# Preparing CLS Professionals to be Consumers and Producers of Research

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**ABSTRACT:** Research proficiency is part of the curriculum in all NAACLS accredited CLS programs. Learning the basic research tools enables students to understand and interpret published research as informed consumers of research. This paper describes an improved and innovative approach to prepare future CLS professionals to be both analytical consumers and active producers of pertinent research.

**ABBREVIATIONS:** CLS: Clinical Laboratory Science, NAACLS: National Accrediting Agency for Clinical Laboratory Science, UTEP: University of Texas-El Paso, TACLS: Texas Association for Clinical Laboratory Science

**INDEX TERMS:** Clinical Laboratory Science, Research methods, Teaching methods, Research instructtion

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## INTRODUCTION

The Clinical Laboratory Science (CLS) curriculum is rich in scientific content as well as in hands-on applications of laboratory procedures. While Clinical Laboratory Scientists are exposed to a broad spectrum of clinical and basic knowledge experience,[1-3] they also need to keep up with new advances and innovations in research. Advances and improvements have been implemented to improve CLS students' critical thinking,[4] transitions to the clinical environment[5] and employment opportunities,[6] but the research curriculum is still primarily taught to fulfill the basic educational requirement in most CLS programs.

The need for training CLS students in searching, reading, and understanding published clinical/medical research has been addressed by the National Accrediting Agency for Clinical Laboratory Science (NAACLS) as an important educational requirement for all accredited CLS programs. Standard 22 of the NAACLS requirements for accreditation of CLS educational programs discusses the curricular requirements, where teaching about research is included as an integral part of the instructional areas.[7] Section B # 8 of the NAACLS curricular requirements (standard 22) states that "the curriculum must include knowledge of research design/practice sufficient to evaluate published studies as an informed consumer." Based on this research educational requirement, Clinical Laboratory Scientists graduating from accredited CLS programs should be able to read and evaluate published research.[8-10] This implementation of the CLS research requirement would passively deliver the research educational content without active student involvement. It falls short of expecting the students to create research ideas, collect their research data and participate in scholarly presentations to share their research findings with other professionals. If this educational requirement were to be actively implemented to engage the students in the research process, it would not only achieve the basic knowledge as stated by NACCLS, but it would also increase the students' interest in, and comprehension of, the processes of clinical/medical research. It would also open new avenues and future opportunities for the CLS

graduates. Some of these opportunities would include career opportunities in research laboratories and pharmaceutical companies. Greater access to opportunities in higher education can result by stimulating student interest in pursuing graduate education and participation in research projects.

In this paper, a course design based on an active learning model for clinical/medical research (Clinical Investigation) is described. This class is designed with an innovative approach that combines both the knowledge requirement by NAACLS for preparing CLS students as informed consumers of research, and the active learning component for engaging the students in designing, completing, and presenting their own research projects. The main objective of this Clinical Investigation class is to graduate CLS students who are both consumers and producers of research.

Students at the University of Texas-El Paso's (UTEP) CLS program are accepted in their junior year after they have finished their pre-professional course pre-requisites. The students then progress as a cohort. A typical cohort is about 22 students. During the junior year the students take core CLS courses such as clinical chemistry, hematology and infectious diseases. In their senior year they take professional courses such as clinical education, laboratory management, preceptorship (clinical rotation) and the research class (clinical investigation).

**Course Description**

Clinical Investigation is a senior level class offered every Fall semester, which is also the semester when senior CLS students start their clinical rotations. At that time the students are exposed to clinical practice that complements the basic knowledge that they acquired during their junior year in the CLS program. This course is intended to introduce CLS students to the fundamental processes of conducting research in the health sciences. The course is designed to have two complementary learning components: the first component includes the basic research knowledge and the second component includes the active application of research. The course objectives are arranged accordingly, where objectives 1-5 are aligned with the first learning component and objectives 6-8 are aligned with the second learning component (Table 1).

**Table 1.** Course Objectives

Upon completion of this course the students are expected to be able to:

1. Evaluate analytical, descriptive and experimental research.
2. Summarize and critique published research studies.
3. Discuss basic measurement concepts such as validity, reliability and objectivity, scales of measurements, field tests and laboratory tests.
4. Interpret data, tables and summaries typically presented in research studies.
5. Interpret analytical, descriptive and experimental research.
6. Plan for and design research projects, which includes selecting a problem, selecting an appropriate research method, locating and using appropriate referencing format.
7. Plan and implement both descriptive and inferential statistical data analysis.
8. Use written and verbal forms for communicating results of research.

**Table 2.** Basic Research Knowledge Component

(A) **Instructions Units:**

1. Introduction to Research
2. The Scientific Method
3. Types of Research in Health Sciences
4. Research Planning
5. Research Design
6. Data Collection
7. Descriptive Statistics
8. Inferential Statistics
9. Dissemination and Critical Evaluation of Research

(B) **Textbooks:**

1. *Title:* Introduction to Research in the Health Sciences
   *Authors:* Stephen Polgar and Shane A. Thomas
   *Publisher:* Churchill, Livingston
2. *Title:* Exploring Research
   *Author:* Salkind, N.
   *Publisher:* Pearson Prentice Hall

The basic research knowledge component in this class consists of instructional units that cover various aspects and steps of the research process. Table 2(A) includes a list of instructional topics that are taught as part of this component. These educational units are delivered to the students in a combination of lecture and discussion formats. For each research educational topic, the basic information is presented to the students, and then the

students are engaged in an active discussion on the applications of the research topic. Various assignments are also provided to broaden the students' understanding of the application of each educational component. Two textbooks (Table 2(B)) are used in this class, and they are available to the students to complement the instructional units.

The active application of the research component consists of working on individual students' research projects. Students apply the knowledge they gain and the tools they learn from the first component of the class to plan, design, carry out and present their own research projects. Early in the semester the students select a researchable health related topic that is of interest to them and has benefits to the local and/or global research community. Keeping in mind that the students' research projects should be completed during one academic semester, the students plan research projects that can be finished within 15 weeks. A general class schedule with timelines is described in Table 3. As part of the research design, the students comply with UTEP's research requirement by submitting their research studies to the Internal Review Board (IRB) for approval. Students also learn the skills and benefits of team work. Each group of two students works together on one research project with continuous consultation with the course instructor. The students plan their research topic and decide on the type of research approach they will use to collect and analyze their data. They then write their research study plan and submit it for IRB approval. Students who conduct their research in conjunction with other agencies such as local hospitals or schools need to submit their studies for approval from these organizations also. The students present their completed research projects in three formats. First, the projects are presented orally in a PowerPoint format to an audience from the CLS and other programs in the College of Health Sciences at UTEP. The presentation must include a clear hypothesis, data collection, data analysis, discussion and conclusion. Then, every group of students submits their research project in the format of a research paper. This is an active writing experience where students apply the scientific method in documenting their research project from start to finish. To enhance the students' ability to disseminate and discuss their research findings to other students and faculty, the students also present their projects in research poster format at UTEP's annual Research Expo. Several groups of students also presented their research posters at the annual Texas Association for Clinical Laboratory Sciences (TACLS) conference.

**Assessment**

The assessment in this class evaluates the students' proficiency in the course's two components. Both the students' knowledge and understanding of the research process as well as their application of research through their research projects are evaluated.

**Table 3.** General Schedule and Timelines for Class Activities

| Week | Lecture Topic / Activity | Deadlines |
|---|---|---|
| 1 | Introduction to Research; The Scientific Method | |
| 2 | Research in Health Sciences, IRB | Research Topic Selection |
| 3 | Research Planning | Assignment-1 |
| 4 | Test - 1 | Test - 1 |
| 5 | Research Design Submission to IRB | Research Study |
| 6 | Data Collection | |
| 7 | Descriptive Statistics; Inferential Statistics | Assignment-2 |
| 8 | Dissemination and Critical Evaluation of Research | |
| 9 | Test - 2 | Test - 2 |
| 10 | Student Projects in Progress | |
| 11 | Student Projects in Progress | |
| 12 | Student Projects in Progress | |
| 13 | Student Oral Presentations | |
| 14 | Student Oral Presentations | |
| 15 | Student Oral Presentations | 1. Research Paper<br>2. Research Poster: electronic submission accepted, to be evaluated by the instructor. Students present the posters in the Spring semester |

Evaluating the students' comprehension and knowledge of the research process is essential to ensure their success in applying research and completing their projects. Therefore, assignments are designed to complement the instructional units and to strengthen the connection

between abstract instruction and application of research. Exams are also given to the students on the topics covered in class. The assignments and exams are designed to be aligned with objectives 1-5 (Table 1).

In evaluating the students' research projects, the assessment goals are to ensure that the students learned and applied the scientific method in their writing and presentation, and to evaluate their ability to communicate new information and research data to other students and professionals. These activities assess the student's performance on objectives 6-8 (Table 1). Students are given guidelines and requirements for writing the research paper, preparing the poster and the oral presentation. The students' research papers are graded and corrected, then returned to the students with grading sheets that contain comments for improvement and/or corrections. As the students present their research orally in a seminar format to the audience from the College of Health Sciences, the students learn self-confidence by being able to present data that they collected and analyzed. This presentation is often their first experience in presenting and providing new information to an audience; information that is not completely collected from published papers and textbooks. The students' participation in the Research Expo at UTEP is an excellent learning experience for sharing their findings and research with other students and faculty in the research and professional community. This experience motivates some students to attend the Texas State CLS conference (TACLS) and present their posters.

**Synopsis of two years experience of teaching Clinical Investigation**

Teaching Clinical Investigation using the design described in this paper for the past two years has emphasized the benefits, value and importance of actively engaging the CLS students in designing and carrying out research projects. Students have been enthusiastic and excited about the new experience. Most of the students selected research topics that could benefit our local community or that focused on understanding a phenomenon that they observed during their clinical rotations in the laboratories. A sample of the topics of the students' research projects is summarized in Table 4.

**Table 4.** Sample Topics of Students' Projects

1. Prevalence of Risk Factors for Diabetes Among Students at the College of Health Sciences
2. Identification of Segmented versus Band Cells Among Medical Technologists
3. Do Dialysis Centers in El Paso Have Sufficient Capacity to Meet the Needs of the City's Diabetic Patients?
4. Attitudes of Parents and Students Towards HPV Vaccine in Middle School
5. Posttraumatic Stress Syndrome Among Soldiers Returning from Iraq
6. CLS Workforce in El Paso, TX
7. CLS Workforce in Tucson, AZ
8. Hereditary Abnormal Red Blood Indices: A family Study
9. Comparison Between Professional Attitudes Among Health Science Major Students and Students in Other Majors at UTEP
10. Workload and Binge Drinking: Comparison Between CLS and Social Work Students
11. Comparing the Quality Control Between Coulter LH 750 and Coulter LH 755
12. UTEP CLS Program-an Intra Study
13. A Correlation Study to Compare Hematocrit Measuring Methods in The Clinical Laboratories
14. MRSA Awareness Among CLS Students Versus The General Public
15. Factors Affecting the Preference for Automation versus Manual Methods in the Clinical Laboratories
16. Obsessive Compulsive Disorder Among Laboratory Personnel
17. Incidence of Bacterial Meningitis in El Paso Local Hospitals
18. Incidence of AIDS in El Paso versus Austin
19. Incidence of Vancomycin Resistant Enterococcus in El Paso Local Hospitals

Students learned through practice to plan and complete projects. Students were inspired and participated in professional conferences locally at the UTEP level and at the state level at TACLS. One group presented a research poster at the 2008 TACLS conference and two groups at the 2009 TACLS conference. The benefits of engaging students in research extended beyond their graduation. The fear of applying and conducting research projects was alleviated and replaced with curiosity and interest in most students. Approximately 15% of the students are pursuing degrees in higher education after graduating from the CLS program.

Even though the outcomes of using this approach in teaching Clinical Investigation are excellent, there are a few points that are worth keeping in mind before

adopting this approach. Since this approach requires continuous communication between the students and their instructor, the instructor should always be available to the students and provide continuous advice as the students progress in their projects. Students should also update the instructor frequently so as to overcome obstacles and prevent delays in their projects. Careful time management is an important tool that the students need to develop as part of this approach. Students need to plan for many deadlines, including some major deadlines such as IRB study submission, research paper and oral presentation due dates, and the poster presentation schedule. Minor deadlines are also important but are easier to keep because these deadlines take place at the same time for the entire class and the students are used to them. They include exams and assignments' deadlines as well as regular updates and communications with the instructor. However, despite these challenges, this approach in teaching research is a great experience for both the instructor and the students; it allows the students to interact with local health agencies and organizations and improves the students' communication skills.

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## 2011 CLEC Abstract Deadline

The deadline for abstracts for oral presentation at the 2011 ASCLS Clinical Laboratory Educators' Conference (CLEC) is October 1, 2010. Submission instructions and the proposal form may be found at www.ascls.org/conferences. The completed proposal form and abstract must be submitted electronically by the deadline. There will be no poster presentations or technology demonstrations at CLEC 2011. Presentations acceptable for submission include research studies, teaching tools or education/curriculum projects.

The 2011 CLEC will be held February 17-21 in Fort Lauderdale, FL. Additional meeting information will be available at the ASCLS Conferences website.