. There was also agreement as to which competencies the students should possess in each service area. There was an apparent linking or commonality of learning experiences needed by students involved in the various service areas.

V. COMPETENCY-BASED TEACHER EDUCATION

Maxwell stated:

> At least partially in response to the demand for accountability, a new pedagogy is being embraced, modeled on the systems analysis approach employed in the design of military hardware. Competency or performance based teacher education has been studied for some time in state departments of education and colleges of all states (1974, p. 306).

Consideration of the literature and studies on competency based education would be incomplete without a review of the work reported on competency-based teacher education (CBTE). In 1976 Fardig and others at the Center for Vocational Education considered the current progress of implementation of performance based teacher education. This report was the culmination of ten years of intensive effort. The first efforts had been to develop a research base for a valid program in vocational teacher education. The next step was to develop and field test materials to aid instruction. Three-hundred eighty-four professional competencies were divided into 100 separately produced individual learning booklets. These are called the Center's PBTE modules. However

> Much research work still must be done before we can conclusively link teacher competencies with student learning and occupational success.... The identified competencies constitute a far more solid foundation on which to build a teacher education curriculum than the intuitive and inbred approach to curriculum contruction that has often characterized teacher education in the past (Fardig, 1976, p. 11).

In developing the competency-based teacher education background upon which the allied health profession studies are built eight different studies and reports will be considered. Burke (1972), Cook and others (1973), Getz (1973), Graves (1974), Gunderson (1971), Houston (1972) and Norton (1976) have reported studies or considered the state of the art thus contributing to the overall data base in dealing with competencies in teacher education.

Burke Report

An individualized performance-based teacher education program (IPT) has been in operation at Weber State College, Ogden, Utah since September, 1970. The teacher education faculty there has produced individualized instructional units called WILKITS, Weber Individualized Learning Kits. The WILKIT is a unit of work intended to assist a student in the professional component of teaching training (1972, p. 41). Some students found it hard to move through the kits on their own while others found them relevant and challenging. One tendency was to save the assigned kits until the end of the grading period before completing them. This is probably a reflection of the traditional structured approach that students have learned before they enter this portion of their professional teaching preparation (1972, p. 43).

Cook Study

The Department of Vocational and Applied Arts Education at Wayne State University in 1972 reported on their VAE System. The two major components of this system were an instructional system and a management of information system. "The fact that there are two compenents is somewhat unique. Most CBTE programs give little or no attention to the development of a supporting management information system" (1972). The procedure for this study began with the compiling of a list of competencies needed by teachers. The initial list was based upon the first Cotrell project. However, the final form reflects the particular emphasis and concerns of the Wayne State faculty. The pre-certification list contains 75 competencies. To develop this list a trial list was sent to over 3,000 people. These people were involved in business and industry, vocational programs, school administration and teaching. Each competency was analyzed to identify the component parts. These parts became performance objectives. "The performance objectives are the vehicles by which the competencies are embedded in the actual instruction. Needs assessment in this model design will include testing for both exit and prerequisite skills" (1972).

Getz Study

The Professional Sequence Guide was developed at the Illinois State University, Normal. It consisted of self-paced instructional packages used as core curricula for junior and senior students in the professional education program. Getz stated

> The program is competency-based; that is, the desired teaching behaviors are specified in the selfpaced packages and a demonstration of proficiency is needed before credit is awarded (1973, p. 300).

These packets vary as to content and level of mastery. One of the difficulties is the ability to measure specific areas, such as, teacher flexibility. Some recommendations from this project are:

> More effort must be expanded in the direction of specifying those elements of the teacher's role that are not easily identifiable. Until higher order competencies are specified in instructional packages competency based programs will remain subject to the charge of content simplicity. Also a competency-based program produces special problems for evaluation. Assessment should be based on some overt performance of the student (p. 302).

This professional sequence was designed to enable students to move at their own pace. Many students had difficulty in self-pacing themselves to complete the program. They needed assistance in planning their activities and work schedules to ensure completion. An additional cautionary note was:

> teacher educators contemplating this approach may profit from the experiences of schools that have made such a change. The results are rewarding but the adjustment by staff and students is slower and more agonizing than most would suspect (p. 302).

Graves Study

In this study, Graves (1974) identified the vocational and career development competencies needed for counselors of students in grades 7 through 12 in Tennessee. The problem was to identify and determine the importance of specific competencies, in seven areas under the general category of vocational and career development. The study sought to determine what competencies are needed by the counselor to

1. develop and maintain a self-directed career education information center.
2. develop job descriptions
3. assist the student in using career cluster and career ladder concepts
4. compile and disseminate employment and vocational training opportunities
5. conduct job placement programs
6. relate to others with whom he will work in education and industry
7. plan and implement a development career education program, including prevocational programs (p. 7).

The sample for the study included local directors of vocational-technical education programs, the State Advisory Council for Vocational-Technical Education, State Department of Education personnel, supervisors of instruction and counselor educators in Tennessee. Thirty-two statements of necessary competencies were identified. The DELPHI technique (Helmer, 1966) was used to validate the statements. The jury for the DELPHI technique consisted of forty professionals from industry, business, and education. There were three probes with additions being allowed. The recommendations and results of the study were

1. counselors need to be informed of current educational and vocational training opportunities
2. counselors need skills in planning and implementing career and pre-vocational programs
3. counseling and decision making competencies are also considered important
4. inservice and preservice programs should address these three major areas of competencies needed (p. 125).

<u>Gunderson and Others Study</u>

This project from Oregon State University was reported in July of 1971. The problem of the study was to determine common professional education competencies of community college vocational instructors. Respondents for the study represented eight subject matter areas; agriculture, business and office, distributive education, health occupations, home economics, trade and industry, service occupations, and technical. The sample was drawn from four Western States; California, Colorado, Oregon, and Washington. The rationale for the study was to analyze the responses of 160 randomly selected vocational instructors representing all the vocational areas. Forty community colleges, ten per state, were chosen. Then four instructors were chosen from each community college in the sample. There was no statistical difference among the community colleges' mean scores. Gunderson, Lindahl, Miller, and Courtney concluded:

1. Community college instructors of vocational education subjects resemble one another with regard to the 99 competencies which were studied.
2. Clusters of competencies can be generated for the curriculum through the procedures of factor analysis.
3. Community colleges are very much alike in the instructor characteristics measured in this study (1971, p. 18).

Houston

Robert W. Houston has been a highly articulate proponent of CBTE. In 1974 he stated, "competency-based education was highly visible in the late 1960's and early 70's. It reflected general cultural trends as well as specific educational goals" (1974, p. vii). He had written in 1972:

> Rarely if ever has any movement swept through teacher education so rapidly or captured the attention of so many in so short a time as has the competency-based movement. Already well underway, the approach holds promise of renovating and regenerating teacher education . . . by early 1972 some 17 states either had announced certification changes to be based on competencies or had declared their interest or intention (p. ix).

In 1974 Houston and Jones developed five propositions concerning teachers.

1. The teacher is a liberally educated person with a broad background in his teaching field.
2. The teacher reflects in his actions that he is a student of human behavior.
3. The teacher makes decisions on a rational basis.
4. The teacher employs a wide variety of appropriate communication and instructional strategies.
5. The teacher exhibits behavior which reflects professionalism (p. 17).

An overview of professional competency-based education was stated in the conclusions. They wrote:

> The actions of the professional constitute an interrelationship between theoretical considerations and behavioral manifestations. The four stages of the process are: (1) goals and objectives are delineated and based on perceived needs; (2) strategies for achieving these goals and objectives are planned; (3) plans for achieving goals and objectives are implemented; and (4) the extent to which goals or objectives are achieved is evaluated (p. 19).

When the controversy swirling around CBTE settles and the court battles have been won or lost probably education will recognize this as one alternative or new approach to teaching and learning (Sandoz, 1974, p. 305). This movement has encouraged a new look at teacher certification. Also professional associations and accreditation groups are now moving into this field more wholeheartedly. Norton stated

> In the 1970's the impetus was to further individualize and make more flexible the format of education. Traditional programs are based on time and credit. Everyone started at the same point even though some were forced to repeat learned material (1976, p. 5).

VI. COMPETENCIES IN THE ALLIED HEALTH FIELD

There is a growing awareness that with greater emphasis on certification and licensure, more appropriate guidelines must be developed in the Allied Health Professions. "Education has a long history of demonstrated achievements and as such the need for education as a part of professional development and career advancement is well established" (Crowley, 1978, p. 410). Flexibility in medical education has been growing in importance during the last decade. Electives began to appear in the medical curriculum in the late 1950's. This trend reflects the growing role of the medical students in managing their own education. Students are likely to learn best in electives because they reflect what the student perceives to be in their own career interest (Bowles, 1976, p. 65). Jason wrote about medical educators

> In general we have failed to appreciate how enormously complex are the processes of acquiring effective clinical skills. We have failed to perceive that people need to work at the gradual accumulation of component competencies before being able to perform successfully any amalgamated, composite abilities (1970, p. 2094).

Five projects or studies will be reviewed in the Allied Health Professions. Those studies by Barlow (1971), Brown, R. E. (1978), Dickerson (1975), Crowley (1975), and Kettering Medical Center (1978) will be included.

Barlow and Others

The UCLA Allied Health Professions Project was conducted with Melvin Barlow (1971) as chairman. Funding was from a DHEW Grant. The purpose of the research was to develop curricula for laboratory personnel. A survey instrument was developed with the assistance of the National Technical Advisory Committee. The questionnaire contained 534 items based on a task inventory of medical laboratory occupations. The sample consisted of 224 individuals in twenty-nine institutions. Analysis of data established that routine tasks include equipment maintenance, specimen processing, and the use of laboratory equipment. Tasks in the four clinical areas of urinalysis, hematology, microbiology, and biochemistry could serve as a basis for beginning students. Other recommendations included the suggestions that some difficult training procedures should be delayed until the educational background could be developed. In addition a yearly curriculum review is necessary to insure continued relevance to educational needs. Barlow stated

> One advantage of using this skills/knowledge process approach is that the occupational requirements for the medical laboratory can be determined with a high degree of uniformity. The same skills and knowledge are required in a 300 bed modern city hospital laboratory as for the same process performed in a 50 bed remote Alaskan hospital (p. 64).

Brown Study

The work of the Competence Delineation Committee for the American Society for Medical Technologists in 1974 was reported by R. E. Brown in 1978. The complete and through list of 400 competency statements provided the springboard for the present study. The purpose of the Delineation Committee was "to develop a systemic approach to the identification of the components of competence in the profession of medical technology" (Brown, 1978, p. 399). Three categories for classifying data were established (1) task inventory, (2) statement of competence, and (3) knowledge/skills/value system.

Small groups of medical technologists in each of the disciplines of medical technology were formed into task groups. The Task Groups developed a Task Inventory for each area. Then each Task Group developed Statements of Competence that one must possess to perform these tasks. Brown wrote

> The Statements of Competence category includes a series of statements of abilities which implies the specific knowledge, skills, and test specificity and, when correlated with these elements in the other categories, describe what one must possess to function appropriately in the field (1978, p. 401).

The culmination of the work of the committee was a report entitled "Statements of Competence of Clinical Laboratory Practitioners (non-physician)" which was endorsed by the 1976 ASMT House of Delegates. In August 1976, these statements were published in the ASMT News. By February 1978, the statements had been refined and redefined to represent those competencies appropriate for career entry level medical laboratory personnel. Selected portions were used with permission (Appendix B) in this study.

Kettering Medical Center Study

The MLT/MT Ladder Curriculum Objectives report published by the Kettering Medical Center was the result of six years of research funded by the National Institute of Health and the W. K. Kellogg Foundation. The project was undertaken to develop and implement a "2 + 2" MLT/MT ladder program. The program officials felt the proposed format would result in upward mobility and would allow more time to teach the clinical materials.

The methodology for the research was based on task analysis, to establish a job difficulty rating. Frequency data was used to establish how often the task was performed.

> Each task was analyzed for knowledge, judgement, perception, and responsibility required of the performer and converted to total difficulty rating. In the Instructional Cost Effectiveness Study the tentative job roles were analyzed for their instruction time versus percent of total tests performed within each department of a clinical laboratory (1978, p. i).

Results of the study revealed that 50 percent of the total laboratory curriculum was allocated to 90-95 percent of the tests actually ordered within each department. The final curriculum outline was coded to the ASMT Position Paper on expected capabilities at career entry.

The courses were designed and sequenced to provide:

1. Opportunity for accurate career choice through actual clinical laboratory experiences in the freshman year.

2. Learning experiences in a simulated laboratory in order to maximize learning efficiency and contain instruction costs.

3. Coordinated learning experiences throughout the program in which theory is taught before simulated laboratory experience and both are sequenced before actual clinical laboratory experience.

4. Learning environment which requires students to achieve mastery level criteria but recognizes that efficiency will be gained in the first few months of employment.

5. Opportunity to gain academic credit for on-the-job training through small unit criterion-referenced examinations, including practical examinations.

6. Self-instructional materials whenever appropriate to reduce instructional costs and provide a mechanism for continuing education (1978, p. i).

The Kettering study used competency statements to develop contemporary instructional materials and curricula for the education of medical technologists. The major comment about needed curriculum changes was:

> The curriculum should include clinical correlation, infrequent-difficult tasks, education, administration and supervision, research, and quality assurance (1978, p. i).

Crowley Study

In 1975 Crowley reported on a study in curriculum design for medical technology. The purpose of this study was to utilize input of clinical laboratory educators, other practitioners, and students as sources of data in the development of an undergraduate curriculum in medical technology. "The need for this curriculum was based on stated deficiences by alumni, increased population, and changes in professional roles in medical laboratories" (Crowley, 1975, p. 45). Another basic purpose of the study was to analyze trends of program needs in medical technology education, as these trends are perceived by practitioners in the field. The DELPHI technique was modified and used in this study. The personal interview was used in the beginning of the study "to establish rapport, to elicit specific information, and to define general areas of concern" (p. 46). The sample consisted of personnel from five hospital schools affiliated with the University of Massachusetts at Amherst. Pathologists, teaching supervisors, students, and technical specialists agreed to participate. Two community colleges with MLT programs had faculty that were willing to participate. The instrument developed from the interviews consisted of forty-eight items. On the three DELPHI probes the overall response rate was 79 percent. The result showed that most of the present courses should be retained. A new course in instrumentation was strongly supported. Also course content should include decision making, troubleshooting of equipment and procedures, as well as teaching and managerial functions. The two major recommendations from the study were

1. A follow-up study should be designed to gather data relative to the placement of new courses in the preclinical or clinical portions of the curriculum.

2. A comparison study should be completed with a subject group composed of medical technology college faculty members to determine their perceptions of curriculum needs, and potential changes in the role of the laboratory personnel (p. 50).

Dickerson Study

The purpose of this study was to discover the truth to reports that considerable disagreement existed between the nursing educators and nursing service personnel. Of particular concern were the expectations of each group in terms of preparation of students for the professional roles they must play in modern health care. The questions the study sought to answer were:

1. Is there a difference in the ratings of competencies for beginning nurse practitioners by administrators in schools of nursing and administrators in nursing service?

2. What areas of nursing practice contribute to the disagreement between nursing education and nursing service personnel?

3. Is there a difference in the ratings by administrators from the three types of nursing programs with ratings by administrators of nursing service (1975, p. 3)?

Rationale for the study was based on the premise that students should be trained to handle successfully the roles they are to fill. The content of this training is based to a great degree on the role expectations of the nursing instructors and administrators of schools of nursing. However, the role expectations in the hospital depend to a great degree upon the nursing service administrators and supervisors. The discrepancy between these two sets of expectations can lead to frustration on the part of the new nurse practitioners.

The survey method of data collections was used. The instrument consisted to a rating scale of thirty competency items. The questionnaire was mailed to a sample of 292 nurses after validation by a jury of experts. One hundred and sixty-one responses were usable in the analysis of data. The sample was composed of administrators of fifty baccalaureate schools, fifty associate degree schools, sixty-five diploma schools, and the administrators of nursing services of 127 hospitals. The study population was confined to the Southern Region as defined by the National League for Nursing (1975, p. 37).

Findings from the analysis of data were:

1. There was a significant difference in the ratings of competencies for a beginning nurse practitioner between administrators of nursing education from all three types of educational programs and administrators of nursing services (p. 86).

2. All thirty competencies were rated as necessary or essential by the majority of the raters, supporting the ratings of the jurors who valididated the instrument (p. 88).

Conclusions drawn from the data were:

1. There were significant differences in the expectations of competencies for the beginning nurse practitioner as rated by administrators of nursing education and nursing service in the Southern Region (p. 89).

2. Beginning nurse practitioners do not complete their educational programs equipped with the knowledge and skills expected by the administrators of nursing service (p. 89).

3. There should be more coordination between educators and nursing service personnel in curriculum development. Since the practice of nursing remains in a constant state of change it becomes imperative for the educational preparation of nurses to be coordinated with the needs of nursing service in the delivery of care (p. 89).

These findings have serious implications for educators and employers in the other Allied Health Professions. The expense and human factors in training of personnel require that educators examine possibilities to improve the probability of satisfaction and success on the part of students upon entry into the professions. The educator also has a moral obligation to society to help provide competent personnel to aid in the care of the patient.

VII. SUMMARY

Five areas were considered in reviewing the literature as a foundation for this study. The studies reviewed traced the trend from the ancient method of teaching physicians through improved medical education to current emphasis on competency-based education by professional associations and societies.

In the gradual transition of medical education over the centuries, numerous changes have taken place. The earliest years can be characterized as a one way street. The professors expounded on philosophy and dispensed facts. As the need for clinical skills emerged hospital and laboratory experience became mandatory.

In 1910 strict admission standards were set for medical schools to improve the image of medicine and provide competent practitioners. Full time teaching and laboratory faculty, and an integrated relationship between medical school and university faculty were supported as principles for improvement (Coggeshall, 1969, p. 162). Allied health personnel were generally trained by the hospitals until after World War II. For most programs the universities now provide the theoretical foundation while the hospitals provide the hands-on and patient contact experiences. Recent developments for the education of medical technoligists include limited clinical facilities, a large pool of excellent students, and a rapid acceleration of the development of new technology and new techniques. Also students now demand an opportunity to have a part in developing what should be studied and when. "They (the students) called for more carefully integrated relationships between basic science course work and clinical instruction" (Carnegie Commission, 1970, p. 91).

Survey research has become an accepted method to accumulate data to improve and extend our knowledge. Both Bushnell (1973) and Harrison (1979) surveyed to examine different aspects of education. The B. J. Brown study (1971) used material from students as an important source of information to examine teachers' effectiveness.

The remaining studies emphasized the development of competency-based education. This alternative approach to curriculum development was first used in efforts to improve teacher education. Additional research was conducted in examining other facets of vocational-technical education. More recently studies have been carried out by professional groups to apply competency-based educational approaches to training in the particular field. The studies reported by the ASMT Committee on Delineation of Competencies and the Kettering Medical Center's <u>MLT/MT Career Ladder Curriculum</u> both illustrate this concern.

Some of the major points gleaned from the studies include:

1. Planning is highly important in quality educational programs.

2. Goal oriented instruction is more effective than the traditional method.

3. Effective execution of teaching depends upon identifying the level of ability to be developed for performance of the task and the conditions under which the student performs the task (Lima, 1973).

4. Improved flexibility in the curriculum is needed in both materials and evaluation. The curriculum must be flexible enough to change to meet current needs. The addition of course work in decision making, instrumentation, and management was strongly supported for medical technology students by Crowley (1975).

5. Individualized self paced instruction should be encouraged. However, students who are products of our highly structured public secondary schools need assistance in planning their activities and work schedules to insure completion of packets (Burke, 1972).

6. There should be general agreement between educators and employers as to the expected competencies for entry level personnel.

7. For effective field experiences teacher/employer cooperation is essential (Craig, 1967).

8. Educational guidelines should be developed from identified competencies.

9. Assessment of professional competencies was necessary to the development of a system for evaluation of educational effectiveness (American Home Economics Association, 1974).

Houston (1974) wrote that there were four stages in the process of competency-based education:

1. Goals and objectives are delineated and based on perceived needs.

2. Strategies for achieving these goals and objectives are planned.

3. Plans for achieving goals and objectives are implemented and

4. the extent to which goals and objectives are achieved are evaluated (p. 19).

These points emphasize the need for a continuous planning and evaluation for education to remain current in clinical laboratory and educational sciences. Reevaluation, objectives, planning, and implementation should be the four major concerns in the cycle of contemporary education. In this respect, competency-based education has developed into a significant alternative in modern education.

CHAPTER III

PROCEDURES FOR COLLECTING AND ANALYZING THE DATA

The methodology for this study was a questionnaire. The instrument consisted of a list of competency statements for determination of current need in the preparation of an entry level medical technologist. Opinions from educational coordinators, instructors, and students were secured to determine which competencies they considered currently essential. Opinions were also requested as to where in the curricula these competencies were to be acquired. The purposes of this chapter are to describe (1) development of the instrument, (2) definition of the sample, (3) collection and coding of the data, and (4) statistical procedures employed.

I. INSTRUMENTATION

Data for this study were collected by means of a questionnaire. Competency statements for career entry into the field of medical laboratory technology were listed. One of the purposes was to identify current essential competencies. The survey of literature aided in choosing competencies that were included on the first draft of the questionnaire. The report developed by the Competency Delineation Committee for the American Society of Technologists (1976) was used as a major source with permission (Appendix B). Only selected competencies were used from this list of 400 statements. The first draft consisted of 200 statements. This list was used for pilot testing. Twelve persons, four academic collegiate based MT instructors, four hospital laboratory supervisors, and four hospitals laboratory managers, considered this list. After being given ten days to determine their opinion, each person was interviewed. The major changes suggested by this group were to move and combine statements from the speciality areas to the general section. This section contained statements of competency common to all the areas of the laboratory. Additional statements were deleted completely. The final instrument contained ninety-one statements.

The final form of the instrument had the statements in six groups (1) Clinical Laboratory General - 20 competencies; (2) Clinical Chemistry - 9 competencies; (3) Immunology - 11 competencies; (4) Immunohematology - 12 competencies; (5) Microbiology - 16 competencies; and (6) Hematology - 23 competencies. Urinalysis was not included as a separate section. Most of techniques for analysis of this body fluid are now incorporated into other areas such as clinical chemistry and hematology.

Each respondent was asked to first consider each statement as to "Essential" or "Non-essential." Then if a particular competency was judged "Essential" by the respondent, either "Preclinical" or "Clinical" responses were also to be marked.

A cover letter describing the project was printed on the outer face of the instrument (see Appendix D). The technique of photocopy reduction was used to permit placing four pages of competency statements on two pages of printed instrument. The back page of the questionnaire contained spaces for comments and additional competencies (see Appendix D).

II. DEFINITION OF THE POPULATION AND SELECTION OF THE SAMPLE

The population for this study was the personnel and students in the 667 accredited schools of medical technology as listed in the AMED (7th edition). A stratified sample of 170 schools was selected. These schools were approved to enroll at least fifteen students. The researcher was concerned that smaller schools might not have a full time educational coordinator on the staff.

By using the formula from McCarty (1970, p. 29)

$$n = \frac{(1.96)^2 pq}{d^2 \frac{N-1}{N} + \frac{(1.96)^2 pq}{N}}$$

where: N = Population

n = Sample size

d^2 = beta error $(0.05)^2$

$p = (0.5)$

$q = (1 - p)$

the sample size was calculated to be 118. The sample was selected using the random number table in Educational Research by L. R. Gay (1976, p. 325). The regional distribution of the schools was checked to insure that each region was represented. The regional representation for the first mailing was: Region 1 = 12; Region 2 = 36; Region 3 = 21; Region 4 = 21; and Region 5 = 19 (see Figure 1 for the states in each Region).

An introductory letter requesting that the school participate in the study was sent to the educational coordinator of each school in the sample. A pre-addressed stamped postcard was included with each letter. The card had space for the address of the person to whom the packet of questionnaires was to be sent. Sixty-nine cards were received during the next four weeks. Packets were mailed to each of these sixty nine schools.

III. COLLECTION AND CODING OF THE DATA

The packet sent to each school contained eight instruments, an instructional note, and a pre-addressed stamped envelope. The instructions in the packet requested that the educational coordinator complete one questionnaire (pink copy), distribute three to randomly selected instructors (blue copies), and distribute four to randomly selected senior students (white copies). When the eight questionnaires were completed the coordinator was to collect them and return them to the researcher for analysis.

The questionnaire was designed with the competency statements grouped by laboratory area. The statements were numbered within each group. All of these were renumbered 1 through 91 to process the data on to IBM computer punch cards.

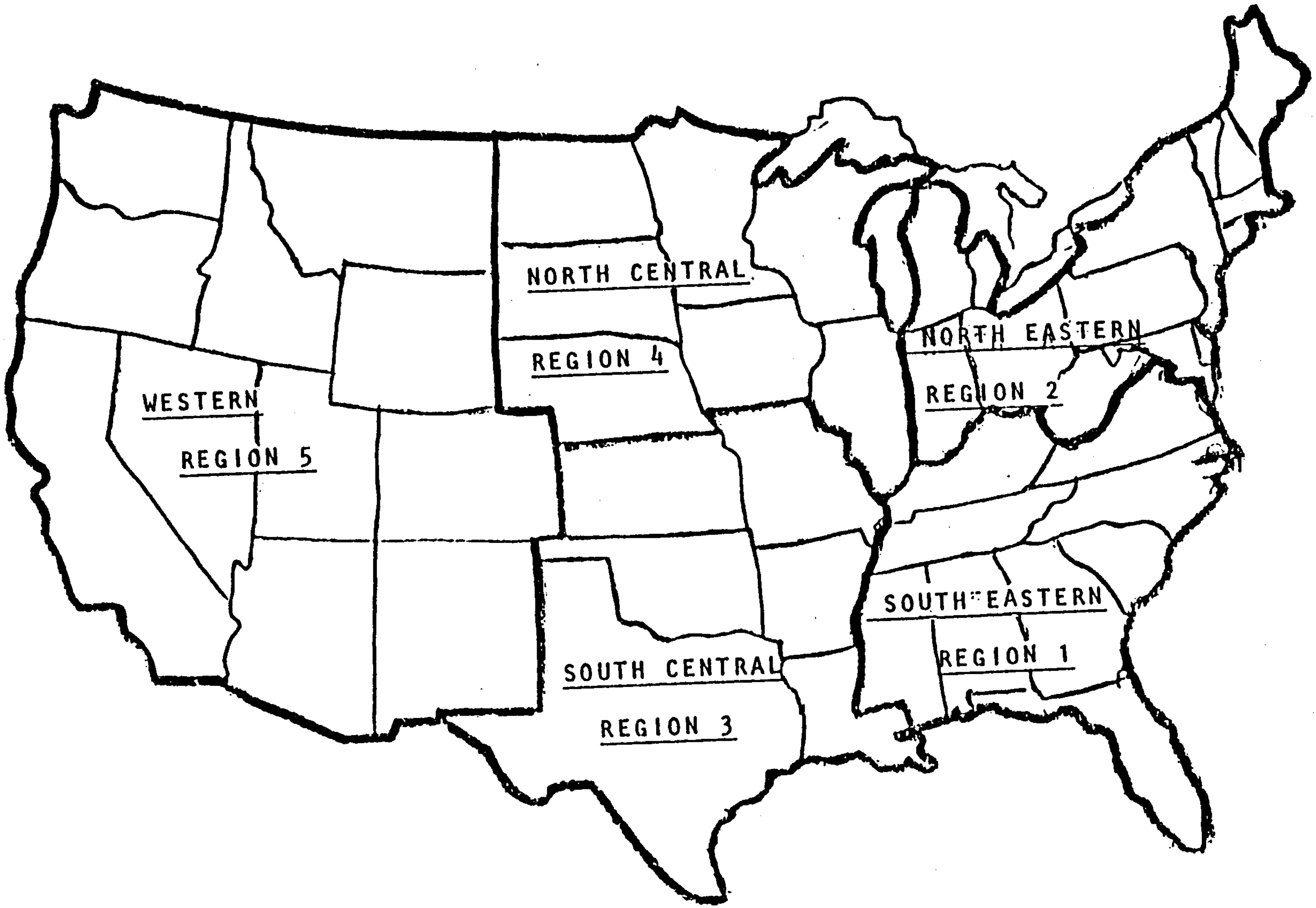

Figure 1. Regions of Distribution of Sample Schools of Medical Technology.

Each instrument was coded as to hospital, region of the United States, and date of response. The copies were individually coded

pink - educational coordinator, 1

blue - instructors, 2, 3, 4

white - students, 5, 6, 7, 8

Each competency was coded with a card column for either "Essential," "Non-essential," "Preclinical," "Clinical," and "No Response." The data were punched into cards for the computer run.

A follow up letter was mailed to those schools that had been sent packets and from whom no packet had been received. Fourteen addition sets of questionnaires were received before the cutoff date. A total of fifty-six out of sixty-nine or 80 percent of the schools that said they would participate did so. Three-hundred eighty-six instruments were returned.

A group of twenty schools that did not return the postcard were sent a letter (see Appendix E). Included with the letter was a postcard. The educational coordinators were requested to state on the post card the reasons for their non participation in the project. Table 1 is a summary of the responses and non responses from the schools in the sample.

IV. STATISTICAL PROCEDURES EMPLOYED

Two textbooks served as reference sources in statistics, these were: James A. Davis' <u>Elementary Survey Analysis</u> and Sidney Siegel's

TABLE 1

SUMMARY OF RESPONSES TO LETTER OF PARTICIPATION

Reply	Number of Schools
Agreed to participate[a]	69
School policy prevented participation	4
School chose not to participate	7
Student responses would be invalid as they had not entered clinical phase[b]	4
School did not receive original letter[b]	4
School had been absorbed into another college unit	1
School had been disbanded	1
No response to either letter	28

a = 56 schools actually participated

b== Schools that responded to the follow up letter sent to 20 nonparticipating schools.

Nonparametric Statistics. The Statistical Package for the Social Sciences (SPSS) by Nie (1975) was the primary source of computer protocol. The CROSSTABS and FREQUENCIES subprograms were used. CROSSTABS were used to yield comparative differences by computation of Chi-square. Yates corrected Chi-square was applied to tables of greater than twenty-one cases. When smaller than minimal frequencies (5) are encountered the Chi-square test is not meaningful (Siegel, 1956, p. 110). The tables from the computer run contained frequency and percentages figured for each competency for each group of respondents. The data from the FREQUENCIES subprogram yielded overall percentages and frequencies for the total 382 cases.

For the nominal level data the level of significance was set as 0.05. Each of the questions of the study was considered in relation to the results of the analysis of data. The competencies included on the final form were those receiving a 75 percent or greater essential rating. This final listing was examined by a jury composed of pathologists, chief technologists, and laboratory managers. In an interview situation, each was asked if he or she considered these statements the current essential competencies for new career entry level employees in the position of medical technologist.

CHAPTER IV

PRESENTATION OF DATA

I. INTRODUCTION

Each section of this chapter deals with one research question or one aspect of a question. The relationships between the opinions of the (1) educational coordinators and instructors, (2) educational coordinators and students, and (3) instructors and students were considered in answering the research questions. Chi-square was computed using the SPSS subprogram CROSSTABS (Nie, 1975). A number of the cells in the two by two tables for each competency generated with this program contained zeros or very small numbers. The Chi-square computed from these data is not meaningful, particularly zero cells. "The Chi-square test requires that the expected frequencies in each cell should not be too small. When they are smaller than minimal, the test may not be properly or meaningfully used," stated Seigel (1956, p. 110). These figures are reported to allow comparison between tables. Missing responses were tallied but were not used in the calculations. These missing responses are reported in the tables as column "M". The results were weighted to recognize training and experience. The opinions of fifty-six educational coordinators were considered equivalent to those of 154 instructors, and 176 students.

Respondents were asked to mark statements considered "Essential" as to where in the curriculum that particular skill or knowledge should be acquired. The possible responses were "Pre-clinical" and "Clinical." Some respondents felt that the background for a competency should be gained in the academic setting and the proficiency of technique should be mastered in the clinical phase. They marked both responses. All responses were considered in the determination of curriculum position.

The final list of essential competency statements was compiled by including those statements that were rated "Essential" by at least 75 percent of each of the groups. The final phase of the study was to present this list of identified essential competencies to a jury of potential employers. This jury was composed of pathologists, laboratory managers, and chief technologists.

II. ESSENTIAL COMPETENCIES AS IDENTIFIED BY EDUCATIONAL COORDINATORS AND INSTRUCTORS

Comparison of the responses from the educational coordinators (56) and the instructors (154) showed that both groups considered most of the listed competencies essential. Eighty of the ninety-one statements on the questionnaire were rated "Essential" by at least 75 percent of each group. Table 2 shows there were no significant differences of opinion between the educational coordinators and the instructors on any of the eighty retained competency statements.

The statements deleted from the list are a reflection of changing technology. One procedure that respondents considered "Non-essential" was "Prepare autogenous vaccines" (statement 67). A few years ago this

TABLE 2

COMPARISON OF OPINIONS OF EDUCATIONAL COORDINATORS AND INSTRUCTORS ON COMPETENCIES RATED ESSENTIAL AT THE SEVENTY FIVE PERCENT LEVEL

Statements	Educational Coordinators (N=56)					Instructors (N=154)					Chi-Square	Significance*
	Essential		Non-Essential			Essential		Non-Essential				
	No.[b]	%	No.[b]	%	M[a]	No.	%	No.	%	M[a]		
1. Evaluate requested procedure to determine specimen collection method.	55	98.2	1	1.8	0	139	95.2	7	4.8	8	0.33	0.56
2. Obtain specimen using techniques to maintain integrity of specimen in relation to test to be performed.	56	100.0	0	0	0	141	96.6	5	3.4	8	0.80	0.37
3. Assess patient's reaction to collection procedures.	46	83.6	9	16.4	1	113	77.9	32	22.1	9	0.48	0.48
4. Identify specimen according to protocol.	54	100.0	0	0	2	143	97.9	3	2.1	8	0.17	0.68
5. Inspect and evaluate suitability of specimen for analysis requested.	56	100.0	0	0	0	143	97.3	4	2.7	7	0.46	0.45
6. Prepare aliquots or components of specimen for analysis.	54	96.4	2	3.6	0	139	95.2	7	4.8	8	0.001	0.99
8. Select reagents for requirements of the analysis.	53	96.4	2	3.6	1	137	93.8	9	6.2	8	0.12	0.72
9. Prepare reagents according to prescribed directions.	53	94.6	3	5.4	0	145	98.6	7	1.4	7	1.29	0.26
10. Label prepared reagents.	55	98.2	1	1.8	0	144	98.0	3	2.0	7	0.20	0.65
11. Store reagents properly.	56	100.0	0	0	0	144	98.0	3	2.0	7	0.18	0.67
12. Calibrate or standardize instruments.	56	100.0	0	0	0	141	96.0	5	3.4	8	0.80	0.37
13. Operate instruments utilizing established protocols.	56	100.0	0	0	0	142	97.9	3	2.1	9	0.19	0.66

TABLE 2 (Continued)

Statements	Educational Coordinators (N=56) Essential No.	%	Non-Essential No.	%	M	Instructors (N=154) Essential No.	%	Non-Essential No.	%	M	Chi-Square	Significance
14. Recognize equipment or instrument malfunction.	56	100.0	0	0	0	144	98.0	3	2.0	7	0.18	0.67
15. Follow a preventive maintenance program for all instruments and equipment.	54	96.4	2	3.6	0	136	93.2	10	6.8	8	0.30	0.58
16. Identify sources of biohazards.	54	96.4	2	3.6	0	145	98.6	2	1.4	7	0.20	0.65
17. Recognize unsafe laboratory practices.	53	98.1	1	1.9	2	145	98.6	2	1.4	7	0.16	0.69
18. Define immediate action to be taken in case of accident or injury.	56	100.0	0	0	0	146	99.3	1	0.7	7	0.25	0.62
19. Select control samples to monitor assays and procedures.	52	92.9	4	7.1	0	129	88.4	17	11.6	8	0.46	0.50
20. Conduct quality control procedures.	55	98.2	1	1.8	0	144	98.0	3	2.0	7	0.20	0.65
21. Determine normal or significant values according to established protocols.	49	89.1	6	10.9	1	134	95.7	6	4.3	14	1.96	0.16
23. Determine the conformity of reference values and test results to the established protocols.	50	92.6	4	7.4	2	129	92.1	11	7.9	14	0.04	0.84
24. Perform the analysis according to prescribed methodology.	55	100.0	0	0	1	140	100.0	0	0	14	----	----
25. Obtain analytical data and convert to test results.	54	98.2	1	1.8	1	133	95.0	7	5.0	14	0.37	0.54
26. Recognize and react to primary indicators of malfunction in instruments or indicator systems.	55	100.0	0	0	1	139	99.3	1	0.7	14	0.23	0.63

TABLE 2 (Continued)

Statements	Educational Coordinators (N=56)					Instructors (N=154)					Chi-Square	Signif-icance
	Essential		Non-Essential			Essential		Non-Essential				
	No.	%	No.	%	M	No.	%	No.	%	M		
27. Evaluate the acceptability of control samples.	53	96.4	2	3.6	1	135	96.4	5	3.6	14	0.16	0.68
28. Correlate the test result with other patient data.	46	83.6	9	16.4	1	122	87.1	18	12.9	14	0.17	0.68
31. Identify antibody specificity with its antithetical antigen and describe its titer, avidity or quantity.	50	90.9	5	9.1	1	129	93.5	9	6.5	16	0.09	0.75
32. Prepare the required working reagents.	53	96.4	2	3.6	1	135	97.8	3	2.2	16	0.005	0.94
33. Select and standardize controls.	51	92.7	4	7.3	1	128	93.4	9	6.6	17	0.02	0.89
34. Maintain records in accordance with regulations.	49	89.1	6	10.9	1	131	94.2	8	5.8	15	0.89	0.34
35. Determine and perform appropriate procedures.	54	98.2	1	1.8	1	133	98.5	2	1.5	19	0.22	0.63
36. Perform the calculations necessary to convert results into the proper form or units for reporting.	54	98.2	1	1.8	1	137	99.3	1	0.7	16	0.01	0.91
37. Assess unusual test reactions.	52	94.5	3	5.5	1	125	90.6	13	9.4	16	0.38	0.54
38. Correlate test results with other laboratory data and patient data.	45	81.8	10	18.2	1	119	86.2	19	13.8	16	0.30	0.58
40. Report results in specified form and manner to appropriate staff.	54	98.2	1	1.8	1	131	94.9	7	5.1	16	0.39	0.53
41. Maintain records of donation in accordance with regulations.	47	85.5	8	14.5	1	117	84.2	22	15.8	15	0.001	0.99

TABLE 2 (Continued)

Statements	Educational Coordinators (N=56)					Instructors (N=154)					Chi-Square	Significance
	Essential		Non-Essential			Essential		Non-Essential				
	No.	%	No.	%	M	No.	%	No.	%	M		
42. Recognize the legal aspects of the blood donation program.	52	94.5	3	5.5	1	121	87.7	17	12.3	16	1.32	0.25
43. Determine donor eligibility.	51	92.7	4	7.3	1	131	94.9	7	5.1	16	0.06	0.80
44. Describe procedures and possible side effects of whole blood donation to donor.	50	90.9	5	9.1	1	121	88.3	16	11.7	17	0.07	0.79
45. Select proper container and anticoagulants.	54	98.2	1	1.8	1	130	94.2	8	5.8	16	0.65	0.42
46. Perform whole blood collection.	46	83.6	9	16.4	1	107	77.0	32	23.0	15	0.68	0.40
47. Process, label and store blood properly.	54	98.2	1	1.8	1	127	91.4	12	8.6	15	1.94	0.16
48. Assess donor's reaction.	47	87.0	7	13.0	2	111	79.9	28	20.1	15	0.91	0.34
49. Prepare blood components for therapeutic needs.	42	76.4	13	23.6	1	109	79.0	29	21.0	16	0.04	0.84
50. Label according to applicable standards.	51	94.4	3	5.6	2	127	91.4	12	8.6	15	0.17	0.68
51. Maintain quality of product for use is transfusion.	54	98.2	1	1.8	1	129	93.5	9	6.5	16	0.94	0.33
52. Identify possible cause of transfusion reaction.	52	96.3	2	3.7	2	136	97.8	3	2.2	15	0.01	0.92
53. Determine growth characteristics and requirements of various organisms.	54	96.4	2	3.6	0	141	100.0	0	0	13	2.15	0.14
54. Select media for various organisms.	56	100.0	0	0	0	142	100.0	0	0	12	----	----
55. Evaluate methods for growth and identification of microbial organisms.	46	82.1	10	17.9	0	121	85.8	20	14.2	13	0.18	0.67

TABLE 2 (Continued)

Statements	Educational Coordinators (N=56) Essential No.	%	Non-Essential No.	%	M	Instructors (N=154) Essential No.	%	Non-Essential No.	%	M	Chi-Square	Significance
56. Record, review and report results.	56	100.0	0	0	0	139	97.9	3	2.1	12	0.20	0.65
57. Establish proper safety procedures for handling infectious specimens.	51	91.1	5	8.9	0	135	95.7	6	4.3	13	0.89	0.34
58. Prepare direct smear.	56	100.0	0	0	0	140	98.6	2	1.4	12	0.01	0.92
59. Assess morphological and structural characteristics of organisms and other specimen contents.	56	100.0	0	0	0	140	98.6	2	1.4	12	0.01	0.92
60. Describe microscopic observations.	56	100.0	0	0	0	140	98.6	2	1.4	12	0.01	0.92
61. Evaluate results.	56	100.0	0	0	0	135	95.1	7	4.9	12	1.60	0.21
62. Select and implement an identification protocol appropriate to the source and characteristics of the specimen.	50	90.9	5	9.1	1	124	88.6	16	11.4	14	0.05	0.83
63. Select and perform serological tests.	52	92.9	4	7.1	0	134	94.4	8	5.6	12	0.005	0.94
64. Correlate all analyses and information to identify organism.	56	100.0	0	0	0	137	97.9	3	2.1	14	0.21	0.64
65. Select and perform antimicrobial evaluation procedures for microbial susceptibility of organism(s).	53	94.6	3	5.4	0	134	95.7	6	4.3	14	0.003	0.96
66. Report findings to appropriate persons or agencies.	55	98.2	1	1.8	0	130	91.5	12	8.5	12	1.92	0.16
69. Establish procedures to evaluate hematological determinations.	41	75.9	13	24.1	2	103	75.2	34	24.8	17	0.006	0.94
72. Establish procedures for correlation of results.	45	83.3	9	16.7	2	105	76.6	32	23.4	17	0.67	0.41

TABLE 2 (Continued)

Statements	Educational Coordinators (N=56)					Instructors (N=154)					Chi-Square	Signif-icance
	Essential		Non-Essential			Essential		Non-Essential				
	No.	%	No.	%	M	No.	%	No.	%	M		
73. Identify physiological and pathophysiological factors for which hematological procedures can contribute useful data.	42	76.4	13	23.6	1	113	83.1	23	16.9	18	0.76	0.38
74. Select the procedures appropriate for the request for service.	48	88.9	6	11.1	2	119	86.9	18	13.1	17	0.02	0.89
75. Control physical conditions critical to the test.	54	98.2	1	1.8	1	136	98.6	2	1.4	16	0.21	0.65
76. Select appropriate procedure for accuracy and speed consistent with daily workload.	46	83.6	9	16.4	1	118	86.1	19	13.9	17	0.05	0.83
77. Enumerate formed elements in specimen.	55	100.0	0	0	1	134	98.5	2	1.5	18	0.01	0.91
78. Calculate results in appropriate units.	55	100.0	0	0	1	135	97.8	3	2.2	16	0.21	0.65
79. Measure and evaluate physical properties of specimen.	53	100.0	0	0	3	132	97.8	3	2.2	19	0.20	0.65
80. Select, perform, monitor, and evaluate cytochemical procedures for cellular constituents.	44	81.5	10	18.5	2	111	82.8	23	17.2	20	0.001	0.99
81. Select, perform, monitor, and evaluate procedures that do not require stain.	47	87.0	7	13.0	2	117	88.0	16	12.0	21	0.005	0.94
82. Calculate results to conform to prescribed units.	55	100.0	0	0	1	136	99.3	1	0.7	17	0.22	0.64
83. Report results which are descriptive, qualitative, or quantitative in nature.	55	100.0	0	0	1	134	97.1	4	2.9	16	0.51	0.47
84. Perform and evaluate biochemical and physiological assays.	51	94.4	3	5.6	2	118	88.1	16	11.9	20	1.09	0.29

TABLE 2 (Continued)

Statements	Educational Coordinators (N=56)					Instructors (N=154)					Chi-Square	Significance
	Essential		Non-Essential			Essential		Non-Essential				
	No.	%	No.	%	M	No.	%	No.	%	M		
85. Recognize and react to indicators of test or instrument malfunction.	55	100.0	0	0	1	133	96.4	5	3.6	16	0.86	0.35
86. Correlate quantitative, biochemical, physiological and morphological data to verify results.	54	98.2	1	1.8	1	129	94.9	7	5.1	18	0.41	0.52
87. Correlate the test results with other patient data when possible.	48	87.3	7	12.7	1	119	86.2	19	13.8	16	0.002	0.97
88. Evaluate the acceptability of controls.	54	98.2	1	1.8	1	135	97.8	3	2.2	16	0.16	0.69
89. Integrate test data to lead to a conclusion or decision about the normality of a system.	43	81.1	10	18.9	3	107	78.7	29	21.3	18	0.03	0.86

a = Missing values are tallied and not used in the calculations.

b = When minimal frequencies and zeros are encountered the Chi-square test is not meaningful (Siegel, 1956,p.110).

* = No values significant at the 0,05 level,

was an accepted and often performed procedure. Regulations Governing Tennessee Medical Laboratory Act, November 1, 1974, Regulation 5C, Section H, page 37 specifically prohibits the use of this procedure.

III. ESSENTIAL COMPETENCIES AS IDENTIFIED BY INSTRUCTORS AND STUDENTS

Comparison of the responses from the instructors (154) and the students (176) resulted in the deletion of statement three from the list of essential competency statements. The statement, "Assess patient's reaction to collection procedures," was rated "Essential" by only 58.3 percent of the students. Greater importance was placed on this competency by the instructors (77.9 percent rated it "Essential") and the educational coordinators (83.6 percent rated it "Essential"). There were significant differences of opinion between the instructors and the students on eleven additional competency statements (Table 3). The statements on which their opinions differed significantly at the 0.05 level were:

10. Label prepared reagents.
32. Prepare the required working reagents.
50. Label according to applicable standards.
55. Evaluate methods for growth and identification of microbial organisms.
72. Establish procedures for correlation of results.

The statements on which their opinions differed significantly at the 0.01 level were:

TABLE 3

COMPARISON OF OPINIONS OF INSTRUCTORS AND STUDENTS ON COMPETENCIES RATED ESSENTIAL AT THE SEVENTY FIVE PERCENT LEVEL

Statements	Instructors (N=154)					Students (N=176)					Chi-Square	Signif-icance
	Essential		Non-Essential			Essential		Non-Essential				
	No.	%	No.	%	M^a	No.	%	No.	%	M^a		
1. Evaluate requested procedure to determine specimen collection method.	139	95.2	7	4.8	8	162	92.6	13	7.4	1	0.55	0.46
2. Obtain specimen using techniques to maintain integrity of specimen in relation to test to be performed.	141	96.6	5	3.4	8	171	97.2	5	2.8	0	0.001	0.98
4. Identify specimen according to protocol.	143	97.9	3	2.1	8	166	94.9	9	5.1	1	1.34	0.25
5. Inspect and evaluate suitability of specimen for analysis requested.	143	97.3	4	2.7	7	174	98.9	2	1.1	0	0.41	0.52
6. Prepare aliquots or components of specimen for analysis.	139	95.2	7	4.8	8	164	93.2	12	6.8	0	0.28	0.59
8. Select reagents for requirements of the analysis.	137	93.8	9	6.2	8	167	94.9	9	5.1	0	0.03	0.87
9. Prepare reagents according to prescribed directions.	145	98.6	2	1.4	7	173	98.3	3	1.7	0	0.04	0.84
10. Label prepared reagents.	144	98.0	3	2.0	7	162	92.6	13	7.4	1	3.84	0.05*
11. Store reagents properly.	144	98.0	3	2.0	7	166	94.3	10	5.7	0	1.89	0.17
12. Calibrate or standardize instruments.	141	96.6	5	3.4	8	174	98.9	2	1.1	0	1.04	0.31
13. Operate instruments utilizing established protocols.	142	97.9	3	2.1	9	176	100.0	0	0	0	1.78	0.18
14. Recognize equipment or instrument malfunction.	144	98.0	3	2.0	7	173	98.9	2	1.1	1	0.04	0.84
15. Follow a preventive maintenance program for all instruments and equipment.	136	93.2	10	6.8	8	164	93.7	11	6.3	1	0.001	0.98

TABLE 3 (Continued)

Statements	Instructors (N=154) Essential No.	Essential %	Non-Essential No.	Non-Essential %	M	Students (N=176) Essential No.	Essential %	Non-Essential No.	Non-Essential %	M	Chi-Square	Significance
16. Identify sources of biohazards.	145	98.6	2	1.4	7	174	98.9	2	1.1	0	0.10	0.75
17. Recognize unsafe laboratory practices.	145	98.6	2	1.4	7	173	98.9	2	1.1	1	0.11	0.74
18. Define immediate action to be taken in case of accident or injury.	146	99.3	1	0.7	7	170	97.7	4	2.3	2	0.51	0.48
19. Select control samples to monitor assays and procedures.	129	88.4	17	11.6	8	165	93.8	11	6.3	0	2.28	0.13
20. Conduct quality control procedures.	144	98.0	3	2.0	7	172	97.7	4	2.3	0	0.06	0.81
21. Determine normal or significant values according to established protocols.	134	95.7	6	4.3	14	168	95.5	8	4.5	0	0.03	0.87
23. Determine the conformity of reference values and test results to the established protocols.	129	92.1	11	7.9	14	168	96.0	7	4.0	1	1.49	0.22
24. Perform the analysis according to prescribed methodology.	140	100.0	0	0	14	175	99.4	1	0.6	0	0.13	0.91
25. Obtain analytical data and convert to test results.	133	95.0	7	5.0	14	167	96.5	6	3.5	3	0.15	0.69
26. Recognize and react to primary indicators of malfunction in instruments or indicator systems.	139	99.3	1	0.7	14	174	98.9	2	1.1	0	0.39	0.84
27. Evaluate the acceptability of control samples.	135	96.4	5	3.6	14	171	97.7	4	2.3	1	0.12	0.73
28. Correlate the test result with other patient data.	122	87.1	18	12.9	14	159	90.9	16	9.1	1	0.76	0.38

TABLE 3 (Continued)

Statements	Instructors (N=154)					Students (N=176)					Chi-Square	Signif-icance
	Essential No.	Essential %	Non-Essential No.	Non-Essential %	M	Essential No.	Essential %	Non-Essential No.	Non-Essential %	M		
31. Identify antibody specificity with its antithetical antigen and describe its titer, avidity or quantity.	129	93.5	9	6.5	16	166	95.9	7	4.1	4	0.51	0.48
32. Prepare the required working reagents.	135	97.8	3	2.2	16	160	91.4	15	8.6	1	4.71	0.03*
33. Select and standardize controls.	128	93.4	9	6.6	17	159	91.4	15	8.6	2	0.21	0.64
34. Maintain records in accordance with regulations.	131	94.2	8	5.8	15	160	92.0	14	8.0	2	0.32	0.57
35. Determine and perform appropriate procedures.	133	98.5	2	1.5	19	170	98.8	2	1.2	4	0.06	0.79
36. Perform the calculations necessary to convert results into the proper form, or units for reporting.	137	99.3	1	0.7	16	166	96.5	6	3.5	4	1.55	0.21
37. Assess unusual test reactions.	125	90.6	13	9.4	16	170	97.7	4	2.3	2	6.26	0.01*
38. Correlate test results with other laboratory data and patient data.	119	86.2	19	13.8	16	152	87.9	21	12.1	3	0.07	0.80
40. Report results in specified form and manner to appropriate staff.	131	94.9	7	5.1	16	163	93.7	11	6.3	2	0.05	0.82
41. Maintain records of donation in accordance with regulations.	117	84.2	22	15.8	15	163	94.2	10	5.8	3	7.40	0.007**
42. Recognize the legal aspects of the blood donation program.	121	87.7	17	12.3	16	161	93.1	12	6.9	3	2.03	0.15
43. Determine donor eligibility.	131	94.9	7	5.1	16	165	95.4	8	4.6	3	0.01	0.93

TABLE 3 (Continued)

Statements	Instructors (N=154)					Students (N=176)					Chi-Square	Signif-icance
	Essential		Non-Essential			Essential		Non-Essential				
	No.	%	No.	%	M	No.	%	No.	%	M		
44. Describe procedures and possible side effects of whole blood donation to donor.	121	88.3	16	11.7	17	162	93.6	11	6.4	3	2.09	0.15
45. Select proper container and anticoag-ulants.	130	94.2	8	5.8	16	165	95.4	8	4.6	3	0.04	0.84
46. Perform whole blood collection.	107	77.0	32	23.0	15	143	83.1	29	16.9	4	1.48	0.22
47. Process, label and store blood properly.	127	91.4	12	8.6	15	172	99.4	1	0.6	3	10.59	0.001***
48. Assess donor's reaction.	111	79.9	28	20.1	15	145	83.3	28	16.2	3	0.57	0.45
49. Prepare blood components for therapeutic needs.	109	79.0	29	21.0	16	158	91.3	15	8.7	3	8.64	0.003**
50. Label according to applicable standards.	127	91.4	12	8.6	15	167	97.1	5	2.9	4	3.83	0.05*
51. Maintain quality of product for use in transfusion.	129	93.5	9	6.5	16	169	98.3	3	1.7	4	3.50	0.06
52. Identify possible cause of transfusion reaction.	136	97.8	3	2.2	15	170	98.3	3	1.7	3	0.02	0.89
53. Determine growth characteristics and requirements of various organisms.	141	100.0	0	0	13	175	100.0	0	0	1	----	----
54. Select media for various organisms.	142	100.0	0	0	12	176	100.0	0	0	0	----	----
55. Evaluate methods for growth and identi-fication of microbial organisms	121	85.8	20	14.2	13	163	93.1	12	6.9	1	3.84	0.05*
56. Record, review and report results.	139	97.9	3	2.1	12	171	97.2	5	2.8	0	0.01	0.96
57. Establish proper safety procedures for handling infectious specimens.	135	95.7	6	4.3	13	170	97.1	5	2.9	1	0.13	0.71

TABLE 3 (Continued)

Statements	Instructors (N=154) Essential No.	%	Non-Essential No.	%	M	Students (N=176) Essential No.	%	Non-Essential No.	%	M	Chi-Square	Significance
58. Prepare direct smear.	140	98.6	2	1.4	12	174	99.4	1	0.6	1	0.03	0.86
59. Assess morphological and structural characteristics of organisms and other specimen contents.	140	98.6	2	1.4	12	173	98.3	3	1.7	0	0.06	0.81
60. Describe microscopic observations.	140	98.6	2	1.4	12	172	98.3	3	1.7	1	0.06	0.81
61. Evaluate results.	135	95.1	7	4.9	12	171	97.2	5	2.8	0	0.46	0.49
62. Select and implement an identification protocol appropriate to the source and characteristics of the specimen.	124	88.6	16	11.4	14	167	95.4	8	4.6	1	4.27	0.04
63. Select and perform serological tests.	134	94.4	8	5.6	12	167	95.4	8	4.6	1	0.03	0.86
64. Correlate all analyses and information to identify organism.	137	97.9	3	2.1	14	175	99.4	1	0.6	0	0.54	0.46
65. Select and perform antimicrobial evaluation procedures for microbial susceptibility of organism(s).	134	95.7	6	4.3	14	172	98.3	3	1.7	1	1.04	0.30
66. Report findings to appropriate persons or agencies.	130	91.5	12	8.5	12	159	90.3	17	9.7	0	0.03	0.86
69. Establish procedures to evaluate hematological determinations.	103	75.2	34	24.8	17	142	81.6	32	18.4	2	1.53	0.22
72. Establish procedures for correlation of results.	105	76.6	32	23.4	17	151	86.8	23	13.2	2	4.74	0.03*
73. Identify physiological and pathophysiological factors for which hematological procedures can contribute useful data.	113	83.1	23	16.9	18	163	94.8	9	5.2	4	9.91	0.002**

TABLE 3 (Continued)

Statements	Instructors (N=154) Essential No.	Essential %	Non-Essential No.	Non-Essential %	M	Students (N=176) Essential No.	Essential %	Non-Essential No.	Non-Essential %	M	Chi-Square	Significance
74. Select the procedures appropriate for the request for service.	119	86.9	18	13.1	17	151	86.8	23	13.2	2	0.02	0.88
75. Control physical conditions critical to the tests.	136	98.6	2	1.4	16	163	93.7	11	6.3	2	3.44	0.06
76. Select appropriate procedure for accuracy and speed consistent with daily workload.	118	86.1	19	13.9	17	153	87.4	22	12.6	1	0.03	0.87
77. Enumerate formed elements in specimen.	134	98.5	2	1.5	18	172	98.3	3	1.7	1	0.08	0.76
78. Calculate results in appropriate units.	135	97.8	3	2.2	16	172	98.3	3	1.7	1	0.01	0.90
79. Measure and evaluate physical properties of specimens.	132	97.8	3	2.2	19	168	96.0	7	4.0	1	0.31	0.58
80. Select, perform, monitor, and evaluate cytochemical procedures for cellular constituents.	111	82.8	23	17.2	20	150	87.2	22	12.8	4	0.83	0.36
81. Select, perform, monitor, and evaluate procedures that do not require stain.	117	88.0	16	12.0	21	156	91.8	14	8.2	6	0.82	0.37
82. Calculate results to conform to prescribed units.	136	99.3	1	0.7	17	172	98.3	3	1.7	1	0.67	0.79
83. Report results which are descriptive, qualitative, or quantitative in nature.	134	97.1	4	2.9	16	170	97.1	5	2.9	1	0.10	0.75
84. Perform and evaluate biochemical and physiological assays.	118	88.1	16	11.9	20	165	96.5	6	3.5	5	6.77	0.009**
85. Recognize and react to indicators of test or instrument malfunction.	133	96.4	5	3.6	16	174	99.4	1	0.6	1	2.37	0.12

TABLE 3 (Continued)

Statements	Instructors (N=154)					Students (N=176)					Chi-Square	Signif-icance
	Essential		Non-Essential			Essential		Non-Essential				
	No.	%	No.	%	M	No.	%	No.	%	M		
86. Correlate quantitative, biochemical physiological and morphological data to verify results.	129	94.9	7	5.1	18	171	97.7	4	2.3	1	1.09	0.29
87. Correlate the test results with other patient data when possible.	119	86.2	19	13.8	16	160	91.4	15	8.6	1	1.65	1.19
88. Evaluate the acceptability of controls.	133	97.8	3	2.2	16	170	97.1	5	2.9	1	0.01	0.98
89. Integrate test data to lead to a conclusion or decision about the normality of a system.	107	78.7	29	21.3	18	146	84.9	26	15.1	4	1.59	0.21

a = Missing values are tallied and not used in the calculations.

* = Significant at the 0.05 level.

** = Significant at the 0.01 level.

*** = Significant at the 0.001 level.

37. Assess unusual test reactions.

41. Maintain records of donation in accordance with regulations.

49. Prepare blood components for therapeutic needs.

73. Identify physiological and pathphysiological factors for which hematological procedures can contribute useful data.

84. Perform and evaluate biochemical and physio-chemical assays.

The statement on which their opinions differed significantly at the 0.001 level was:

47. Process, label and store blood properly.

These differences may be due to a lack of congruence in role expectations between the two groups. None of these differences effected the final list of competency statements.

IV. ESSENTIAL COMPETENCIES AS IDENTIFIED BY EDUCATIONAL COORDINATORS AND STUDENTS

Comparison of the responses from the educational coordinators (56) and the students (176) did not change the list of essential competency statements. There were significant differences of opinion between the educational coordinators and the students on three competency statements (Table 4). The statement on which their opinions differed significantly at the 0.05 level was:

56. Record, review and report results.

TABLE 4

COMPARISON OF OPINIONS OF EDUCATIONAL COORDINATORS AND STUDENTS ON COMPETENCIES RATED ESSENTIAL AT THE SEVENTY FIVE PERCENT LEVEL

Statements	Educational Coordinators (N=56)					Students (N=176)					Chi-Square	Signif-icance
	Essential No.	Essential %	Non-Essential No.	Non-Essential %	M[a]	Essential No.	Essential %	Non-Essential No.	Non-Essential %	M[a]		
1. Evaluate requested procedure to determine specimen collection method.	55	98.2	1	1.8	0	162	92.6	13	7.4	1	1.49	0.22
2. Obtain specimen using techniques to maintain integrity of specimen in relation to test to be performed.	56	100.0	0	0	0	171	97.2	5	2.8	0	0.56	0.46
4. Identify specimen according to protocol.	54	100.0	0	0	2	166	94.9	9	5.1	1	1.69	0.19
5. Inspect and evaluate suitability of specimen for analysis requested.	56	100.0	0	0	0	174	98.9	2	1.1	0	0.001	0.98
6. Prepare aliquots or components of specimen for analysis.	54	96.4	2	3.6	0	164	93.2	12	6.8	0	0.32	0.57
8. Select reagents for requirements of the analysis.	53	96.4	2	3.6	1	167	94.9	9	5.1	0	0.01	0.93
9. Prepare reagents according to prescribed directions.	53	94.6	3	5.4	0	173	98.3	3	1.7	0	1.03	0.31
10. Label prepared reagents.	55	98.2	1	1.8	0	162	92.6	13	7.4	1	1.49	0.22
11. Store reagents properly.	56	100.0	0	0	0	166	94.3	10	5.7	0	2.09	0.15
12. Calibrate or standardize instruments.	56	100.0	0	0	0	174	98.9	2	1.1	0	0.001	0.98
13. Operate instruments utilizing established protocols.	56	100.0	0	0	0	176	100.0	0	0	0	----	----
14. Recognize equipment or instrument malfunction.	56	100.0	0	0	0	173	98.9	2	1.1	1	0.001	0.98
15. Follow a preventive maintenance program for all instruments and equipment.	54	96.4	2	3.6	0	164	93.7	11	6.3	1	0.19	0.66

TABLE 4 (Continued)

Statements	Educational Coordinators (N=56) Essential No.	Essential %	Non-Essential No.	Non-Essential %	M	Students (N=176) Essential No.	Essential %	Non-Essential No.	Non-Essential %	M	Chi-Square	Significance
16. Identify sources of biohazards.	54	96.4	2	3.6	0	174	98.9	2	1.1	0	0.40	0.53
17. Recognize unsafe laboratory practices.	53	98.1	1	1.9	2	173	98.9	2	1.1	1	0.08	0.77
18. Define immediate action to be taken in case of accident or injury.	56	100.0	0	0	0	170	97.7	4	2.3	2	0.31	0.58
19. Select control samples to monitor assays and procedures.	52	92.9	4	7.1	0	165	93.8	11	6.3	0	0.01	0.94
20. Conduct quality control procedures.	55	98.2	1	1.8	0	172	97.7	4	2.3	0	0.09	0.76
21. Determine normal or significant values according to established protocols.	49	89.1	6	10.9	1	168	95.5	8	4.5	0	1.97	0.16
23. Determine the conformity of reference values and test results to the established protocols.	50	92.6	4	7.4	2	168	96.0	7	4.0	1	0.44	0.51
24. Perform the analysis according to prescribed methodology.	55	100.0	0	0	1	175	99.4	1	0.6	0	0.38	0.54
25. Obtain analytical data and convert to test results.	54	98.2	1	1.8	1	167	96.5	6	3.5	3	0.03	0.87
26. Recognize and react to primary indicators of malfunction in instruments or indicator systems.	55	100.0	0	0	1	174	98.9	2	1.1	0	0.001	0.97
27. Evaluate the acceptability of control samples.	53	96.4	2	3.6	1	171	97.7	4	2.3	1	0.004	0.95
28. Correlate the test result with other patient data.	46	83.6	9	16.4	1	159	90.9	16	9.1	1	1.56	0.21

TABLE 4 (Continued)

Statements	Educational Coordinators (N=56)					Students (N=176)					Chi-Square	Signif-icance
	Essential		Non-Essential			Essential		Non-Essential				
	No.	%	No.	%	M	No.	%	No.	%	M		
31. Identify antibody specificity with its antithetical antigen and describe its titer, avidity or quantity.	50	90.9	5	9.1	1	165	95.9	7	4.1	4	1.22	0.27
32. Prepare the required working reagents.	53	96.4	2	3.6	1	160	91.4	15	8.6	1	0.86	0.36
33. Select and standardize controls.	51	92.7	4	7.3	1	159	91.4	15	8.6	2	0.001	0.97
34. Maintain records in accordance with regulations.	49	89.1	6	10.9	1	160	92.0	14	8.0	2	0.15	0.70
35. Determine and perform appropriate procedures.	54	98.2	1	1.8	1	170	98.8	2	1.2	4	0.09	0.76
36. Perform the calculations necessary to convert results into the proper form or units for reporting.	54	98.2	1	1.8	1	166	96.5	6	3.5	4	0.03	0.86
37. Assess unusual test reactions.	52	94.5	3	5.5	1	170	97.7	4	2.3	2	0.54	0.46
38. Correlate test results with other laboratory data and patient data.	45	81.8	10	18.2	1	152	87.9	21	12.1	3	0.83	0.36
40. Report results in specified form and manner to appropriate staff.	54	98.2	1	1.8	1	163	93.7	11	6.3	2	0.92	0.34
41. Maintain records of donation in accordance with regulations.	47	85.5	8	14.5	1	163	94.2	10	5.8	3	3.29	0.07
42. Recognize the legal aspects of the blood donation program.	52	94.5	3	5.5	1	161	93.1	12	6.9	3	0.01	0.94
43. Determine donor eligibility.	51	92.7	4	7.3	1	165	95.4	8	4.6	3	0.18	0.67

TABLE 4 (Continued)

Statements	Educational Coordinators (N=56) Essential No.	%	Non-Essential No.	%	M	Students (N=176) Essential No.	%	Non-Essential No.	%	M	Chi-Square	Significance
44. Describe procedures and possible side effects of whole blood donation to donor.	50	90.9	5	9.1	1	162	93.6	11	6.4	3	0.15	0.69
45. Select proper container and anticoagulants.	54	98.2	1	1.8	1	165	95.4	8	4.6	3	0.28	0.59
46. Perform whole blood collection.	46	83.6	9	16.4	1	143	83.1	29	16.9	4	0.01	0.90
47. Process, label and store blood properly.	54	98.2	1	1.8	1	172	99.4	1	0.6	3	0.001	0.98
48. Assess donor's reaction.	47	87.0	7	13.0	2	145	83.8	28	16.2	3	0.13	0.72
49. Prepare blood components for therapeutic needs.	42	76.4	13	23.6	1	158	91.3	15	8.7	3	7.34	0.007**
50. Label according to applicable standards.	51	94.4	3	5.6	2	167	97.1	5	2.9	4	0.25	0.62
51. Maintain quality of product for use in transfusion.	54	98.2	1	1.8	1	169	98.3	3	1.7	4	0.31	0.58
52. Identify possible cause of transfusion reaction.	52	96.3	2	3.7	2	170	98.3	3	1.7	3	0.11	0.74
53. Determine growth characteristics and requirements of various organisms.	54	96.4	2	3.6	0	175	100.0	0	0	1	2.83	0.09
54. Select media for various organisms.	56	100.0	0	0	0	176	100.0	0	0	0	----	----
55. Evaluate methods for growth and identification of microbial organisms	46	82.1	10	17.9	0	163	93.1	12	6.9	1	4.75	0.03*
56. Record, review and report results.	56	100.0	0	0	0	171	97.2	5	2.8	0	0.56	0.45
57. Establish proper safety procedures for handling infectious specimens.	51	91.1	5	8.9	0	170	97.1	5	2.9	1	2.45	0.12

TABLE 4 (Continued)

Statements	Educational Coordinators (N=56)					Students (N=176)					Chi-Square	Signif-icance
	Essential		Non-Essential			Essential		Non-Essential				
	No.	%	No.	%	M	No.	%	No.	%	M		
58. Prepare direct smear.	56	100.0	0	0	0	174	99.4	1	0.6	1	0.36	0.55
59. Assess morphological and structural characteristics of organisms and other specimen contents.	56	100.0	0	0	0	173	98.3	3	1.7	0	0.09	0.76
60. Describe microscopic observations.	56	100.0	0	0	0	172	98.3	3	1.7	1	0.09	0.76
61. Evaluate results.	56	100.0	0	0	0	171	97.2	5	2.8	0	0.56	0.46
62. Select and implement an identification protocol appropriate to the source and characteristics of the specimen.	50	90.9	5	9.1	1	167	95.4	8	4.6	1	0.87	0.35
63. Select and perform serological tests.	52	92.9	4	7.1	0	167	95.4	8	4.6	1	0.17	0.68
64. Correlate all analyses and information to identify organism.	56	100.0	0	0	0	175	99.4	1	0.6	0	0.37	0.54
65. Select and perform antimicrobial evaluation procedures for microbial susceptibility of organism(s).	53	94.6	3	5.4	0	172	98.3	3	1.7	1	1.02	0.31
66. Report findings to appropriate persons or agencies.	55	98.2	1	1.8	0	159	90.3	17	9.7	0	2.66	0.10
69. Establish procedures to evaluate hematological determinations.	41	75.9	13	24.1	2	142	81.6	32	18.4	2	0.52	0.47
72. Establish procedures for correlation of results.	45	83.3	9	16.7	2	151	86.8	23	13.2	2	0.17	0.68
73. Identify physiological and pathophysiological factors for which hematological procedures can contribute useful data.	42	76.4	13	23.6	1	163	94.8	9	5.2	4	14.09	0.0002***

TABLE 4 (Continued)

Statements	Educational Coordinators (N=56)					Students (N=176)					Chi-Square	Signif-icance
	Essential		Non-Essential			Essential		Non-Essential				
	No.	%	No.	%	M	No.	%	No.	%	M		
74. Select the procedures appropriate for the request for service.	48	88.9	6	11.1	2	151	86.8	23	13.2	2	0.03	0.86
75. Control physical conditions critical to the tests.	54	98.2	1	1.8	1	163	93.7	11	6.3	2	0.92	0.34
76. Select appropriate procedure for accuracy and speed consistent with daily workload.	46	83.6	9	16.4	1	153	87.4	22	12.6	1	0.24	0.62
77. Enumerate formed elements in specimen.	55	100.0	0	0	1	172	98.3	3	1.7	1	0.09	0.77
78. Calculate results in appropriate units.	55	100.0	0	0	1	172	98.3	3	1.7	1	0.09	0.77
79. Measure and evaluate physical properties of specimen:.	53	100.0	0	0	3	168	96.0	7	4.0	1	1.05	0.31
80. Select, perform, monitor, and evaluate cytochemical procedures for cellular constituents.	44	81.5	10	18.5	2	150	87.2	32	12.8	4	0.69	0.41
81. Select, perform, monitor, and evaluate procedures that do not require stain.	47	87.0	7	13.0	2	156	91.8	14	8.2	6	0.59	0.44
82. Calculate results to conform to prescribed units.	55	100.0	0	0	1	172	98.3	3	1.7	1	0.09	0.77
83. Report results which are descriptive, qualitative, or quantitative in nature.	55	100.0	0	0	1	170	97.1	5	2.9	1	0.54	0.46
84. Perform and evaluate biochemical and physiological assays.	51	94.4	3	5.6	2	165	96.5	6	3.5	5	0.07	0.77
85. Recognize and react to indicators of test or instrument malfunction.	55	100.0	0	0	1	174	99.4	1	0.6	1	0.38	0.54

TABLE 4 (Continued)

Statements	Educational Coordinators (N=56)					Students (N=176)					Chi-Square	Signif-icance
	Essential		Non-Essential			Essential		Non-Essential				
	No.	%	No.	%	M	No.	%	No.	%	M		
86. Correlate quantitative, biochemical physiological and morphological data to verify results.	54	98.2	1	1.8	1	171	97.7	4	2.3	1	0.10	0.75
87. Correlate the test results with other patient data when possible.	48	87.3	7	12.7	1	160	91.4	15	8.6	1	0.42	0.51
88. Evaluate the acceptability of controls.	54	98.2	1	1.8	1	170	97.1	5	2.9	1	0.01	0.95
89. Integrate test data to lead to a conclusion or decision about the normality of a system.	43	81.1	10	18.9	3	146	84.9	26	15.1	4	0.19	0.66

a = Missing values are tallied and not used in the calculations.

* = Significant at the 0.05 level.

** = Significant at the 0.01 level.

*** = Significant at the 0.001 level

The statement on which their opinions differed significantly at the 0.01 level was:

49. Prepare blood components for therapeutic needs.

The statement on which their opinions differed significantly at the 0.001 level was:

73. Identify physiological and pathophysiological factors for which hematological procedures can contribute useful data.

These two groups agreed on 96 percent of the essential competency statements.

V. CURRICULUM PLACEMENT OF ESSENTIAL COMPETENCIES BY EDUCATIONAL COORDINATORS AND INSTRUCTORS

The respondents were instructed to make a second judgement on the statements they marked "Essential." The two possible responses dealt with curriculum placement. These responses were "Preclinical" or "Clinical." A small number from each group of respondents checked both responses for some of the competency statements. Their justification was that the theoretical foundation for some competencies should be acquired in the academic setting while practical proficiency could only be gained in the hospital. Placement of the competency statements in "Preclinical" or "Clinical" phases of the curriculum was determined by the choices of 50 percent or more of either group. Some statements appeared in both phases as a result of the double responses discussed above. Tables 5 and 6 composite tabulations of data from Tables 7, 8 and 9. Table 5 lists

TABLE 5

ESSENTIAL COMPETENCIES INCLUDED IN THE PRECLINICAL CURRICULUM BY EDUCATIONAL COORDINATORS, INSTRUCTORS, AND STUDENTS

Statements	Educational Coordinators (N=56) No.(%)	Instructors (N=154) No.(%)	Students (N=176) No.(%)
9. Prepare reagents according to prescribed directions.	37(67.9)	107(73.7)	112(64.8)
10. Label prepared reagents.	38(69.1)	108(75.0)	109(67.3)
11. Store reagents properly.	38(69.1)	98(68.1)	107(64.5)
12. Calibrate or standardize instruments.*	26(46.4)	63(44.7)	87(50.0)
16. Identify sources of biohazards.*	30(55.5)	87(60.0)	111(63.8)
17. Recognize unsafe laboratory practices.*	34(64.2)	104(71.7)	137(79.2)
18. Define immediate action to be taken in case of accident or injury.*	36(64.3)	104(71.7)	122(71.8)
25. Obtain analytical data and convert to test results.*	18(33.4)	71(53.4)	89(53.9)
32. Prepare the required working reagents.*	23(39.6)	69(51.1)	88(55.0)
36. Perform the calculations necessary to convert results into the proper form or units for reporting.*	21(38.9)	69(50.3)	107(64.5)
53. Determine growth characteristics and requirements of various organisms.	37(68.5)	104(73.7)	139(79.5)
54. Select media for various organisms.	34(60.7)	92(64.8)	127(72.1)

TABLE 5 (Continued)

Statements	Educational Coordinators (N=56) No.(%)	Instructors (N=154) No.(%)	Students (N=176) No.(%)
55. Evaluate methods for growth and identification of microbial organisms.	21(45.4)	60(49.6)	112(68.7)
57. Establish peoper safety procedures for handling infectious specimens.	35(58.7)	94(69.6)	130(76.4)
58. Prepare direct smear.	36(64.3)	93(66.5)	132(75.9)
59. Assess morphological and structural characteristics of organisms and other specimen contents.	30(53.6)	75(53.6)	121(70.0)
60. Describe microscopic observations.	40(71.4)	99(70.7)	133(77.3)
64. Correlate all analyses and information to identify organism.	13(30.3)	42(30.6)	97(55.5)
73. Identify physiological and pathophysiological factors for which hematological procedures can contribute useful data.	15(35.7)	39(34.4)	87(53.4)
77. Enumerate formed elements in specimen.	23(41.8)	60(44.8)	93(54.1)
78. Calculate results in appropriate units.	23(41.8)	74(54.8)	115(66.9)
82. Calculate results to conform to prescribed units.*	21(38.2)	69(50.7)	103(59.9)

* = These competencies are included in both phases of the curriculum.

TABLE 6

ESSENTIAL COMPETENCIES INCLUDED IN THE CLINICAL CURRICULUM BY EDUCATIONAL COORDINATORS, INSTRUCTORS, AND STUDENTS.

Statements	Educational Coordinators (N=56) No.(%)	Instructors (N=154) No.(%)	Students (N=176) No.(%)
1. Evaluate requested procedure to determine specimen collection method.	52(94.5)	114(82.0)	120(74.1)
2. Obtain specimen using techniques to maintain integrity of specimen in relation to test to be performed.	53(94.6)	118(83.7)	134(78.4)
4. Identify specimen according to protocol.	49(90.8)	116(81.1)	127(76.5)
5. Inspect and evaluate suitability of specimen for analysis requested.	48(85.7)	122(85.3)	129(74.2)
6. Prepare aliquots or components of specimen for analysis.	42(77.8)	99(71.3)	110(67.1)
8. Select reagents for requirements of the analysis.	36(68.0)	86(62.8)	89(53.3)
12. Calibrate or standardize instruments.*	36(64.3)	86(61.0)	94(54.0)
13. Operate instruments utilizing established protocols.	37(66.1)	94(66.2)	116(65.9)
14. Recognize equipment or instrument malfunction.	44(78.5)	109(75.6)	135(77.9)
15. Follow a preventive maintenance program for all instruments and equipment.	48(88.9)	115(84.6)	134(81.7)

TABLE 6 (Continued)

Statements	Educational Coordinators (N=56) No. (%)	Instructors (N=154) No. (%)	Students (N=176) No. (%)
16. Identify sources of biohazards.*	30(55.5)	66(45.5)	67(38.5)
17. Recognize unsafe laboratory practices.*	28(52.8)	51(35.2)	40(23.1)
18. Define immediate action to be taken in case of accident or injury.*	30(53.6)	51(35.2)	56(32.9)
19. Select control samples to monitor assays and procedures.	47(90.4)	108(83.8)	125(75.7)
20. Conduct quality control procedures.	45(81.8)	107(74.3)	119(67.2)
21. Determine normal or significant values according to established protocols.	38(77.6)	100(74.6)	109(64.9)
23. Determine the conformity of reference values and test results to the established protocols.	43(80.0)	99(76.7)	124(73.8)
24. Perform the analysis according to prescribed methodology.	37(67.2)	82(58.6)	92(52.6)
25. Obtain analytical data and convert to test results.*	37(68.6)	67(50.4)	80(48.5)
26. Recognize and react to primary indicators of malfunction in instruments or indicator systems.	44(80.0)	100(71.9)	123(70.6)
27. Evaluate the acceptability of control samples.	40(75.5)	99(73.4)	112(65.5)
28. Correlate the test result with other patient data.	44(85.0)	104(85.2)	123(77.3)

TABLE 6 (Continued)

Statements	Educational Coordinators (N=56) No.(%)	Instructors (N=154) N=(%)	Students (N=176) No.(%)
31. Identify antibody specificity with its antithetical antigen and describe its titer, avidity or quantity.	39(68.0)	91(61.9)	97(58.8)
32. Prepare the required working reagents.*	36(64.2)	72(53.3)	72(45.0)
33. Select and standardize controls.	43(80.4)	101(78.9)	112(70.5)
34. Maintain records in accordance with regulations	46(87.8)	110(83.9)	135(84.4)
35. Determine and perform appropriate procedures.	45(83.4)	102(76.7)	105(61.8)
36. Perform the calculations necessary to convert results into the proper form or units for reporting.*	35(64.8)	72(52.5)	61(36.7)
37. Assess unusual test reactions.	46(88.4)	106(84.8)	122(71.8)
38. Correlate test results with other laboratory data and patient data.	46(91.1)	102(85.7)	120(78.9)
40. Report results in specified form and manner to appropriate staff.	51(94.4)	116(88.5)	140(85.9)
41. Maintain records of donation in accordance with regulations.	49(97.9)	111(94.9)	137(84.0)
42. Recognize the legal aspects of the blood donation program.	40(76.9)	83(68.6)	90(55.9)

TABLE 6 (Continued)

Statements	Educational Coordinators (N=56) No.(%)	Instructors (N=154) No.(%)	Students (N=176) No.(%)
43. Determine donor eligibility.	39(76.5)	97(74.0)	101(61.2)
44. Describe procedures and possible side effects of whole blood donation to donor.	40(80.0)	86(71.1)	98(60.5)
45. Select proper container and anticoagulants.	44(81.5)	100(76.9)	111(67.3)
46. Perform whole blood collection.	43(93.5)	96(89.8)	110(76.9)
47. Process, label and store blood properly.	52(96.3)	114(89.8)	145(84.3)
48. Assess donor's reaction.	47(100.)	100(90.1)	113(77.9)
49. Prepare blood components for therapeutic needs.	41(97.6)	105(96.3)	149(94.3)
50. Label according to applicable standards.	45(88.2)	106(83.5)	130(77.8)
51. Maintain quality of product for use in transfusion.	53(98.1)	121(93.8)	150(88.8)
52. Identify possible cause of transfusion reaction.	42(80.7)	115(84.5)	112(65.9)
56. Record, review and report results.	41(73.2)	106(76.3)	111(64.9)
61. Evaluate results.	41(73.2)	105(77.8)	91(53.2)
62. Select and implement an identification protocol appropriate to the source and characteristics of the specimen.	39(78.0)	94(75.8)	111(66.5)
63. Select and perform serological tests.	39(75.0)	96(71.7)	115(68.9)

TABLE 6 (Continued)

Statements.	Educational Coordinators (N=56) No.(%)	Instructors (N=154) No.(%)	Students (N=176) No.(%)
65. Select and perform antimicrobial evaluation procedures for microbial susceptibility of organism(s).	43(81.2)	109(81.4)	108(62.8)
66. Report findings to appropriate persons or agencies.	53(96.3)	119(91.5)	138(86.8)
69. Establish procedures to evaluate hematological determinations.	34(82.9)	80(77.7)	104(73.2)
72. Establish procedures for correlation of results.	40(88.9)	79(75.3)	106(70.2)
74. Select the procedures appropriate for the request for service.	42(87.5)	95(79.8)	118(78.1)
75. Control physical conditions critical to the tests.	40(74.1)	95(69.8)	109(66.9)
76. Select appropriate procedure for accuracy and speed consistent with daily workload.	44(95.7)	109(92.3)	141(92.2)
79. Measure and evaluate physical properties of specimen.	39(73.6)	90(68.2)	87(51.8)
80. Select, perform, monitor, and evaluate cytochemical procedures for cellular constituents.	38(86.3)	88(79.3)	108(72.0)
81. Select, perform, monitor, and evaluate procedures that do not require stain.	39(83.0)	97(82.9)	104(66.6)
82. Calculate results to conform to prescribed units.*	37(67.3)	71(52.2)	69(40.1)
83. Report results which are descriptive, qualitative, or quantitative in nature.	44(80.0)	89(66.4)	100(58.8)

TABLE 6 (Continued)

Statements	Educational Coordinators (N=56) No. (%)	Instructors (N=154) No. (%)	Students (N=176) No. (%)
84. Perform and evaluate biochemical and physiological assays	42(82.4)	87(73.7)	114(69.1)
85. Recognize and react to indicators of test or instrument malfunction.	42(76.3)	110(82.7)	134(77.0)
86. Correlate quantitative, biochemical, physiological and morphological data to verify results.	46(85.2)	109(84.5)	119(69.6)
87. Correlate the test results with other patient data when possible.	44(91.7)	105(88.3)	131(81.9)
88. Evaluate the acceptability of controls.	42(77.8)	100(74.1)	112(65.9)
89. Integrate test data to lead to a conclusion or decision about the normality of a system	37(86.1)	94(87.8)	111(76.0)

* = These competencies are included in both phases of the curriculum.

all the statements included in the "Preclinical" phase. Table 6 lists the statements included in the "Clinical" phase. There are twenty-two statements in Table 5, page 81 and sixty-five statements in Table 6.

There were few significant differences of opinion between the educational coordinators and instructors in regard to curriculum placement. Table 7 shows that only four instances of significant differences exist. This is a reflection of almost complete agreement between these two groups.

VI. CURRICULUM PLACEMENT OF ESSENTIAL COMPETENCIES BY INSTRUCTORS AND STUDENTS

Comparison of the responses of instructors and students tabulated in Table 8 show that more significant differences of opinion exist between these two groups. There were thirty statements in which the opinions of instructors differed significantly from those of the students. The students tended to place more of the statements in the "Preclinical" years. This indicates the students expect to acquire more of their needed skills and knowledge during the three academic years.

VII. CURRICULUM PLACEMENT OF ESSENTIAL COMPETENCIES BY EDUCATIONAL COORDINATORS AND STUDENTS

Educational coordinators' opinions on curriculum placement differed significantly from the students' opinions on thirty-nine competency statements. More of the students included these competencies in the "Preclinical" phase of their education and professional training. Tables

TABLE 7

COMPARISON OF OPINIONS OF EDUCATIONAL COORDINATORS AND INSTRUCTORS ON CURRICULUM PLACEMENT OF ESSENTIAL COMPETENCIES

Statements	Educational Coordinators (N=56)					Instructors (N=154)					Chi-Square	Signif-icance
	Pre-Clinical		Clinical			Pre-Clinical		Clinical				
	No.	%[b]	No.	%[b]	M[a]	No.	%[b]	No.	%[b]	M[a]		
1. Evaluate requested procedure to determine specimen collection method.	3	5.5	52	94.5	1	27	19.4	114	82.0	8	5.99	0.05*
2. Obtain specimen using techniques to maintain integrity of specimen in relation to test to be performed.	3	5.4	53	94.6	0	24	17.0	118	83.7	8	4.67	0.10
4. Identify specimen according to protocol.	6	11.2	49	90.8	2	29	20.3	116	81.1	8	2.69	0.26
5. Inspect and evaluate suitability of specimen for analysis requested.	8	14.3	48	85.7	0	24	16.8	122	85.3	7	1.21	0.55
6. Prepare aliquots or components of specimen for analysis.	12	22.2	42	77.8	0	43	31.0	99	71.3	8	2.20	0.33
8. Select reagents for requirements of the analysis.	19	35.9	36	68.0	1	53	38.7	86	62.8	8	1.30	0.52
9. Prepare reagents according to prescribed directions.	37	67.9	21	39.6	0	107	73.7	43	29.6	7	2.49	0.29
10. Label prepared reagents.	38	69.1	21	38.2	0	108	75.0	39	27.1	7	4.27	0.12
11. Store reagents properly.	38	69.1	21	38.2	0	98	68.1	50	34.7	7	2.05	0.36
12. Calibrate or standardize instruments.	26	46.4	36	64.3	0	63	44.7	86	61.0	8	1.57	0.46
13. Operate instruments utilizing established protocols.	25	44.6	37	66.1	0	57	40.1	94	66.2	9	1.15	0.56
14. Recognize equipment or instrument malfunction.	16	28.5	44	78.5	0	41	28.5	109	75.6	7	0.86	0.65
15. Follow a preventive maintenance program for all instruments and equipment.	8	14.8	48	88.9	0	29	21.3	115	84.6	8	1.06	0.59

TABLE 7 (Continued)

Statements	Educational Coordinators (N=56) Pre-Clinical No.	%	Clinical No.	%	M	Instructors (N=154) Pre-Clinical No.	%	Clinical No.	%	M	Chi-Square	Significance
16. Identify sources of biohazards.	30	55.5	30	55.5	0	87	60.0	66	45.5	7	2.70	0.26
17. Recognize unsafe laboratory practices.	34	64.2	28	52.8	2	104	71.7	51	35.2	7	6.86	0.03*
18. Define immediate action to be taken in case of accident or injury.	36	64.3	30	53.6	0	104	71.7	51	35.2	7	8.87	0.01**
19. Select control samples to monitor assays and procedures.	6	11.3	47	90.4	3	23	17.9	108	83.8	8	1.35	0.51
20. Conduct quality control procedures.	14	25.5	45	81.8	0	44	30.6	107	74.3	7	1.52	0.47
21. Determine normal or significant values according to established protocols.	11	22.4	38	77.6	7	38	28.4	100	74.6	14	1.76	0.42
23. Determine the conformity of reference values and test results to the established protocols.	13	20.0	43	80.0	2	33	25.6	99	76.7	14	1.48	0.48
24. Perform the analysis according to prescribed methodology.	20	35.9	37	67.2	1	63	45.0	82	58.6	14	1.28	0.52
25. Obtain analytical data and convert to test results.	18	33.4	37	68.6	3	71	53.4	67	50.4	14	6.23	0.04*
26. Recognize and react to primary indicators of malfunction in instruments or indicator systems.	13	23.6	44	80.0	2	46	33.1	100	71.9	14	1.67	0.43
27. Evaluate the acceptability of control samples.	14	26.4	40	75.5	4	40	29.7	99	73.4	14	0.29	0.87
28. Correlate the test result with other patient data.	11	15.2	44	85.0	1	20	16.4	104	85.2	14	0.13	0.94

TABLE 7 (Continued)

Statements	Educational Coordinators (N=56) Pre-Clinical No.	%	Clinical No.	%	M	Instructors (N=154) Pre-Clinical No.	%	Clinical No.	%	M	Chi-Square	Signif-icance
31. Identify antibody specificity with its antithetical antigen and describe its titer, avidity or quantity.	20	34.0	39	68.0	1	42	32.5	91	69.7	16	0.07	0.97
32. Prepare the required working reagents.	23	39.6	36	64.2	2	69	51.1	72	53.3	16	2.02	0.36
33. Select and standardize controls.	15	25.5	43	80.4	1	30	23.4	101	78.9	17	1.42	0.49
34. Maintain records in accordance with regulations.	11	16.3	46	87.8	1	23	17.5	110	83.9	15	1.39	0.49
35. Determine and perform appropriate procedures.	10	18.7	45	83.4	1	36	27.1	102	76.7	19	1.60	0.45
36. Perform the calculations necessary to convert results into the proper form or units for reporting.	21	38.9	35	64.8	3	69	50.3	72	52.5	16	2.36	0.31
37. Assess unusual test reactions.	7	13.4	46	88.4	4	23	18.4	106	84.8	16	0.67	0.72
38. Correlate test results with other laboratory data and patient data.	11	13.3	46	91.1	1	18	15.1	102	85.7	16	3.07	0.22
40. Report results in specified form and manner to appropriate staff.	3	5.6	51	94.4	3	17	13.0	116	88.5	16	2.42	0.30
41. Maintain records of donation in accordance with regulations.	4	2.1	49	97.9	3	6	5.1	111	94.9	15	0.19	0.67
42. Recognize the legal aspects of the blood donation program.	13	25.0	40	76.9	4	41	33.9	83	68.6	16	1.34	0.51
43. Determine donor eligibility.	12	23.5	39	76.5	5	34	26.0	97	74.0	16	0.02	0.88

TABLE 7 (Continued)

Statements	Educational Coordinators (N=56)					Instructors (N=154)					Chi-Square	Significance
	Pre-Clinical		Clinical			Pre-Clinical		Clinical				
	No.	%	No.	%	M	No.	%	No.	%	M		
44. Describe procedures and possible side effects of whole blood donation to donor.	13	26.0	40	80.0	5	37	30.6	86	71.1	17	3.46	0.18
45. Select proper container and anticoagulants.	10	18.5	44	81.5	2	31	23.9	100	76.9	16	0.92	0.63
46. Perform whole blood collection.	4	8.7	43	93.5	6	13	12.2	96	89.8	15	0.56	0.76
47. Process, label and store blood properly.	2	3.7	52	96.3	2	13	10.2	114	89.8	15	1.35	0.24
48. Assess donor's reaction.	0	0	47	100.0	9	11	9.9	100	90.1	15	3.59	0.06
49. Prepare blood components for therapeutic needs.	1	2.4	41	97.6	13	5	4.6	105	96.3	16	0.55	0.76
50. Label according to applicable standards.	6	11.8	45	88.2	5	22	17.3	106	83.5	15	1.08	0.58
51. Maintain quality of product for use in transfusion.	1	1.9	53	98.1	2	10	7.8	121	93.8	16	2.44	0.29
52. Identify possible cause of transfusion reaction.	12	23.0	42	80.7	4	25	18.3	115	84.5	15	0.53	0.77
53. Determine growth characteristics and requirements of various organisms.	37	68.5	21	38.9	2	104	73.7	42	29.7	13	2.12	0.35
54. Select media for various organisms.	34	60.7	23	41.1	2	92	64.8	94	38.0	12	0.41	0.81
55. Evaluate methods for growth and identification of microbial organisms	21	45.4	27	58.6	10	60	49.6	64	52.9	13	0.74	0.69
56. Record, review and report results.	17	30.4	41	73.2	0	37	26.6	106	76.3	12	0.29	0.86
57. Establish proper safety procedures for handling infectious specimens.	35	58.7	22	43.2	5	94	69.6	52	38.5	13	0.67	0.71

TABLE 7 (Continued)

Statements	Educational Coordinators (N=56) Pre-Clinical No.	%	Clinical No.	%	M	Instructors (N=154) Pre-Clinical No.	%	Clinical No.	%	M	Chi-Square	Significance
58. Prepare direct smear.	36	64.3	22	39.3	0	93	66.5	52	37.2	12	0.08	0.96
59. Assess morphological and structural characteristics of organisms and other specimen contents.	30	53.6	27	48.2	0	75	53.6	69	49.3	12	0.19	0.91
60. Describe microscopic observations.	40	71.4	20	35.7	0	99	70.7	47	33.6	12	0.67	0.71
61. Evaluate results.	17	30.4	41	73.2	0	33	24.4	105	77.8	12	0.81	0.61
62. Select and implement an identification protocol appropriate to the source and characteristics of the specimen.	15	30.0	39	78.0	7	34	27.4	94	75.8	14	1.87	0.39
63. Select and perform serological tests.	14	26.9	39	75.0	4	44	32.9	96	71.7	12	0.99	0.61
64. Correlate all analyses and information to identify organism.	13	30.3	39	76.7	4	42	30.6	99	72.2	14	2.02	0.36
65. Select and perform antimicrobial evaluation procedures for microbial susceptibility of organism(s).	13	24.6	43	81.2	3	31	23.2	109	81.4	14	0.12	0.94
66. Report findings to appropriate persons or agencies.	3	5.4	53	96.3	1	14	10.8	119	91.5	12	1.44	0.48
69. Establish procedures to evaluate hematological determinations.	7	17.1	34	82.9	13	26	25.2	80	77.7	17	1.84	0.40
72. Establish procedures for correlation of results.	5	11.2	40	88.9	11	29	27.7	79	75.3	17	5.24	0.08
73. Identify physiological and pathophysiological factors for which hematological procedures can contribute useful data.	15	35.7	30	71.4	13	39	34.4	79	69.9	18	0.47	0.79

TABLE 7 (Continued)

Statements	Educational Coordinators (N=56)					Instructors (N=154)					Chi-Square	Significance
	Pre-Clinical No.	%	Clinical No.	%	M	Pre-Clinical No.	%	Clinical No.	%	M		
74. Select the procedures appropriate for the request for service.	6	12.5	42	87.5	8	29	24.4	95	79.8	17	3.75	0.15
75. Control physical conditions critical to the tests.	16	29.6	40	74.1	3	47	34.5	95	69.8	16	0.42	0.81
76. Select appropriate procedure for accuracy and speed consistent with daily workload.	2	4.3	44	95.7	11	10	8.4	109	92.3	17	0.98	0.61
77. Enumerate formed elements in specimen.	23	41.8	36	65.5	1	60	44.8	81	60.4	18	0.60	0.74
78. Calculate results in appropriate units.	23	41.8	34	61.8	1	74	54.8	67	49.6	16	2.65	0.27
79. Measure and evaluate physical properties of specimen.	16	30.2	39	73.6	3	47	35.6	90	68.2	19	0.53	0.77
80. Select, perform, monitor, and evaluate cytochemical procedures for cellular constituents.	8	18.1	38	86.3	12	27	24.3	88	79.3	20	1.07	0.58
81. Select, perform, monitor, and evaluate procedures that do not require stain.	8	17.0	39	83.0	9	25	21.4	97	82.9	21	2.09	0.35
82. Calculate results to conform to prescribed units.	21	38.2	37	67.3	1	69	50.7	71	52.2	17	3.89	0.14
83. Report results which are descriptive, qualitative, or quantitative in nature.	14	25.5	44	80.0	1	48	35.8	89	66.4	16	4.32	0.11
84. Perform and evaluate biochemical and physiological assays.	12	23.5	42	82.4	5	35	29.7	87	73.7	20	1.83	0.40
85. Recognize and react to indicators of test or instrument malfunction.	15	27.2	42	76.3	1	30	22.6	110	82.7	16	1.15	0.56

TABLE 7 (Continued)

Statements	Educational Coordinators (N=56) Pre-Clinical No.	%	Clinical No.	%	M	Instructors (N=154) Pre-Clinical No.	%	Clinical No.	%	M	Chi-Square	Significance
86. Correlate quantitative, biochemical physiological and morphological data to verify results.	9	16.7	46	85.2	3	25	19.4	109	84.5	18	0.52	0.77
87. Correlate the test results with other patient data when possible.	5	10.4	44	91.7	8	16	13.5	105	88.3	16	0.44	0.80
88. Evaluate the acceptability of controls.	15	27.8	42	77.8	2	39	28.9	100	74.1	16	0.92	0.63
89. Integrate test data to lead to a conclusion or decision about the normality of a system.	8	18.7	37	86.1	13	16	14.9	94	87.8	18	0.44	0.80

a = Missing values are tallied and not used in the calculations.

b = Some respondents included a competency in both phases so percentages may exceed 100 percent.

* = Significant at the 0.05 level.

** = Significant at the 0.01 level.

*** = Significant at the 0.001 level.

TABLE 8

COMPARISON OF OPINIONS OF INSTRUCTORS AND STUDENTS ON CURRICULUM PLACEMENT OF ESSENTIAL COMPETENCIES

Statements	Instructors (N=154)					Students (N=176)					Chi-Square	Signif-icance
	Pre-Clinical No.	% [b]	Clinical No.	% [b]	M [a]	Pre-Clinical No.	% [b]	Clinical No.	% [b]	M [a]		
1. Evaluate requested procedure to determine specimen collection method.	27	19.4	114	82.0	8	42	25.9	120	74.1	1	4.86	0.09
2. Obtain specimen using techniques to maintain integrity of specimen in relation to test to be performed.	24	17.0	118	83.7	8	39	22.8	134	78.4	0	1.63	0.44
4. Identify specimen according to protocol.	29	20.3	116	81.1	8	39	23.5	127	76.5	1	3.19	0.20
5. Inspect and evaluate suitability of specimen for analysis requested.	24	16.8	122	85.3	7	46	26.5	129	74.2	0	7.09	0.03*
6. Prepare aliquots or components of specimen for analysis.	43	31.0	99	71.3	8	56	34.1	110	67.1	0	0.93	0.63
8. Select reagents for requirements of the analysis.	53	38.7	86	62.8	8	79	47.3	89	53.3	0	3.15	0.21
9. Prepare reagents according to prescribed directions.	107	73.7	43	29.6	7	112	64.8	62	35.9	0	5.97	0.05*
10. Label prepared reagents.	108	75.0	39	27.1	7	109	67.3	54	33.3	1	3.24	0.20
11. Store reagents properly.	98	68.1	50	34.7	7	107	64.5	61	36.7	0	1.33	0.51
12. Calibrate or standardize instruments.	63	44.7	86	61.0	8	87	50.0	94	54.0	0	1.75	0.42
13. Operate instruments utilizing established protocols.	57	40.1	94	66.2	9	67	38.1	116	65.9	0	0.93	0.63
14. Recognize equipment or instrument malfunction.	41	28.5	109	75.6	7	42	24.3	135	77.9	1	1.23	0.54
15. Follow a preventive maintenance program for all instruments and equipment.	29	21.3	115	84.6	8	34	20.7	134	81.7	0	2.56	0.28

TABLE 8 (Continued)

Statements	Instructors (N=154)					Students (N=176)					Chi-Square	Signif-icance
	Pre-Clinical No.	%	Clinical No.	%	M	Pre-Clinical No.	%	Clinical No.	%	M		
16. Identify sources of biohazards.	87	60.0	66	45.5	7	111	63.8	67	38.5	0	3.14	0.21
17. Recognize unsafe laboratory practices.	104	71.7	51	32.5	7	137	79.2	40	23.1	1	7.19	0.03*
18. Define immediate action to be taken in case of accident or injury.	104	71.7	51	32.5	7	122	71.8	56	32.9	2	0.36	0.83
19. Select control samples to monitor assays and procedures.	23	17.9	108	83.8	8	43	26.0	125	75.7	0	2.88	0.24
20. Conduct quality control procedures.	44	30.6	107	74.3	7	54	31.4	119	67.2	0	6.40	0.04*
21. Determine normal or significant values according to established protocols.	38	28.4	100	74.6	14	60	35.7	109	64.9	0	5.47	0.07
23. Determine the conformity of reference values and test results to the established protocols.	33	25.6	99	76.7	14	45	26.8	124	73.8	1	1.89	0.39
24. Perform the analysis according to prescribed methodology.	63	45.0	82	58.6	14	96	49.1	92	52.6	0	1.94	0.38
25. Obtain analytical data and convert to test results.	71	53.4	67	50.4	14	89	53.9	80	48.5	3	0.51	0.77
26. Recognize and react to primary indicators of malfunction in instruments or indicator systems.	46	33.1	100	71.9	14	53	30.4	123	70.6	0	4.18	0.12
27. Evaluate the acceptability of control samples.	40	29.7	99	73.4	14	60	35.1	112	65.5	1	4.44	0.11
28. Correlate the test result with other patient data.	20	16.4	104	85.2	14	37	23.2	123	77.3	1	3.30	0.19

TABLE 8 (Continued)

Statements	Instructors (N=154) Pre-Clinical No.	%	Clinical No.	%	M	Students (N=176) Pre-Clinical No.	%	Clinical No.	%	M	Chi-Square	Significance
31. Identify antibody specificity with its antithetical antigen and describe its titer, avidity or quantity.	42	32.5	91	69.7	16	68	41.2	97	58.8	4	7.10	0.03*
32. Prepare the required working reagents.	69	51.1	72	53.3	16	88	55.0	72	45.0	1	8.34	0.01**
33. Select and standardize controls.	30	23.4	101	78.9	17	49	30.9	112	70.5	2	2.98	0.22
34. Maintain records in accordance with regulations.	23	17.5	110	83.9	15	25	15.6	135	84.4	2	2.48	0.29
35. Determine and perform appropriate procedures.	36	27.1	102	76.7	19	65	38.2	105	61.8	4	13.03	0.002**
36. Perform the calculations necessary to convert results into the proper form or units for reporting.	69	50.3	72	52.5	16	107	64.5	61	36.7	4	8.01	0.02*
37. Assess unusual test reactions.	23	18.4	106	84.8	16	49	28.8	122	71.8	2	5.32	0.009**
38. Correlate test results with other laboratory data and patient data.	18	15.1	102	85.7	16	34	22.4	120	78.9	3	2.26	0.32
40. Report results in specified form and manner to appropriate staff.	17	13.0	116	88.5	16	24	14.7	140	85.9	2	1.02	0.60
41. Maintain records of donation in accordance with regulations.	6	5.1	111	94.9	15	26	16.0	137	84.0	3	6.85	0.009**
42. Recognize the legal aspects of the blood donation program.	41	33.9	83	68.6	16	72	44.7	90	55.9	3	5.92	0.05*
43. Determine donor eligibility.	34	26.0	97	74.0	16	65	39.4	101	61.2	3	6.41	0.04*

TABLE 8 (Continued)

Statements	Instructors (N=154) Pre-Clinical No.	%	Clinical No.	%	M	Students (N=176) Pre-Clinical No.	%	Clinical No.	%	M	Chi-Square	Significance
58. Prepare direct smear.	93	66.5	52	37.2	12	132	75.9	46	26.4	1	4.17	0.12
59. Assess morphological and structural characteristics of organisms and other specimen contents.	75	53.6	69	49.3	12	121	70.0	54	31.3	0	10.88	0.004**
60. Describe microscopic observations.	99	70.7	47	33.6	12	133	77.3	42	24.4	1	3.95	0.14
61. Evaluate results.	33	24.4	105	77.8	12	85	49.7	91	53.2	0	20.64	0.0001***
62. Select and implement an identification protocol appropriate to the source and characteristics of the specimen.	34	27.4	94	75.8	14	58	34.7	111	66.5	1	4.08	0.13
63. Select and perform serological tests.	44	32.9	96	71.7	12	53	31.7	115	68.9	1	5.02	0.08
64. Correlate all analyses and information to identify organism.	42	30.6	99	72.2	14	97	55.5	83	47.5	0	19.88	0.0001***
65. Select and perform antimicrobial evaluation procedures for microbial susceptibility of organism(s).	31	23.2	109	81.4	14	65	37.8	108	62.8	1	16.27	0.0003***
66. Report findings to appropriate persons or agencies.	14	10.8	119	91.5	12	21	13.2	138	86.8	0	5.17	0.08
69. Establish procedures to evaluate hematological determinations.	26	25.2	80	77.7	17	40	28.2	104	73.2	2	1.20	0.55
72. Establish procedures for correlation of results.	29	27.7	79	75.3	17	45	29.8	106	70.2	2	4.92	0.09
73. Identify physiological and pathophysiological factors for which hematological procedures can contribute useful data.	39	34.4	79	69.9	18	87	53.4	76	46.6	4	19.83	0.0001***

TABLE 8 (Continued)

Statements	Instructors (N=154) Pre-Clinical No.	%	Clinical No.	%	M	Students (N=176) Pre-Clinical No.	%	Clinical No.	%	M	Chi-Square	Significance
44. Describe procedures and possible side effects of whole blood donation to donor.	37	30.6	86	71.1	17	64	39.5	98	60.5	3	5.75	0.05*
45. Select proper container and anticoagulants.	31	23.9	100	76.9	16	54	32.7	111	67.3	3	4.45	0.11
46. Perform whole blood collection.	13	12.2	96	89.8	15	33	23.1	110	76.9	4	5.26	0.01**
47. Process, label and store blood properly.	13	10.2	114	89.8	15	28	16.3	145	84.3	3	2.68	0.26
48. Assess donor's reaction.	11	9.9	100	90.1	15	32	21.1	113	77.9	3	5.81	0.02*
49. Prepare blood components for therapeutic needs.	5	4.6	105	96.3	16	9	5.7	149	94.3	3	2.00	0.37
50. Label according to applicable standards.	22	17.3	106	83.5	15	37	22.2	130	77.8	4	2.68	0.26
51. Maintain quality of product for use in transfusion.	10	7.8	121	93.8	16	19	11.2	150	88.8	4	4.77	0.09
52. Identify possible cause of transfusion reaction.	25	18.3	115	84.5	15	61	35.9	112	65.9	3	13.88	0.001***
53. Determine growth characteristics and requirements of various organisms.	104	73.7	42	29.7	13	139	79.5	37	21.2	1	5.50	0.06
54. Select media for various organisms.	92	64.8	94	38.0	12	127	72.1	51	28.9	0	3.51	0.17
55. Evaluate methods for growth and identification of microbial organisms	60	49.6	64	52.9	13	112	68.7	52	31.9	1	13.33	0.001***
56. Record, review and report results.	37	26.6	106	76.3	12	62	36.3	111	64.9	0	5.49	0.06
57. Establish proper safety procedures for handling infectious specimens.	94	69.6	52	38.5	13	130	76.4	45	26.4	1	4.81	0.03

TABLE 8 (Continued)

Statements	Instructors (N=154) Pre-Clinical No.	%	Clinical No.	%	M	Students (N=176) Pre-Clinical No.	%	Clinical No.	%	M	Chi-Square	Significance
74. Select the procedures appropriate for the request for service.	29	24.4	95	79.8	17	33	21.9	118	78.1	2	6.49	0.03*
75. Control physical conditions critical to the tests.	47	34.5	95	69.8	16	55	33.7	109	66.9	2	4.78	0.09
76. Select appropriate procedure for accuracy and speed consistent with daily workload.	10	8.4	109	92.3	17	12	7.8	141	92.2	1	1.30	0.52
77. Enumerate formed elements in specimen.	60	44.8	81	60.4	18	93	54.1	80	46.5	1	10.60	0.005**
78. Calculate results in appropriate units.	74	54.8	67	49.6	16	115	66.9	57	33.1	1	13.94	0.0009***
79. Measure and evaluate physical properties of specimen:.	47	35.6	90	68.2	19	81	48.2	87	51.8	1	13.26	0.001***
80. Select, perform, monitor, and evaluate cytochemical procedures for cellular constituents.	27	24.3	88	79.3	20	43	28.7	108	72.0	4	4.39	0.11
81. Select, perform, monitor, and evaluate procedures that do not require stain.	25	21.4	97	82.9	21	53	33.9	104	66.6	6	12.18	0.002**
82. Calculate results to conform to prescribed units.	69	50.7	71	52.2	17	103	59.9	69	40.1	1	8.53	0.01**
83. Report results which are descriptive, qualitative, or quantitative in nature.	48	35.8	89	66.4	16	70	41.2	100	58.8	1	5.30	0.07
84. Perform and evaluate biochemical and physiological assays.	35	29.7	87	73.7	20	53	32.1	114	69.1	5	2.11	0.35
85. Recognize and react to indicators of test or instrument malfunction.	30	22.6	110	82.7	16	41	23.6	134	77.0	1	7.56	0.02*

TABLE 8 (Continued)

Statements	Instructors (N=154)					Students (N=176)					Chi-Square	Significance
	Pre-Clinical No.	%	Clinical No.	%	M	Pre-Clinical No.	%	Clinical No.	%	M		
86. Correlate quantitative, biochemical physiological and morphological data to verify results.	25	19.4	109	84.5	18	52	30.4	119	69.6	1	14.64	0.0007***
87. Correlate the test results with other patient data when possible.	16	13.5	105	88.3	16	30	18.7	131	81.9	1	2.73	0.26
88. Evaluate the acceptability of controls.	39	28.9	100	74.1	16	58	34.1	112	65.9	1	6.99	0.03*
89. Integrate test data to lead to a conclusion or decision about the normality of a system.	16	14.9	94	87.8	18	35	24.0	111	76.0	4	9.27	0.009**

a = Missing values are tallied and not used in the calculations.

b = Some respondents included a competency in both phases so percentages may exceed 100 percent.

* = Significant at the 0.05 level.

** = Significant at the 0.01 level.

*** = Significant at the 0.001 level.

TABLE 9

COMPARISON OF OPINIONS OF EDUCATIONAL COORDINATORS AND STUDENTS ON CURRICULUM PLACEMENT OF ESSENTIAL COMPETENCIES

Statements	Educational Coordinators (N=56)					Students (N=176)					Chi-Square	Signif-icance
	Pre-Clinical		Clinical			Pre-Clinical		Clinical				
	No.	%	No.	%	M	No.	%	No.	%	M		
1. Evaluate requested procedure to determine specimen collection method.	3	5.5	52	94.5	1	42	25.9	120	74.1	1	9.26	0.002**
2. Obtain specimen using techniques to maintain integrity of specimen in relation to test to be performed.	3	5.4	53	94.6	0	39	22.8	134	78.4	0	8.58	0.01**
4. Identify specimen according to protocol.	6	11.2	49	90.8	2	39	23.5	127	76.5	1	7.99	0.02*
5. Inspect and evaluate suitability of specimen for analysis requested.	8	14.3	48	85.7	0	46	26.5	129	74.2	0	3.60	0.16
6. Prepare aliquots or components of specimen for analysis.	12	22.2	42	77.8	0	56	34.1	110	67.1	0	3.04	0.22
8. Select reagents for requirements of the analysis.	19	35.9	36	68.0	1	79	47.3	89	53.3	0	5.92	0.05*
9. Prepare reagents according to prescribed directions.	37	67.9	21	39.6	0	112	64.8	62	35.9	0	9.12	0.01**
10. Label prepared reagents.	38	69.1	21	38.2	0	109	67.3	54	33.3	1	8.00	0.02*
11. Store reagents properly.	38	69.1	21	38.2	0	107	64.5	61	36.7	0	5.64	0.06
12. Calibrate or standardize instruments.	26	46.4	36	64.3	0	87	50.0	94	54.0	0	4,49	0.11
13. Operate instruments utilizing established protocols.	25	44.6	37	66.1	0	67	38.1	116	65.9	0	3.74	0.15
14. Recognize equipment or instrument malfunction.	16	28.5	44	78.5	0	42	24.3	135	77.9	1	2.94	0.23
15. Follow a preventive maintenance program for all instruments and equipment.	8	14.8	48	88.9	0	34	20.7	134	81.7	0	1.68	0.43

TABLE 9 (Continued)

Statements	Educational Coordinators (N=56) Pre-Clinical No.	%	Clinical No.	%	M	Students (N=176) Pre-Clinical No.	%	Clinical No.	%	M	Chi-Square	Significance
16. Identify sources of biohazards.	30	55.5	30	55.5	0	111	63.8	67	38.5	0	10.11	0.006**
17. Recognize unsafe laboratory practices.	34	64.2	28	52.8	2	137	79.2	40	23.1	1	24.07	0.0001***
18. Define immediate action to be taken in case of accident or injury.	36	64.3	30	53.6	0	122	71.8	56	32.9	2	12.82	0.002**
19. Select control samples to monitor assays and procedures.	6	11.5	47	90.4	3	43	26.0	125	75.7	0	5.16	0.07
20. Conduct quality control procedures.	14	25.5	45	81.8	0	54	31.4	119	67.2	0	11.08	0.004**
21. Determine normal or significant values according to established protocols.	11	22.4	38	77.6	7	60	35.7	109	64.9	0	3.17	0.20
23. Determine the conformity of reference values and test results to the established protocols.	13	20.0	43	80.0	2	45	26.8	124	73.8	1	1.13	0.57
24. Perform the analysis according to prescribed methodology.	20	35.9	37	67.2	1	96	49.1	92	52.6	0	4.04	0.13
25. Obtain analytical data and convert to test results.	18	33.4	37	68.6	3	89	53.9	80	48.5	3	6.93	0.03*
26. Recognize and react to primary indicators of malfunction in instruments or indicator systems.	13	23.6	44	80.0	2	53	30.4	123	70.6	0	3.09	0.21
27. Evaluate the acceptability of control samples.	14	26.4	40	75.5	4	60	35.1	112	65.5	1	2.47	0.29
28. Correlate the test result with other patient data.	11	15.2	44	85.0	1	37	23.2	123	77.3	1	2.77	0.25

TABLE 9 (Continued)

Statements	Educational Coordinators (N=56) Pre-Clinical No.	%	Clinical No.	%	M	Students (N=176) Pre-Clinical No.	%	Clinical No.	%	M	Chi-Square	Significance
31. Identify antibody specificity with its antithetical antigen and describe its titer, avidity or quantity.	20	34.0	39	68.0	1	68	41.2	97	58.8	4	4.46	0.11
32. Prepare the required working reagents.	23	39.6	36	64.2	2	88	55.0	72	45.0	1	10.87	0.004**
33. Select and standardize controls.	15	25.5	43	80.4	1	49	30.9	112	70.5	2	5.03	0.08
34. Maintain records in accordance with regulations.	11	16.3	46	87.8	1	25	15.6	135	84.4	2	6.82	0.03*
35. Determine and perform appropriate procedures.	10	18.7	45	83.4	1	65	38.2	105	61.8	4	11.31	0.003**
36. Perform the calculations necessary to convert results into the proper form or units for reporting.	21	38.9	35	64.8	3	107	64.5	61	36.7	4	13.46	0.001***
37. Assess unusual test reactions.	7	13.4	46	88.4	4	49	28.8	122	71.8	2	6.61	0.04*
38. Correlate test results with other laboratory data and patient data.	11	13.3	46	91.1	1	34	22.4	120	78.9	3	4.84	0.09
40. Report results in specified form and manner to appropriate staff.	3	5.6	51	94.4	3	24	14.7	140	85.9	2	3,20	0.20
41. Maintain records of donation in accordance with regulations.	4	2.1	49	97.9	3	26	16.0	137	84.0	3	5.05	0.02*
42. Recognize the legal aspects of the blood donation program.	13	25.0	40	76.9	4	72	44.7	90	55.9	3	7.71	0.02*
43. Determine donor eligibility.	12	23.5	39	76.5	5	65	39.4	101	61.2	3	4.41	0.11

TABLE 9 (Continued)

Statements	Educational Coordinators (N=56)					Students (N=176)					Chi-Square	Signif-icance
	Pre-Clinical		Clinical			Pre-Clinical		Clinical				
	No.	%	No.	%	M	No.	%	No.	%	M		
44. Describe procedures and possible side effects of whole blood donation to donor.	13	26.0	40	80.0	5	64	39.5	98	60.5	3	14.98	0.0006***
45. Select proper container and anticoagulants.	10	18.5	44	81.5	2	54	32.7	111	67.3	3	3.31	0.69
46. Perform whole blood collection.	4	8.7	43	93.5	6	33	23.1	110	76.9	4	9.01	0.01**
47. Process, label and store blood properly.	2	3.7	52	96.3	2	28	16.3	145	84.3	3	5.67	0.06
48. Assess donor's reaction.	0	0	47	100.0	9	32	21.1	113	77.9	3	10.91	0.001***
49. Prepare blood components for therapeutic needs.	1	2.4	41	97.6	13	9	5.7	149	94.3	3	0.23	0.63
50. Label according to applicable standards.	6	11.8	45	88.2	5	37	22.2	130	77.8	4	2.04	0.15
51. Maintain quality of product for use in transfusion.	1	1.9	53	98.1	2	19	11.2	150	88.8	4	3.34	0.07
52. Identify possible cause of transfusion reaction.	12	23.0	42	80.7	4	61	35.9	112	65.9	3	4.62	0.10
53. Determine growth characteristics and requirements of various organisms.	37	68.5	21	38.9	2	139	79.5	37	21.2	1	12.69	0.002**
54. Select media for various organisms.	34	60.7	23	41.1	2	127	72.1	51	28.9	0	2.87	0.24
55. Evaluate methods for growth and identification of microbial organisms	21	45.4	27	58.6	10	112	68.7	52	31.9	1	12.87	0.002**
56. Record, review and report results.	17	30.4	41	73.2	0	62	36.3	111	64.9	0	2.49	0.29
57. Establish proper safety procedures for handling infectious specimens.	35	58.7	22	43.2	5	130	76.4	45	26.4	1	8.65	0.01**

TABLE 9 (Continued)

Statements	Educational Coordinators (N=56)					Students (N=176)					Chi-Square	Significance
	Pre-Clinical No.	Pre-Clinical %	Clinical No.	Clinical %	M	Pre-Clinical No.	Pre-Clinical %	Clinical No.	Clinical %	M		
58. Prepare direct smear.	36	64.3	22	39.3	0	132	75.9	46	26.4	1	3.36	0.19
59. Assess morphological and structural characteristics of organisms and other specimen contents.	30	53.6	27	48.2	0	121	70.0	54	31.3	0	5.35	0.07
60. Describe microscopic observations.	40	71.4	20	35.7	0	133	77.3	42	24.4	1	5.35	0.07
61. Evaluate results.	17	30.4	41	73.2	0	85	49.7	91	53.2	0	6.96	0.03*
62. Select and implement an identification protocol appropriate to the source and characteristics of the specimen.	15	30.0	39	78.0	7	58	34.7	111	66.5	1	8.23	0.02*
63. Select and perform serological tests.	14	26.9	39	75.0	4	53	31.7	115	68.9	1	1.40	0.50
64. Correlate all analyses and information to identify organism.	13	30.3	39	76.7	4	97	55.5	83	47.5	0	15.31	0.0005***
65. Select and perform antimicrobial evaluation procedures for microbial susceptibility of organism(s).	13	24.6	43	81.2	3	65	37.8	108	62.8	1	11.11	0.004**
66. Report findings to appropriate persons or agencies.	3	5.4	53	96.3	1	21	13.2	138	86.8	0	6.65	0.04*
69. Establish procedures to evaluate hematological determinations.	7	17.1	34	84.9	13	40	28.2	104	73.2	2	2.32	0.31
72. Establish procedures for correlation of results.	5	11.1	40	88.9	11	45	29.8	106	70.2	2	0.12	0.91
73. Identify physiological and pathophysiological factors for which hematological procedures can contribute useful data.	15	35.7	30	71.4	13	87	53.4	76	46.6	4	3.89	0.14

TABLE 9 (Continued)

Statements	Educational Coordinators (N=56)					Students (N=176)					Chi-Square	Signif-icance
	Pre-Clinical		Clinical			Pre-Clinical		Clinical				
	No.	%	No.	%	M	No.	%	No.	%	M		
74. Select the procedures appropriate for the request for service.	6	12.5	42	87.5	8	33	21.9	118	78.1	2	1.47	0.22
75. Control physical conditions critical to the tests.	16	29.6	40	74.1	3	55	33.7	109	66.9	2	3.57	0.17
76. Select appropriate procedure for accuracy and speed consistent with daily workload.	2	4.3	44	95.7	11	12	7.8	141	92.2	1	0.23	0.63
77. Enumerate formed elements in specimen.	23	41.8	36	65.5	1	93	54.1	80	46.5	1	12.81	0.002**
78. Calculate results in appropriate units.	23	41.8	34	61.8	1	45	66.9	57	33.1	1	18.64	0.0001***
79. Measure and evaluate physical properties of specimen:.	16	30.2	39	73.6	3	81	48.2	87	51.8	1	13.13	0.001***
80. Select, perform, monitor, and evalúate cytochemical procedures for cellular constituents.	8	18.1	38	86.3	12	43	28.7	108	72.0	4	6.65	0.04*
81. Select, perform, monitor, and evaluate procedures that do not require stain.	8	17.0	39	83.0	9	53	33.9	104	66.6	6	5.04	0.08
82. Calculate results to conform to pre-scribed units.	21	38.2	37	67.3	1	103	59.9	69	40.1	1	19.47	0.0001***
83. Report results which are descriptive, qualitative, or quantitative in nature.	14	25.5	44	80.0	1	70	41.2	100	58.8	1	16.09	0.0003***
84. Perform and evaluate biochemical and physiological assays.	12	23.5	42	82.4	5	53	32.1	114	69.1	5	6.55	0.04*
85. Recognize and react to indicators of test or instrument malfunction.	15	27.2	42	76.3	1	41	23.6	134	77.0	1	3.07	0.22

TABLE 9 (Continued)

Statements	Educational Coordinators (N=56) Pre-Clinical No.	%	Clinical No.	%	M	Students (N=176) Pre-Clinical No.	%	Clinical No.	%	M	Chi-Square	Significance
86. Correlate quantitative, biochemical physiological and morphological data to verify results.	9	16.7	46	85.2	3	52	30.4	119	69.6	1	7.97	0.02*
87. Correlate the test results with other patient data when possible.	5	10.4	44	91.7	8	30	18.7	131	81.9	1	3.35	0.19
88. Evaluate the acceptability of controls.	15	27.8	42	77.8	2	58	34.1	112	65.9	1	11.54	0.003**
89. Integrate test data to lead to a conclusion or decision about the normality of a system.	8	18.7	37	86.1	13	35	24.0	111	76.0	4	8.45	0.01**

a = Missing values are tallied and not used in the calculations.

b = Some respondents included a competency in both phases so percentages may exceed 100 percent.

* = Significant at the 0.05 level.

** = Significant at the 0.01 level.

*** = Significant at the 0.001 level.

5 and 6, pages 81 and 83, detail the comparative number of responses from each group used in determining the competencies included in each phase of professional education. These data confirm that it takes both the academic setting and the hospital experiences to complete the training of contemporary medical laboratory technologists. It also supports the premise that students should know what the instructors, educational coordinators, and employers expect of them. Broski (1977) stated: "In essence, all health professionals are required to teach, manage, and problem solve. It is the speciality practice which dictates the content to be addressed," (p. 41). More supportive of the students input, Crowley states:

> Laboratory practitioners, because their ability to function as a profession is at stake, will expect that the educational programs they attend will directly relate to the competencies they are expected to achieve and maintain, (1978, p. 411).

VIII. POTENTIAL EMPLOYERS VALIDATE LIST OF ESSENTIAL COMPETENCIES

The final list of current essential competencies as enumerated in Tables 3 and 4, pages 65 and 73, was presented to a jury of nine potential employers including: pathologists, chief medical technologists, and laboratory managers. Most of the jury unanimously agreed that the competencies on the final list were essential for employability at career entry level for medical technologists. Table 10 shows a tabulation of the jury's negative responses. All of the panel considered fifty-five of the statements "Essential." Two members marked eight of the statements

TABLE 10

COMPETENCIES MARKED NON-ESSENTIAL BY A JURY OF EMPLOYERS OF LABORATORY PERSONNEL

Statements	Times Statement Marked Non-Essential N=9
General Laboratory	
1. Evaluate requested procedure to determine specimen collection method.	1
4. Identify specimen according to protocol.	1
8. Select reagents for requirements of the analysis.	1
14. Recognize equipment or instrument malfunction.	1
15. Follow a preventive maintenance program for all instruments and equipment.	1
16. Identify sources of biohazards.	1
18. Define immediate action to be taken in case of accident or injury.	2
19. Select control samples to monitor assay and procedures.	1
Clinical Chemistry	
27. Evaluate the acceptability of control samples	1
28. Correlate the test results with other patient data.	3

TABLE 10 (Continued)

Statements	Times Statement Marked Non-Essential N=9
Immunology	
33. Select and standardize controls.	2
34. Maintain records in accordance with regulations.	1
35. Determine and perform appropriate procedures.	2
38. Correlate test results with other laboratory data and patient data.	3
Immunohematology	
41. Maintain records of donation in accordance with regulations.	1
42. Recognize the legal aspects of the blood donation program.	1
45. Select proper container and anticoagulants.	1
52. Identify possible cause of transfusion reaction.	2
Microbiology	
65. Select and perform antimicrobial evaluation procedures for microbial susceptibility of organisms.	2
Hematology	
72. Establish procedures for correlation of results.	1

TABLE 10 (Continued)

Statements	Times Statement Marked Non-Essential N=9
73. Identify physiological and pathophysiological factors for which hematological procedures can contribute useful data.	2
74. Select the procedures appropriate for the request for service.	1
80. Select, perform, monitor, and evaluate cytochemical procedures for cellular constituents.	2
81 Select, perform, monitor, and evaluate procedures that do not require stain.	1
86. Correlate quantitative, biochemical, physiological, and morphological data to verify results.	1
87. Correlate the test results with other patient data when possible.	1
89. Integrate test data to lead to a conclusion or decision about the normality of a system.	2

"Non-essential." Two additional statements were rated "Non-essential" by three of the jury. When questioned about these two statements, the three people felt that "Correlate the test results with other patient data," should be the duty of supervisory or medical personnel in the laboratory, not entry level personnel. This premise supported the occasional inclusion of the other fifty-three statements in the "Non-essential" group. The total list of seventy-nine statements was considered essential for experienced personnel particularly with supervisory duties. Several members of the jury observed that the length of experience needed would depend on the size of the laboratory staff.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY OF PROBLEM AND PROCEDURES

The primary purpose of the study was to identify the current essential competencies for career entry level medical laboratory technologists. A second purpose for the study was to examine the curriculum placement of the essential competencies. In order to delineate the problem, answers were sought to the following questions:

1. What are the essential competencies currently needed by an entry level medical laboratory technologist?

2. Is there a difference in the opinions of educational coordinators and instructors regarding current essential competencies?

3. Is there a difference in the opinions of instructors and students regarding current essential competencies?

4. Is there a difference in the opinions of educational coordinators and students regarding current essential competencies?

5. In which phase of training should each of the essential competencies be acquired?

6. Is there a difference in the opinions of educational coordinators and instructors as to the phase of training in which competencies should be acquired?

7. Is there a difference in the opinions of instructors and students as to the phase of training in which competencies should be acquired?

8. Is there a difference in the opinions of educational coordinators and students as to the phase of training in which competencies should be acquired?

Data for the study were obtained from educational coordinators, instructors, and students in accredited schools of medical technology across the nation. The continental United States was divided into regions to insure regional representation in the sample. The schools were stratified so that the final population (170 schools) consisted of all accredited schools approved for an enrollment of at least fifteen students.

A questionnaire was developed after pilot testing. The final instrument contained a list of ninety-one competency statements. Each respondent was asked to mark each statement either "Essential" or "Nonessential." If "Essential" was marked then each statement was also to be checked either "Preclinical" or "Clinical."

Eight instruments were sent to each school that chose to participate (69 schools) out of the original random sample of 118 schools. The packet of questionnaires contained one for the educational coordinator, three for instructors, and four for students. A total of 552 instruments were mailed out: 69 to educational coordinators, 207 to instructors, and 276 to students. Three-hundred eighty-six (70 percent) of the instruments were returned; 56 (81.2 percent) from educational coordinators; 154 (74.4 percent) from instructors; and 176 (64 percent) from students.

Chi square was calculated using the SPSS (Nie, 1975) computer package. These computations aided in the presentation of data in tabular form.

The frequencies and percentages were used to determine the placement of each competency in the "Essential," "Non-essential," "Pre-clinical," or "Clinical" categories.

II. SUMMARY OF FINDINGS

From the list of ninety-one competencies included on the instrument, seventy-nine were considered essential by at least 75 percent of each of the three groups. Some of the competencies deleted were important skills and procedures only a few years ago. This is a reflection of the changing technology in this field. Two statements were rated 100 percent "Essential" by two groups, and a third statement was rated 100 percent "Essential" by all groups.

When the opinions of the educational coordinators (56) were compared to those of the instructors (154) there were no significant differences as to which of the statements were "Essential." Eighty statements were rated "Essential" by these groups. The data were presented in Chapter IV to support these findings.

When the opinions of instructors (154) were compared with those of students (176) significant differences became apparent. Statement three was deleted because it was only rated 58.3 percent "Essential" by the students. Because of this deletion the final list contained seventy-nine statements. There were eleven statements on the list on which the instructors and students differed at the 0.05, 0.01, or 0.001 level. These differences may be due to lack of experience on the part of the students or lack of congruence in role expectations between the two groups.

Comparison of the responses from the educational coordinators (56) and students (176) showed few areas of difference in considering the statements "Essential." Only on three statements did the two groups vary to a significant degree at the 0.05 level. There was a 96.2 percent level of agreement as to the essential competencies between educational coordinators and students.

The educational coordinators' and instructors' opinions on curriculum placement agreed closely. Their opinions differed significantly as to the location within the curriculum of only three competencies. In all three instances the educational coordinators favored placement in the "Clinical" curriculum while the greater percentage of instructors responded that these should occur in the students "Preclinical" experiences.

When the instructors' and students' responses on curriculum placement were compared significant differences appeared again. There were significant differences of opinion on thirty statements. The students generally responded that more of the competencies should be acquired in the "Preclinical" phase of their educational experiences.

This difference was even more marked when the opinions of educational coordinators on curriculum placement were compared with those of the students. There were thirty-nine statements on which these two groups differed significantly. Eight statements were included in the "Preclinical" curriculum because of the responses of the students. In the other thirty-one statements the curriculum area was not changed. Student responses showed their wish to acquire more professional preparation at the university.

The ratio of preclinical to clinical placement was 1 to 3 (22 competencies in preclinical, 65 competencies in clinical). Presently the ratio of time spent in the preclinical and clinical phases of the curriculum is the exact opposite. There are three years preclinical and one year clinical required.

In the final phase when the essential competency statements were presented to the jury some new facets of the study became apparent. On fifty-two statements there was agreement that these were essential competencies for career entry. On the remaining twenty-seven at least one panelist marked the competency as "Non-essential." In an interview jury members indicated that these twenty-seven statements required more experience than an entry level employee would have acquired.

III. CONCLUSIONS

The following conclusions were based upon the analysis of data, interpretation of the statistical tests, and other information.

1. In general the criteria identified were essential for the education of medical technologists.

2. The essential competencies should be gained in either the academic or the hospital setting with the major portion to be acquired in the clinical training phase.

3. Some competencies should be addressed in both phases of a student's professional preparation.

4. Respondents perceived placement of the competencies in the curriculum according to their position in the educational program.

5. Competencies needed for entry into the field of medical laboratory technology change over time.

IV. RECOMMENDATIONS

As a result of the study the following recommendations are made:

1. The developed list of statements should be used at a later date to investigate changing educational requirements in this field.

2. The developed list of statements should be used to investigate more fully the opinions of pathologists as compared to chief technologists and educational coordinators of accredited schools.

3. Recent graduate medical technologists that had been employed by non-teaching hospitals for only one year should be included in a study and the responses compared to those of senior students in medical technology curriculums.

4. Plans should be made to convert traditional "3 + 1" programs to "integrated" programs. More time should be spent in acquiring the larger number of competencies.

5. Continuing education must be integrated into the program of each teaching hospital to allow personnel from non-teaching hospitals to stay current with the rapid changes in technology.

LIST OF REFERENCES

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Allied Medical Education Directory/7th Edition. U. S. A.: American Medical Association, 1978.

Allied Health Professions Personnel Training Act. Statutes at Large, 80, Part 1 (1966).

Arends, R. L., Masla, J. A., & Elmes, R. J. Identification and Selection of Teacher Competencies. Buffalo, N. Y.: State University College at Buffalo, 1972.

Barlow, M. L., Anderson. M. H., Hendrick, R. R., Freeland, J. E., Taub, H., & Goldsmith, K. L. A Study of the Clinical Laboratory Occupations. The U. C. L. A. Allied Health Professions Project. Washington, D. C.: Bureau of Research, August 1971. (ERIC Document Reproduction Service No. ED 069 904).

Binkley, H. C. Competencies Needed by Employees in Agricultural Supply Business-Sales and Service. Louisville: The University of Kentucky, College of Education, Department of Agricultural Education, 1965. (ERIC Document Reproduction Service No. ED 018 573).

Bowles, L. T. Flexibility in Medical Education. In R. Jacobs (Ed.), A Flexible Design for Health Professions Education. New York: Wiley Biomedical, 1976.

Broski, D., Alexander, D., Brunner, M., Chidley, M., Finney, W., Johnson, C., Karas, B., Rothenberg, S. Competency Based Curriculum Development. Journal of Allied Health, Winter 1977, 6, 38-44.

Brown, B. J. The relationship between supervision and student evaluation of teaching effectiveness of general business teachers. (Doctoral dissertation, The University of Tennessee, 1971). Dissertation Abstracts International, 1971, 32, 4235A.

Brown, R. E. Competence delineation. American Journal of Medical Technology, May 1978, 44, 398-401.

Brunson, E. V. In support of competency-based education. Business Education World, May 1975, pp. 7-13; 29.

Burke, C. D. The structure and substance of the WILKIT instructional module. Educational Technology, September 1972, 12, 41-43.

Bushnell, D. S. Organizing for Change: New Priorities for Community Colleges. New York: McGraw-Hill, 1973.

Careers in the Medical Laboratory, American Society of Clinical Pathologists, 1976.

Carnegie Commission on Higher Education. Higher Education and the Nation's Health. Policies for Medical and Dental Education. New York: McGraw-Hill, 1970.

Coggeshall, L. T. The Coggeshall Report: A Summary. In E. Purcell (Ed.), World Trends in Medical Education. Baltimore: Johns Hopkins Press, 1969.

Coleman, J. S., Katz, E., & Menzel, H. Medical Innovation. New York: Babb's-Merrill, 1966.

Coltey, R. W. Survey of Medical Technology. St. Louis: C. V. Mosby, 1978.

Competency-Based Professional Education in Home Economics and Criteria-Selected Competencies and Criteria. Symposium sponsored by the American Home Economics Association at Ames, Iowa, February 17, 1974. (ERIC Document Reproduction Service No. ED 109 480.)

Cook, F. S., Newhauser, C. L., & Richey, R. C. A Working Model of: A Competency-Based Teacher Education System. Detroit: Wayne State University, 1973. (ERIC Document Reproduction Service No. ED 077 870.)

Cooper, J. M., Jones, H. L., & Weber, W. Specifying Teacher Competencies. Journal of Teacher Education, 1973, 24 (1), 17-23.

Cotrell, C. J., Chase, S. A., & Molnar, M. J. Model Curricula for Vocational and Technical Teacher Education: Report No. IV, A Foundation for Performance-Based Instruction. Columbus, Ohio: The Ohio State University, The Center for Vocational and Technical Education, 1972. (ERIC Document Reproduction Service No. ED 067 509.)

Craig, D. G. Developmental aspects of off-farm work experience in vocational agriculture in New York state. (Doctoral dissertation, Cornell University, 1967). Dissertation Abstracts International, 1967, 28, 2436A.

Crowley, J. A. A curriculum in medical technology based on perceptions of students and practitioners. American Journal of Medical Technology, 1975, 41 (2) 45-50.

________. Education: a critical component of competence assurance, American Journal of Medical Technology, 1978, 44 (5) 410-412.

Davis, J. A. Elementary Survey Analysis. Englewood Cliffs, New Jersey: Prentice-Hall, 1971.

Dickerson, T. M. An examination of competency ratings for beginning nurse practitioners. (Doctoral dissertation, The University of Tennessee, 1975). Dissertation Abstracts International, 1975, 36 (8), 3870B.

Enright, M. J. Student selection and evaluation. In E. McTernan & R. D. Hawkins (Eds.), Education Personnel for the Allied Health Professions and Services. St. Louis: C. V. Mosby, 1972.

Fardig, G. E., Norton, R. E., & Hamilton, J. B. Guide to the Implementation of Performance Based Teacher Education. Columbus, Ohio: The Ohio State University, The Center for Vocational and Technical Education, 1976.

Frank, W., & Sobel, I. The Shortage of Skilled and Technical Workers. University of Illinois, Institute of Labor and Industrial Relations, 1968.

Gay, L. R. Educational Research. Columbus, Ohio: Charles E. Merrill, 1976.

Getz, H., Kennedy, L., Pierce, W., Edwards, C., & Chesbro, P. From traditional to competency-based teacher education. Phi Delta Kappan, 1973, 54 (5), 300-302.

Glaser, R. J. United States. In E. Purcell (Ed.), World Trends in Medical Education. Baltimore: Johns Hopkins University Press, 1971.

Goldstein, H. M. Health Personnel: Meeting the Explosive Demand for Medical Care. Germantown, Maryland: Aspen Systems, 1977.

________ & Horowitz, M. A. Entry-Level Health Occupations: Development and Future. Baltimore: Johns Hopkins University Press, 1977.

Graves, W. C. The identification of vocational and career development competencies for counselors in grades 7-12 in Tennessee. (Doctoral dissertation, The University of Tennessee, 1974). Dissertation Abstracts International, 1974, 35 (8), 5229A.

Gunderson, O. D., Lindahl, D. G., Miller, J. D., & Courtney, E. W. Professional Education Competencies of Community College Instructors. Corvallis, Oregon: Oregon State University, Division of Vocational, Adult, and Community College Education, 1971.

Guralnik, D. B. (Ed.) Webster's New World Dictionary. (2nd ed.). Cleveland: William Collins and World, 1976.

Harrison, J. S. Criteria for evaluating consumer and homemaking programs as perceived by directors of secondary vocational programs, state supervisors of home economics, and selected teacher educators. Unpublished doctoral dissertation, The University of Tennessee, 1979.

Hayman, J. L. Research in Education. Columbus, Ohio: Charles E. Merrill, 1968.

Helmer, O. Social Technology. New York: Basic Books, 1966.

Hess, J. W., ¢ Leavitt, M. New philosophies in medical education: their effect on the recognition of competence. Journal of the American Medical Association, 1970, 213, 1009-1011.

Houston, W. R. & Howsam, R. B. Competency-Based Teacher Education, Progress, Problems and Prospects. Palo Alto, Calif.: Science Research Associates, 1972.

________, & Jones, H. L. Three Views of Competency-Based Teacher Education: University of Houston. Bloomington, Indiana: Phi Delta Kappa Educational Foundation, 1974.

Jason, H. The relevance of medical education to medical practice. Journal of the American Medical Association, 1970, 212, 2092-2095.

Kerr, E. E. Utilization and preparation of personnel for the health care industry. In Training Health Service Workers: The Critical Challenge. (HEW Conference proceedings.) Washington: U. S. Government Printing office, 1972. (ERIC Document Reproduction Service No. ED 072 231.)

Lima, J. A Project to Develop a Catalog of Business Education Teacher Competencies with Accompanying Performance Based Units. Tampa: University of South Florida, 1973.

Mager, R. F. Preparing Instructional Objectives. Palo Alto, Calif.: Fearon Publishers, 1962.

Maxwell, W. D. PBTE: a case of the emperor's new clothes. Phi Delta Kappan, 1974, 45, 306-309.

McCarthy, P. J. Sampling: Elementary Principles. Ithaca, New York: Cornell University, School of Industrial and Labor Relations, 1970.

McTernan, E. J. Flexible approach to allied health education. In R. M. Jacobs (Ed.), A Flexible Design for Health Professions Education. New York: Wiley Biomedical, 1976.

MLT/MT Ladder Curriculum Objectives. Kettering, Ohio: Kettering Medical Center, 1978.

Nie, H. H., Hull, C. H., Jenkins, J. G., Steinberger, K. & Bent, D. H. SPSS--Statistical Package for the Social Sciences. New York: McGraw-Hill, 1975.

Norton, R. E., Harrington, L., & Gill, J. Performance-Based Teacher Education: The State of the Art. Columbus: The Ohio State University, The Center for Vocational and Technical Education, 1976.

________ & Huany, M. W. Student Guide to Using Performance-Based Teacher Education Materials. Columbus: The Ohio State University, The Center for Vocational and Technical Education, 1975.

Oppenheim, A. N. Questionnaire Design and Attitude Measurement. New York: Basic Books, 1966.

Popham, E. Making business education meaningful with a competency-based curriculum. Business Education World. May 1975, 55, 5-6.

Porreca, A. G. & Stallard, J. J. Common Affective Domain Competencies of Students Among Vocational Areas. Paper presented at the meeting of the American Educational Research Association, San Francisco, April, 1976.

Rausch, V. L. Five years later: a longitudinal study of medical technology graduates. American Journal of Medical Technology. November 1977, 43, 1034-1039.

Reiser, S. J. Medicine and the Reign of Technology. Cambridge: Cambridge University Press, 1978.

Roush, R. E. & Holcomb, J. D. Teaching improvements in higher education: medical education may be the leader. Phi Delta Kappan, 1974, 55, 338-340.

Sandoz, E. CBTE: the nays of Texas. Phi Delta Kappan, 1974, 55, 304-306.

Siegel, S. Nonparametric Statistics. New York: McGraw-Hill, 1956.

Statements of Competence of Clinical Laboratory Practitioners (Non physician). ASMT NEWS, August 1976.

Tyler, R. W. Basic Principles of Curriculum and Instruction. Chicago: The University of Chicago Press, 1949.

Williams, R. A. _An Introduction to the Profession of Medical Technology._ Philadelphia: Lea & Febiger, 1971.

Young, P. V. _Scientific Social Surveys and Research_ (4th ed.). Englewood Cliffs, New Jersey: Prentice-Hall, 1966.

Youse, J. H. & Clark, A. W. Curriculum and career: choice or chance, _American Journal of Medical Technology_, 1977, _43_, 127-130.

APPENDICES

APPENDIX A

LETTER REQUESTING PERMISSION TO USE ASMT LIST

RFD 2 Box 393
Johnson City, Tenn. 37601
October 2, 1978

ASMT Executive Office
Suite 200
5555 W. Loop S.
Bellaire, TX 77401

Dear Colleagues:

Your permission to use selected statements and portions of statements from "Career Entry Statements of Competence Clinical Laboratory Science" and "Statements of Competence of Clinical Laboratory Practitioners (non-physician)" which appeared in the August, 1976, ASMT NEWS is essential to me. I am preparing the survey questionnaire and the review of literature for my doctoral dissertation. Both of your publications are important material in this area.

Thank You,

Annot Littlepage, MT(ASCP)

APPENDIX B

LETTER OF PERMISSION FROM ASMT

December 27, 1978

Ms. Annot Littlepage, MT(ASCP)
RFD 2, Box 393
Johnson City, Tennessee 37601

Dear Ms. Littlepage:

Pursuant to our recent telephone conversation and your two previous communiques, this is to grant you permission to use selected statements and terms from our publication, "Career Entry Statements of Competence Clinical Laboratory Sciences."

Please accept my personal best wishes on your doctoral dissertation.

Sincerely,

AMERICAN SOCIETY FOR MEDICAL TECHNOLOGY

Gary L. Morgan, CAE,APR
Executive Vice-President

GLM/arh

APPENDIX C

LETTER TO SCHOOLS ASKING PARTICIPATION

November 2, 1978

Dear Colleague:

We need your response as a Health Care Professional. The purpose of this National Research Project conducted at The University of Tennessee is to determine competencies needed for career entry in the field of medical technology. Your opinions and those of your instructors and students will aid in the identification of these competencies.

There will be eight questionnaires: one for the program coordinator, three for instructors and four for students. These will take only a short time to complete. There are no right or wrong answers. All individual responses will be kept confidential and completely anonymous.

Please complete and return the enclosed reply card so I will know who is to receive the packet of questionnaires.

Thank you for your assistance.

Sincerely,

Annot Littlepage, MT(ASCP)

APPENDIX D

LETTER AND QUESTIONNAIRE TO SAMPLE

Dear Colleague:

As a Health Care Professional your response is vital.

The purpose of this national research project conducted at The University of Tennessee is to determine competencies needed for career entry in the field of medical technology. This list of competencies should aid in the development of new curriculum guidelines, objectives, and evaluation tools.

The questionnaire will take only a short time to complete. There are no right or wrong answers. All individual responses will be kept confidential and completely anonymous. By returning this questionnaire you have given your consent for me to use your answers as a portion of the combined data from participants in this project.

If you have any questions or concerns about this project you may contact me at Route 2, Box 393, Johnson City, Tenn. 37601.

Thank you for your prompt response.

Sincerely,

Annot Littlepage, MT(ASCP)

PLEASE MARK EACH COMPETENCY AS TO WHETHER IT IS ESSENTIAL OR NON-ESSENTIAL FOR ENTRY INTO THE CAREER OF CLINICAL LABORATORY TECHNOLOGY. IF YOU CONSIDER IT ESSENTIAL PLEASE MARK THE SECOND COLUMN. THIS INDICATES IN WHICH PHASE OF TRAINING THE COMPETENCY SHOULD BE ACQUIRED, PRECLINICAL (BEFORE HOSPITAL INTERNSHIP) OR CLINICAL (DURING HOSPITAL INTERNSHIP).

CLINICAL LABORATORY - GENERAL

	ESSENTIAL	NON-ESSENTIAL	PRECLINICAL	CLINICAL
1. EVALUATE REQUESTED PROCEDURE TO DETERMINE SPECIMEN COLLECTION METHOD.	( )	( )	( )	( )
2. OBTAIN SPECIMEN USING TECHNIQUE TO MAINTAIN INTEGRITY OF SPECIMEN IN RELATION TO TEST TO BE PERFORMED.	( )	( )	( )	( )
3. ASSESS PATIENT'S REACTION TO COLLECTION PROCEDURES.	( )	( )	( )	( )
4. IDENTIFY SPECIMEN ACCORDING TO PROTOCOL.	( )	( )	( )	( )
5. INSPECT AND EVALUATE SUITABILITY OF THE SPECIMEN FOR THE ANALYSIS REQUESTED.	( )	( )	( )	( )
6. PREPARE ALIQUOTS OR COMPONENTS OF SPECIMEN FOR ANALYSIS.	( )	( )	( )	( )
7. DETERMINE NEED FOR REFERRAL SERVICES.	( )	( )	( )	( )
8. SELECT REAGENTS FOR REQUIREMENTS OF THE ANALYSIS.	( )	( )	( )	( )
9. PREPARE REAGENTS ACCORDING TO PRESCRIBED DIRECTIONS.	( )	( )	( )	( )
10. LABEL PREPARED REAGENTS.	( )	( )	( )	( )
11. STORE REAGENTS PROPERLY.	( )	( )	( )	( )
12. CALIBRATE OR STANDARDIZE INSTRUMENTS.	( )	( )	( )	( )
13. OPERATE INSTRUMENTS UTILIZING ESTABLISHED PROTOCOLS.	( )	( )	( )	( )
14. RECOGNIZE EQUIPMENT OR INSTRUMENT MALFUNCTION.	( )	( )	( )	( )
15. FOLLOW A PREVENTIVE MAINTENANCE PROGRAM FOR ALL INSTRUMENTS AND EQUIPMENT.	( )	( )	( )	( )
16. IDENTIFY SOURCES OF BIOHAZARDS.	( )	( )	( )	( )

17. RECOGNIZE UNSAFE LABORATORY PRACTICES.	( )( )	( )( )
18. DEFINE IMMEDIATE ACTION TO BE TAKEN IN CASE OF ACCIDENT OR INJURY.	( )( )	( )( )
19. SELECT CONTROL SAMPLES TO MONITOR ASSAYS AND PROCEDURES.	( )( )	( )( )
20. CONDUCT QUALITY CONTROL PROCEDURES.	( )( )	( )( )

CLINICAL CHEMISTRY

1. DETERMINE NORMAL OR SIGNIFICANT VALUES ACCORDING TO ESTABLISHED PROTOCOLS.	( )( )	( )( )
2. DETERMINE METHOD FOR EACH ANALYTE.	( )( )	( )( )
3. DETERMINE THE CONFORMITY OF REFERENCE VALUES AND TEST RESULTS TO THE ESTABLISHED PROTOCOLS.	( )( )	( )( )
4. PERFORM THE ANALYSIS ACCORDING TO PRESCRIBED METHODOLOGY.	( )( )	( )( )
5. OBTAIN ANALYTICAL DATA AND CONVERT TO TEST RESULTS.	( )( )	( )( )
6. RECOGNIZE AND REACT TO PRIMARY INDICATORS OF MAL-FUNCTION IN INSTRUMENTS OR INDICATOR SYSTEMS.	( )( )	( )( )
7. EVALUATE THE ACCEPTABILITY OF CONTROL SAMPLES.	( )( )	( )( )
8. CORRELATE THE TEST RESULT WITH OTHER PATIENT DATA.	( )( )	( )( )
9. DETERMINE IF ADDITIONAL ANALYSES ARE NEEDED FOR CLARIFICATION OF TEST RESULTS.	( )( )	( )( )

IMMUNOLOGY

1. SELECT A TEST SYSTEM THAT WILL MAXIMIZE VISUALIZATION OF THE ANTIGEN-ANTIBODY REACTION.	( )( )	( )( )
2. IDENTIFY ANTIBODY SPECIFICITY WITH ITS ANTITHETICAL ANTIGEN AND DESCRIBE ITS TITER, AVIDITY OR QUANTITY.	( )( )	( )( )
3. PREPARE THE REQUIRED WORKING REAGENTS.	( )( )	( )( )
4. SELECT AND STANDARDIZE CONTROLS.	( )( )	( )( )
5. MAINTAIN RECORDS IN ACCORDANCE WITH REGULATIONS.	( )( )	( )( )

6. DETERMINE AND PERFORM APPROPRIATE PROCEDURES.	( )( )	( )( )
7. PERFORM THE CALCULATIONS NECESSARY TO CONVERT RESULTS INTO THE PROPER FORM OR UNITS FOR REPORTING.	( )( )	( )( )
8. ASSESS UNUSUAL TEST REACTIONS.	( )( )	( )( )
9. CORRELATE TEST RESULTS WITH OTHER LABORATORY DATA AND PATIENT DATA.	( )( )	( )( )
10. DETERMINE ADDITIONAL ASSAYS THAT MAY BE NECESSARY TO VERIFY TEST RESULTS.	( )( )	( )( )
11. REPORT RESULTS IN SPECIFIED FORM AND MANNER TO APPROPRIATE STAFF.	( )( )	( )( )
IMMUNOHEMATOLOGY		
1. MAINTAIN RECORDS OF DONATION IN ACCORDANCE WITH REGULATIONS.	( )( )	( )( )
2. RECOGNIZE THE LEGAL ASPECTS OF THE BLOOD DONATION PROGRAM.	( )( )	( )( )
3. DETERMINE DONOR ELIGIBILITY.	( )( )	( )( )
4. DESCRIBE PROCEDURES AND POSSIBLE SIDE EFFECTS OF WHOLE BLOOD DONATION TO DONOR.	( )( )	( )( )
5. SELECT PROPER CONTAINER AND ANTICOAGULANTS.	( )( )	( )( )
6. PERFORM WHOLE BLOOD COLLECTION.	( )( )	( )( )
7. PROCESS, LABEL AND STORE BLOOD PROPERLY.	( )( )	( )( )
8. ASSESS DONOR'S REACTION.	( )( )	( )( )
9. PREPARE BLOOD COMPONENTS FOR THERAPEUTIC NEEDS.	( )( )	( )( )
10. LABEL ACCORDING TO APPLICABLE STANDARDS.	( )( )	( )( )
11. MAINTAIN QUALITY OF PRODUCT FOR USE IN TRANSFUSION.	( )( )	( )( )
12. IDENTIFY POSSIBLE CAUSE OF TRANSFUSION REACTION.	( )( )	( )( )
MICROBIOLOGY		
1. DETERMINE GROWTH CHARACTERISTICS AND REQUIREMENTS OF VARIOUS ORGANISMS.	( )( )	( )( )

2. SELECT MEDIA FOR VARIOUS ORGANISMS.	( )( )	( )( )
3. EVALUATE METHODS FOR GROWTH AND IDENTIFICATION OF MICROBIAL ORGANISMS.	( )( )	( )( )
4. RECORD, REVIEW AND REPORT RESULTS.	( )( )	( )( )
5. ESTABLISH PROPER SAFETY PROCEDURES FOR HANDLING INFECTIOUS SPECIMENS.	( )( )	( )( )
6. PREPARE DIRECT SMEAR.	( )( )	( )( )
7. ASSESS MORPHOLOGICAL AND STRUCTURAL CHARACTERISTICS OF ORGANISMS AND OTHER SPECIMEN CONTENTS.	( )( )	( )( )
8. DESCRIBE MICROSCOPIC OBSERVATIONS.	( )( )	( )( )
9. EVALUATE RESULTS.	( )( )	( )( )
10. SELECT AND IMPLEMENT AN IDENTIFICATION PROTOCOL APPROPRIATE TO THE SOURCE AND CHARACTERISTICS OF THE SPECIMEN.	( )( )	( )( )
11. SELECT AND PERFORM SEROLOGICAL TESTS.	( )( )	( )( )
12. CORRELATE ALL ANALYSES AND INFORMATION TO IDENTIFY ORGANISM.	( )( )	( )( )
13. SELECT AND PERFORM ANTIMICROBIAL EVALUATION PROCEDURES FOR MICROBIAL SUSCEPTIBILITY OF ORGANISM(S).	( )( )	( )( )
14. REPORT FINDINGS TO APPROPRIATE PERSONS OR AGENCIES.	( )( )	( )( )
15. PREPARE AUTOGENOUS VACCINES.	( )( )	( )( )
16. MONITOR INFECTION PATTERNS IN THE HOSPITAL.	( )( )	( )( )

HEMATOLOGY

1. ESTABLISH PROCEDURES TO EVALUATE HEMATOLOGICAL DETERMINATIONS.	( )( )	( )( )
2. DETERMINE OPTIMAL METHOD FOR EACH DETERMINATION.	( )( )	( )( )
3. DETERMINE NORMAL RANGE FOR TARGET POPULATION FOR EACH PROCEDURE.	( )( )	( )( )
4. ESTABLISH PROCEDURES FOR CORRELATION OF RESULTS.	( )( )	( )( )

5. IDENTIFY PHYSIOLOGICAL AND PATHOPHYSIOLOGICAL FACTORS FOR WHICH HEMATOLOGICAL PROCEDURES CAN CONTRIBUTE USEFUL DATA.	( )( )	( )( )
6. SELECT THE PROCEDURES APPROPRIATE FOR THE REQUEST FOR SERVICE.	( )( )	( )( )
7. CONTROL PHYSICAL CONDITIONS CRITICAL TO THE TEST.	( )( )	( )( )
8. SELECT APPROPRIATE PROCEDURE FOR ACCURACY AND SPEED CONSISTENT WITH DAILY WORKLOAD.	( )( )	( )( )
9. ENUMERATE FORMED ELEMENTS IN SPECIMEN.	( )( )	( )( )
10. CALCULATE RESULTS IN APPROPRIATE UNITS.	( )( )	( )( )
11. MEASURE AND EVALUATE PHYSICAL PROPERTIES OF SPECIMEN.	( )( )	( )( )
12. SELECT, PERFORM, MONITOR, AND EVALUATE CYTOCHEMICAL PROCEDURES FOR CELLULAR CONSTITUENTS.	( )( )	( )( )
13. SELECT, PERFORM, MONITOR, AND EVALUATE PROCEDURES THAT DO NOT REQUIRE STAIN.	( )( )	( )( )
14. CALCULATE RESULTS TO CONFORM TO PRESCRIBED UNITS.	( )( )	( )( )
15. REPORT RESULTS WHICH ARE DESCRIPTIVE, QUALITATIVE, OR QUANTITATIVE IN NATURE.	( )( )	( )( )
16. PERFORM AND EVALUATE BIOCHEMICAL AND PHYSIOCHEMICAL ASSAYS.	( )( )	( )( )
17. RECOGNIZE AND REACT TO INDICATORS OF TEST OR INSTRUMENT MALFUNCTION.	( )( )	( )( )
18. CORRELATE QUANTITATIVE, BIOCHEMICAL, PHYSIOLOGICAL AND MORPHOLOGICAL DATA TO VERIFY RESULTS.	( )( )	( )( )
19. CORRELATE THE TEST RESULTS WITH OTHER PATIENT DATA WHEN POSSIBLE.	( )( )	( )( )
20. EVALUATE THE ACCEPTABILITY OF CONTROLS.	( )( )	( )( )
21. INTEGRATE TEST DATA TO LEAD TO A CONCLUSION OR DECISION ABOUT THE NORMALITY OF A SYSTEM.	( )( )	( )( )
22. DETERMINE IF ADDITIONAL INFORMATION IS NEEDED FOR CLARIFICATION AND/OR A DEFINITIVE DIAGNOSIS.	( )( )	( )( )
23. CONSULT WITH PHYSICIAN ON ADDITIONAL TESTS WHICH MAY BE NECESSARY TO CLARIFY THE PROBLEM.	( )( )	( )( )

APPENDIX E

FOLLOW UP LETTER TO NON-PARTICIPATING GROUP

January 22, 1979

Dear Colleague:

During November 1978 you were sent the attached letter. Your school was one of the random sample that did not answer my request for your participation. As a follow up and to understand the reasons for non participation in this project I am now asking you to use the enclosed postcard. Please tell me why you chose not to respond or to participate in this study. Your help is vital to the completion of this project.

Thank You.

Sincerely,

Annot Littlepage, MT(ASCP)

APPENDIX F

FOLLOW UP LETTER TO PARTICIPATING GROUP

January 22, 1979

Dear Participant:

The questionnaires for the project entitled "The identification of competencies for career entry into the field of medical technology" were mailed to you between mid November and the present time. If you have completed and mailed back the packet of questionnaires please accept my thanks. If you have not found the time to complete the questionnaires I hope you will take the time soon. Your response is vital to the successful completion of this project.

Thank you for your prompt response.

Sincerely,

Annot Littlepage, MT(ASCP)

APPENDIX G

COPY OF COMPUTER PRINTOUT

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CCMPT STUDY                                                                                06/05/79
COORDINATORS VS INSTRUCTORS
FILE    COMPT     (CREATICN DATE = 06/05/79)    STUDY

* * * * * * * * * * * * * * * * * *   C R O S S T A B U L A T I O N   O F  * * * * * * * * *
  RESPONSE                                                     BY COMPT91
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

                    COMPT91
             COUNT  I
           ROW PCT IESSEN-    NON-   ES              ROW
           COL PCT ITIAL      SENTL                  TOTAL
           TOT PCT I      1  I      2  I      0  I
RESPGNSE   --------I---------I---------I---------I
                 1 I     34  I     20  I     2M  I     54
 ECUC COORDNTRS    I   63.0  I   37.0  I    0.0  I   28.3
                   I   28.8  I   27.4  I    0.0  I
                   I   17.8  I   10.5  I    0.0  I
                  -I---------I---------I---------I
                 2 I     84  I     53  I    17M  I    137
 INSTRUCTORS       I   61.3  I   38.7  I    0.0  I   71.7
                   I   71.2  I   72.6  I    0.0  I
                   I   44.0  I   27.7  I    0.0  I
                  -I---------I---------I---------I
            COLUMN      118        73       19M       191
             TOTAL     61.8      38.2       0.0     100.0

CORRECTED CHI SQUARE =     0.00210 WITH 1 DEGREE OF FREEDOM.  SIGNIFICANCE =  0.9634

NUMBER OF MISSING OBSERVATIONS =    195
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Figure 2. Example of Tables Generated by Computer.

VITA

Annot Faye Millwee Littlepage was born in Dallas, Texas and attended elementary schools in Texas, Arkansas, and Oklahoma. She was graduated from Lamar High School in Houston, Texas in 1951. During her undergraduate years at Rice University she served as a research assistant in biology and at Baylor College of Medicine. After receiving a Bachelor of Arts in Premedical Sciences, she attended Hermann and Brackenridge Hospitals Schools of Medical Technology.

In 1956 Mrs. Littlepage sat for the examination and was registered by the Board of Registery of the American Society of Clinical Pathologists as a Medical Technologist, MT(ASCP). She first served as diagnostic microbiologist in Austin, Texas. Mrs. Littlepage worked in various positions in the clinical area before beginning work on graduate courses and part time teaching.

While teaching at the Johnson City Vocational-Technical School, Mrs. Littlepage entered the Graduate School of The University of Tennessee. In August, 1976 she received a Master of Science Degree in Industrial Education. In September 1977, she was awarded an EPDA Fellowship to continue studies in vocational-technical education. In June of 1978 she returned to Johnson City and served an internship at East Tennessee State University Paramedical Center, later joining the faculty there. In August 1979 she received her Doctor of Education degree.