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A Study of the FEPAC Accredited Graduate Forensic Science Programs' Curricula

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A STUDY OF THE FEPAC ACCREDITED GRADUATE FORENSIC SCIENCE PROGRAMS' CURRICULA

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APPROVAL OF DISSERTATION

SIGNATURE PAGE

I hereby affirm that the following project meets the high academic standards for original scholarship and creative work established by my discipline, college, and the Graduate College of Marshall University. With my signature, I approve the manuscript for publication.

Project Title: A STUDY OF THE FEPAC ACCREDITED GRADUATE FORENSIC SCIENCE PROGRAMS' CURRICULA

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I began this journey planning to increase my knowledge on how to teach. Instead I have discovered talents, changed opinions, and grown as an individual. What I experienced in the Ed.D. program has changed my perception of the world and challenged my beliefs about myself, education, and society. I grew and changed as I learned. In Qualitative Research I learned that a person's words and stories provide valuable data about that person's experiences - data found by no other means. This chapter of my story would not have come to fruition without the support and care of others.

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ABSTRACT

The National Institute of Justice (1999) and the National Academy of Sciences (2009) recommended that forensic science training shift from on-the-job training to formal education. However, the reports cited inconsistencies in the curricula of the forensic science degree programs as an impediment to this. The Forensic Science Education Programs Accreditation Commission (FEPAC) Standards were created to address this issue; however, no studies have been conducted to determine how the accreditation standards have been implemented by the FEPAC accredited graduate programs. This study evaluated the self-study responses (n=11) and website information (n=17) specific to FEPAC's Graduate Curriculum Standards to determine how the graduate programs fulfilled the FEPAC Graduate Curriculum Standards. This study also determined to what extent inconsistencies or consistencies exist among the accredited graduate programs' curricula. This study found that although FEPAC Accredited Graduate Forensic Science Programs exhibited differences (unique characteristics) among their curricula, they did not as whole exhibit significant inconsistencies (lack of agreement). All the graduate programs covered the natural sciences particularly as the areas related to forensic science, such as forensic chemistry and forensic biology. However, the programs' coverage of the comparative sciences, such as firearms and questioned documents was limited. Evaluation of the eleven FEPAC self-study reports revealed that on average these programs exceeded the required ten instructional hours specified by FEPAC as core forensic science topics required of all accredited graduate forensic science programs. All programs in this study required students to complete an independent research project as their capstone experience whether thesis or non-thesis. Additionally, all programs included a requirement for students to attend a graduate

seminar where students presented their independent research findings. Admissions requirements were similar for all programs with the exception of the prerequisite courses required for entry into the graduate program. The study found the FEPAC Accredited Graduate Forensic Science Programs' curricula consistent with unique characteristics among the graduate programs. The curricula were rigorous, scientific-based, and discipline specific.

CHAPTER 1: INTRODUCTION, OVERVIEW, PROBLEM STATEMENT

Introduction

The National Academy of Sciences Report (2009) recommended forensic science training move from in-house training to formal education. Although in-house training has a place in the crime laboratory, formal education can reduce the time it takes to move a new hire to competency. However, crime laboratory directors identified inconsistencies among the curricula of forensic science programs as an impediment to this shift.

With the increase in media coverage of high profile trials and the rise in television crime dramas, there has been an increase in public awareness of forensic evidence. The first network forensic crime drama was *Quincy, M.E.,* that began in the mid-1970s (Ramirez & Parish-Fisher, 2012). In the 1990's the O. J. Simpson case relied heavily on DNA evidence, which caused the defense to scrutinize the procedures and personnel involved in the collection and analysis of the evidence (Ellis, 1995). The procedural errors and jurors' perception of the forensic scientists' knowledge and skills cast doubt on the evidence presented (Ellis, 1995). In the 21st century, forensic crime dramas have increased in popularity beginning with *Law and Order* followed by *CSI: Crime Scene Investigation* (Jackson, 2009). Although these shows have heightened public awareness, they have also created numerous misconceptions about what a crime laboratory can or cannot do (Kruse, 2010). This is one piece of what has come to be known as the *CSI Effect*, which is defined as "the false or exaggerated perception of forensic science techniques by the general public, and how it influences opinions of the public" (Ramirez & Parish-Fisher, p. 5, 2012).

The CSI Effect has affected many areas of the criminal justice system in addition to forensic analysis of evidence. One of the noticeable effects is that investigators and prosecutors now request numerous tests on a myriad of pieces of evidence which has created a backlog in crime laboratories that are already understaffed and underfunded (National Academy of Sciences, 2009; Harriss, 2011). Not only are the crime laboratories overwhelmed by the increased number of requests, but as technology has increased so have the staff training needs (National Academy of Sciences, 2009; Ramirez and Parish-Fisher, 2012). This has also led to defense attorneys questioning the credentials of crime laboratory personnel and the validity of forensic techniques used as in the O. J. Simpson trial (Ellis, 1995). As crime laboratories have struggled to keep up with the demand, many laboratories have hired new personnel to assist with reducing the case backlog. Other laboratories have contracted their backlog to other facilities for analysis.

The CSI Effect has also led to an increase in the number of students applying to forensic science programs (Bergslien, 2006). The increased number of students seeking forensic science education nationally led to an increase in the number of universities offering forensic science degrees (Quarino & Bretell, 2009). Since there were no standards in place to guide curriculum, programs and degrees were created with incredible variability in curriculum (Quarino & Bretell, 2009). Some were extensions of criminal justice programs which merely added a forensic science internship at a local crime laboratory or medical examiner's office with little to no chemistry or biology in the curriculum (Quarino & Bretell, 2009). Because of the rapid growth and variability of forensic science academic programs, crime laboratory directors preferred applicants with biology or chemistry undergraduate degrees due to the standardization of

those degrees nationally (Peterson & DeForest, 1977; Hooker, 1984; Higgins & Selavka, 1988; Siegel, 1988; Furton, Hsu, & Cole, 1999).

Shortly after the O. J. Simpson trial highlighted possible procedural and personnel issues in the Los Angeles Police Department, the National Institute of Justice (NIJ) in conjunction with National Institute of Standards and Technology (NIST), Law Enforcement Standards Office (OLES), and American Society of Crime Lab Directors (ASCLD) evaluated the needs of the forensic science community at a two day workshop in 1997 (National Institute of Justice, 1999). Their report, *Forensic Sciences: Review of Status and Needs* (1999), identified the need to shift the burden of training to formal degree programs. They also identified the need to standardize the curricula offered by the forensic science degree programs (National Institute of Justice, 1999). This began a cascade effect that led to the creation of the Forensic Science Education Programs Accreditation Commission (FEPAC) and subsequently the National Academy of Sciences Committee Report which re-evaluated the needs of the forensic science community.

Several studies surveyed crime laboratory directors. These studies identified inconsistencies between forensic science program curricula as an impediment to hiring personnel with forensic science degrees (Peterson & DeForest, 1977; Hooker, 1984; Higgins & Selavka, 1988; Siegel, 1988; Furton, Hsu, & Cole, 1999). Peterson et al. (1977) determined that although universities felt they were properly preparing their graduates to work in a crime laboratory, the crime laboratory directors did not necessarily agree. Siegel (1988) concluded, "There is apparently little uniformity among programs which call themselves forensic science" (p. 1068). Higgins and Selavka (1988), and Furton, Hsu, and Cole (1999) investigated the crime laboratory directors' preferences regarding applicants' educational background. The studies

continued to find that crime laboratory directors preferred a strong chemistry background rather than or in addition to forensic science because of the continued inconsistencies in forensic science curricula (Almirall & Furton, 2003).

The National Institute of Justice (1999) reviewed the challenges facing forensic science nationally. In the course of their discussions, they made several recommendations regarding the training needs of the profession which included accreditation of academic programs and national standards for education (National Institute of Justice, 1999). These recommendations led to the creation of the Technical Working Group for Education and Training in Forensic Science (TWGED) and eventually the Forensic Science Education Programs Accreditation Commission (FEPAC) (Technical Working Group for Education and Training in Forensic Science, 2004; Forensic Education Programs Accreditation Commission, 2014b). TWGED established "best practices for training and education in forensic science" (Technical Working Group for Education and Training in Forensic Science, 2004, p. 3). FEPAC utilized TWGED's recommendations for curriculum standards to establish a system of accreditation for forensic science programs (Forensic Education Programs Accreditation Commission, 2014b). The expected outcome for these efforts was to reduce inconsistencies in curricula between forensic science programs; however, there are limited studies published that evaluate forensic science programs' curricula following the institution of FEPAC Accreditation. The National Academy of Sciences Committee published in 2009, *Strengthening Forensic Science in the United States: A Path Forward*, which continued to cite inconsistencies among forensic science degree programs as problematic.

Statement of the Problem

Although several studies investigated the coursework and minimum degrees crime laboratory directors prefer new employees to possess, no studies have been conducted to evaluate how the accredited graduate forensic science programs fulfill the FEPAC Accreditation Standards and the extent to which FEPAC Accredited Graduate Forensic Science Programs' curricula are consistent with each other.

Purpose of the Study

The purpose of this study was to evaluate curricula of FEPAC Accredited Graduate Forensic Science Programs to determine: how the curricula of these programs fulfill the FEPAC Graduate Curriculum Standards, and to what extent curricula among graduate programs are consistent with one another.

Rationale of the Study

Each graduate program has fulfilled the FEPAC Graduate Curriculum Standards in order to receive accreditation; however, the manner in which they fulfilled the elements of the curriculum standards may vary among programs. This study sought to understand how each graduate program fulfilled the FEPAC standards by analyzing the programs' websites and self-study documents. By identifying the curriculum consistencies and inconsistencies among FEPAC Accredited Graduate Forensic Science Programs, this study provided an assessment of graduate program curricula.

Significance of the Study

This study established whether the curricula at FEPAC Accredited Graduate Forensic Science Programs provided graduates with knowledge and skills in the forensic science

disciplines that were consistent among graduate programs. Crime laboratory directors spend too much time evaluating coursework and transcripts for applicants or rely upon costly in-house training (National Academy of Sciences, 2009). Prior to the advent of FEPAC accreditation of forensic science programs, crime laboratory directors specifically stated in several studies that inconsistencies among curricula were an impediment to evaluating the knowledge and skills of applicants (Peterson & DeForest, 1977; Hooker, 1984; Higgins & Selavka, 1988; Siegel, 1988; Furton, Hsu, & Cole, 1999). Directors would benefit from knowing what knowledge and skills a graduate of a FEPAC Accredited Graduate Forensic Science Program should possess. FEPAC Accredited Forensic Science Graduate Programs would benefit from knowing how other accredited graduate programs fulfilled different aspects of the FEPAC Graduate Curriculum Standards. Perspective students would benefit by knowing what knowledge and skills they can expect to gain by attending a FEPAC Accredited Graduate Forensic Science Program.

The need to address the inconsistencies among graduate forensic science programs led to TWGED recommending model undergraduate and graduate curricula which FEPAC utilized for their accreditation standards (Technical Working Group for Education and Training in Forensic Science, 2004; Forensic Education Programs Accreditation Commission, 2014b). FEPAC determines whether a forensic science program meets the standards through the graduate or undergraduate program's completion of a self-study which FEPAC verifies through an on-site review process (Forensic Education Programs Accreditation Commission, 2014b). Although two studies, Tregar and Proni (2010) and Springer and Melino (2011), evaluated the curricula of accredited and non-accredited graduate programs after the implementation of FEPAC Accreditation Standards, no study has evaluated only FEPAC Accredited Graduate Programs.

Research Questions

1. How are the accredited graduate forensic science programs implementing the Forensic Science Education Programs Accreditation Commission Graduate Curriculum Standards?
2. What are the consistencies and inconsistencies in curriculum across Forensic Science Education Programs Accreditation Commission Accredited Graduate Forensic Science Programs?

Operational Definitions

The following operational definitions were used to guide this study:

Consistencies among curricula: the information regarding the curricula that is in agreement among all FEPAC Accredited Graduate Forensic Science Programs as presented as gathered from graduate programs' websites and self-study documents.

Inconsistencies among curricula: the information regarding the curricula that are lacking agreement among all FEPAC Accredited Graduate Forensic Science Programs as gathered from graduate programs' websites and self-study documents.

Delimitations

Since the FEPAC Accreditation Standards were implemented in response to perceptions of crime laboratory directors, only FEPAC Accredited Graduate Forensic Science Programs' curricula were reviewed. Since the preferred degree identified by several studies is a Master's of Science degree in Forensic Science, only graduate forensic science programs were reviewed. FEPAC policy requires all information provided in the program's application and self-study remain confidential and only accessible to FEPAC designees (Accreditation, n.d.); therefore,

data were gathered from the graduate forensic science program directors and institutional websites.

Time also presented a limitation to the study. The timeline set by the researcher of this study would not allow the researcher to directly observe the curricula at the accredited graduate programs. To undertake direct observation and possible participation at seventeen graduate programs across the United States would take an exorbitant amount of time and would be cost prohibitive for the researcher.

CHAPTER 2: REVIEW OF THE LITERATURE

Introduction

The word *forensic* is derived from the Latin word *forum* which means public (Siegel & Mirakovits, 2010). During the Roman Empire, the forum was a place where the Senate would conduct public meeting and debate politics (Siegel & Mirakovits, 2010). In today's culture *forensic science* means science utilized in a court of law (Siegel & Mirakovits, 2010). Accordingly, any area of life or science can be involved in the commission or analysis of a crime; therefore, a forensic scientist is an essential element in the criminal justice system.

Forensic science originally began out of a need to solve crimes (Saferstein, 2016). Analyses and equipment from other disciplines such as chemistry, biology, or anthropology, were adapted to determine if a suspect had been in contact with a piece of evidence or in a particular location (National Academies of Sciences, Engineering, & Medicine, 2015; Saferstein, 2016). The profession gleaned what it needed from other scientific disciplines such as DNA analysis from biology (Saferstein, 2016), handwriting analysis from education (Lewis, 2014), and fingerprint analysis from anatomy and anthropology (Saferstein, 2016).

Initially crime laboratories were staffed by police officers who completed an in-house training program or by scientists in the basic sciences from nearby universities (Saferstein, 2016). In-house training programs varied widely between laboratories and within disciplines, usually based on the resources of the laboratory (Hooker, 1984; National Academy of Sciences, 2009). As scientists at the universities became increasingly involved in casework, this precipitated the development of formal forensic science degree programs (Quarino & Brettell,

2009). The first formal forensic science degree began at Michigan State University in 1947 (Peterson & DeForest, 1977).

Forensic science programs began to operate in relative isolation to each other (Peterson & DeForest, 1977) and continue to do so today. Curricula between programs are thought to vary significantly which leaves crime laboratory directors unsure of what knowledge or skills a graduate with a forensic science degree possesses (National Academy of Sciences, 2009). Because of this, many crime laboratory directors prefer to hire applicants with a chemistry undergraduate degree plus a possible forensic science graduate degree and then provide in-house training in forensic science (Hooker, 1984; Higgins & Selavka, 1988; Siegel, 1988; Furton, Hsu, & Cole, 1999). The studies reviewed below compare the forensic science programs' curricula to the crime laboratory directors' expectations.

Studies Comparing Forensic Science Programs

The question then becomes: are forensic science programs producing graduates that possess the knowledge and skills crime laboratory directors are seeking in new employees? This question directly relates to the forensic science education curricula. Using employment as a benchmark, Siegel (1988), and Furton, Hsu, and Cole (1999) surveyed crime laboratory directors to determine what degree they prefer in new hirers. Siegel (1988) found that an undergraduate degree in chemistry or a degree with a heavy chemistry emphasis in conjunction with a graduate degree in forensic science was preferred. However, the comments provided by the crime laboratory directors were illuminating. The crime laboratory directors indicated that the weakness of the forensic science degree was the variability between program curricula

(Siegel, 1988). They could not determine if the degree was built on a basic sciences degree or a criminal justice degree with a few chemistry or biology courses (Siegel, 1988).

Eleven years later, Furton, Hsu, and Cole (1999) surveyed crime laboratory directors to determine the minimum degree requirements for a new hire in the laboratory. Furton, Hsu, and Cole (1999) arrived at the same conclusion as Siegel (1988): crime laboratories preferred to hire applicants with a strong chemistry background. However, unlike Siegel, Furton, Hsu, and Cole (1999) asked crime laboratory directors about the hiring requirements, not their personal preference.

Peterson and DeForest (1977) felt that the most important issue facing crime laboratories was the quality of education the scientists possessed. To enable the crime laboratory directors and university educators to better understand the current status of forensic science education, Peterson and DeForest surveyed twenty-two forensic science programs, both undergraduate and graduate (1977). Information gathered by the survey included: type of degree, year the program was established, geographic location of institution, program's location within the institution, degree title, number of graduates since inception, number of students currently enrolled, employment status of graduates, facilities and equipment for teaching and research, internship, and courses offered (Peterson & DeForest, 1977).

The results of their survey found that the tremendous growth in the number of forensic science degree programs occurred without any coordination of the curricula at a national level (Peterson & DeForerest, 1977). The students graduating from different programs did not possess the same knowledge or skills (Peterson & DeForest, 1977). In as much as forensic

science programs were operating in isolation from each other, a common curriculum covered by all programs would decrease variability (Peterson & DeForest, 1977). They also determined that a degree in forensic science rather than a basic science allows the student to develop a forensic science way of thinking (Peterson & DeForest, 1977).

Hooker (1984) conducted a study specifically to guide the curriculum at Virginia Commonwealth University for a forensic science degree. He surveyed thirteen graduate forensic science programs and visited three programs. He found the degree programs varied significantly between institutions (Hooker, 1984). Hooker (1984) also surveyed 243 crime laboratory directors. The crime laboratory directors indicated that a forensic science degree was of value; they recommended a wide variety of courses and topics that should be part of a forensic science degree (Hooker, 1984). The laboratory directors' recommendations indicated that the variety of needs that exist at various crime laboratories possibly cause variability between programs.

Higgins and Selavka (1988) also surveyed forensic science programs and crime laboratory directors to determine if forensic science programs were fulfilling the needs of the crime laboratories. Nine forensic science graduate programs were surveyed; however, only five responded meaning that any conclusions drawn are based on a limited sample size. Their survey covered a multitude of topics including: entrance requirements, curriculum, facilities, faculty, program position within the university, and funding for teaching assistants and research (Higgins & Selavka, 1988). Higgins and Selavka (1988) found little variation between the responding graduate programs in all areas surveyed. Although they found little variation among forensic science curricula, Siegel (1988), after surveying crime laboratory directors, concluded,

"there is apparently little uniformity among programs which call themselves forensic science" (p. 1068).

As technology and laboratory techniques have increased in sophistication, so has the need for graduate education. The studies outlined above and government reports argue for a uniform core curriculum and minimum course requirements be specified for the individual forensic science disciplines in order to demonstrate the foundation of forensic science education. This would require the implementation of a system of accreditation for forensic science academic programs. This has supposedly been addressed by the creation of the Forensic Education Programs Accreditation Commission (FEPAC).

Higher Education Accreditation in the United States

Accreditation of colleges and universities began in 1885 with the creation of the New England Association of Schools and Colleges (NEASC) (Prince, 2012). The NEASC was created as a non-government, peer review based accreditation system (Prince, 2012). According to the U.S. Department of Education's *Accreditation in the United States*, (n.d.) there are two types of accreditation in higher education: institutional (national and regional), and specialized or programmatic. The different types of accreditation can themselves be accredited by either the Council for Higher Education Accreditation (CHEA) or the United States Department of Education (USDE) (Eaton, 2015). Institutional accreditation applies to the entire university and can be conducted by a regional accrediting organization (U.S. Department of Education, n.d.) such as the Higher Learning Commission and Middle States Commission on Higher Education (Council for Higher Education Accreditation, 2016). Universities with forensic science graduate programs are required to be accredited by a regional accrediting organization prior to seeking

accreditation from Forensic Education Programs Accreditation Commission (FEPAC) (Forensic Education Programs Accreditation Commission, 2015). Programs, such as forensic science education, can exist within multiple universities and can be accredited specifically by their respective professional organizations (U.S. Department of Education, n.d.). Specialized or programmatic accrediting organizations only review the program and not the institution (U.S. Department of Education, n.d.).

The principle of accreditation of a university or program is to demonstrate accountability and academic quality to stakeholders (Eaton, 2009). It is a form of quality assurance conducted by professional organizations. Although the accreditation process is voluntary and non-governmental, federal and state governments have made some financial aid and grants conditional upon accreditation (Ewell & Jankowski, 2015). Initially accreditation focused on the institution or program resources; however, in the 1990's the focus shifted to student learning (Ikenberry & Kuh, 2015). The accreditation process ensures that an institution or program has met certain standards (Ewell & Jankowski, 2015).

Standards-based Curriculum

Accreditation is a sign to stakeholders that the university or program has met or exceeded a certain set of standards; however, it is the standards that the stakeholders must investigate to know what the accreditation means (Ewell & Jankowski, 2015). Standards define what knowledge and abilities a student should possess for a particular subject (Lund & Tannehill, 2010; Squires, 2005). They provide a comprehensive vision of what needs to be taught and afford a foundation for assessing student progress (Squires, 2005). Depending on the purpose of the standards, they can be written from a specific point-of-view (Squires, 2005).

Lund and Tannehill (2010) assert that "Developing a standards-based curriculum begins by looking at the standards; recognizing the skills, knowledge, and dispositions that students should demonstrate to meet these standards (p. 7)."

In order for a standards-based curriculum to be efficacious, several premises must be considered. The content of the standards must be widely accepted in its field and developed by experts in that particular field (Squires, 2005). This should pave the way for the dissemination and acceptance of the standards (Squires, 2005). If they are not accepted than they will not be used (squires, 2005). The standards should be aligned to the curriculum; they are the guide for what is to be taught in the classroom (Squires, 2005). Assessments must also be aligned to the standards to determine successful student achievement (Squires, 2005). Additionally, the assessments must be meaningful to truly demonstrate achievement (Squires, 2005).

Relationship among Accreditation, Assessment, and Curriculum

Accreditation of universities and programs has increased the amount of assessment being conducted because how an institution or program meets the standards is demonstrated by the documentation of student assessment (Ewell & Jankowski, 2015). Assessments in a standards-based curriculum provide students and instructors with the necessary feedback to determine whether the curriculum is facilitating the students in achieving the standards (Lund & Tannehill, 2010). Outcomes from the assessments should be utilized as a means to improve curriculum (Ewell & Jankowski, 2015). Curriculum guides the instructors to properly apply the standards; it is the link between the standards and assessment (Squires, 2005).

The general process for accreditation is self-study, on-site peer review, and board recommendations (Eaton, 2015; Ewell & Jankowski, 2015; Forensic Education Programs

Accreditation Commission, 2015; U.S. Department of Education, n.d.). The self-study is an in-depth self-evaluation of the institution or program's compliance with the accreditation standards (Eaton, 2015; Forensic Education Programs Accreditation Commission, 2015; U.S. Department of Education, n.d.). It affords universities and programs the opportunity to reflect upon student learning and make improvements (Ewell & Jankowski, 2015). The self-study provides information for an on-site peer review team (Eaton, 2015). The on-site team verifies the information found in the self-study (Eaton, 2015). An on-site team for regional accreditation usually includes administrators from other universities (Scott, 2014). For specialty or programmatic accreditation, the on-site team is usually composed of people from that profession (Scott, 2014). FEPAC on-site teams include a practitioner and an academician (Forensic Science Education Programs Accreditation Commission, 2015). The on-site team makes their recommendations to the board, which determines whether to grant accreditation (Eaton, 2015; U.S. Department of Education, n.d.).

History of FEPAC Accreditation

In 1997, the National Institute of Justice (NIJ) in conjunction with National Institute of Standards and Technology (NIST), Law Enforcement Standards Office (OLES), and American Society of Crime Lab Directors (ASCLD), held a two day workshop, *Forensic Science Summit: Roadmap to the Year 2000*, to identify the current needs of the forensic science profession and suggest ways to meet those needs (National Institute of Justice, 1999). The 44 member committee published their results in the NIJ Report titled, *Forensic Science: Review of Status and Needs* (1999). One of the primary needs they identified was training, which included graduate education.

The workshop participants reported the primary role of the crime laboratory is to provide support to those in the field performing casework (National Institute of Justice, 1999). In order to accomplish this, scientists in the crime laboratories need training, including access to quality graduate education; however, this is costly. The NIJ (1999) recognized the importance of higher education particularly in the form of graduate degrees as a cost effective way to develop knowledge and skills of forensic scientists. Academic institutions could assist the crime laboratories by providing education and research (National Institute of Justice, 1999). The NIJ (1999) also recognized the need for accreditation of academic programs to ensure that all programs conform to a minimum national standard.

Technical Working Group for Education and Training in Forensic Science

Based on the NIJ's recommendations in *Forensic Science: Review of Status and Needs* (1999), the Technical Working Group for Education and Training in Forensic Science (TWGED), composed of educators, laboratory directors, and lawyers, met "to establish best practices for training and education in forensic science" (Technical Working Group for Education and Training in Forensic Science, 2004, p. 3). TWGED determined what elements of curricula model undergraduate and graduate degrees in forensic science should possess and published their recommendations in a NIJ Special Report titled, *Education and Training in Forensic Science: A Guide for Forensic Science Laboratories, Educational Institutions, and Students* (Technical Working Group for Education and Training in Forensic Science, 2004).

TWGED members considered all elements of curriculum in their recommendations, including funding, facilities, library support, research, and faculty, in addition to recommended coursework. They stated that undergraduate programs should provide a foundation in basic

science education with a laboratory experience and an introduction to forensic science concepts (Technical Working Group for Education and Training in Forensic Science, 2004). Graduate programs should begin with theoretical concepts but progress to discipline-specific knowledge and skills (Technical Working Group for Education and Training in Forensic Science, 2004). A curriculum model for a graduate forensic science program was designed to cover the primary forensic science disciplines including: controlled substances, toxicology, trace evidence, biological evidence, firearms, fingerprints, impression evidence, questioned documents, and crime science investigation (Technical Working Group for Education and Training in Forensic Science, 2004). Applicants to the graduate program would be required to possess a Bachelor of Science degree in either forensic science or a natural science, or possess equivalent coursework (Technical Working Group for Education and Training in Forensic Science, 2004).

In addition to rigorous coursework, an exemplary graduate program must incorporate other necessary elements. Courses should be taught by qualified faculty with forensic science experience and at least 75% of the full-time science faculty should have an appropriate doctoral degree (Technical Working Group for Education and Training in Forensic Science, 2004). Students must conduct a research project that utilizes a variety of advanced techniques and equipment, which answers a question that benefits forensic science (Technical Working Group for Education and Training in Forensic Science, 2004). Students need to produce a written report of their work and present it in a public forum (Technical Working Group for Education and Training in Forensic Science, 2004). Each graduate program should provide interaction with operational forensic science laboratories and professional organizations. There are a variety of

ways to provide the necessary interactions such as internships and collaborative research (Technical Working Group for Education and Training in Forensic Science, 2004). The institution which offers a graduate forensic science degree needs to provide sufficient laboratory space for instruction and research as well as library resources and sufficient funding to accomplish high quality education (Technical Working Group for Education and Training in Forensic Science, 2004).

Forensic Science Education Programs Accreditation Commission

Based on the recommendation of TWGED, the American Academy of Forensic Sciences (AAFS) first established an ad hoc committee, the Forensic Education Programs Accreditation Committee to develop an accreditation system (Forensic Education Programs Accreditation Commission, 2014b). In 2004 AAFS changed the ad hoc accreditation committee to a standing committee named the Forensic Science Education Programs Accreditation Commission (FEPAC) and charged them with implementation of the system of accreditation (Forensic Education Programs Accreditation Commission, 2014b).

FEPAC provides a "formal evaluation and accreditation system" which colleges and universities can use to enhance forensic science education (Forensic Education Programs Accreditation Commission, 2014b, p. 4). The application of the standards should ensure the quality and rigor of forensic science education (Forensic Education Programs Accreditation Commission, 2014b). The FEPAC standards (2014b) are separated into institutional (standard 3.0), which all programs must meet, and undergraduate (standard 4.0) or graduate (standard 5.0), based on the degree being evaluated. Standard 1 provides an introduction to the accreditation standards (Forensic Education Programs Accreditation Commission, 2014b).

Standard 2 provides a brief overview of the standards (Forensic Education Programs Accreditation Commission, 2014b).

The General Standards (standard 3) that each program must meet involve all areas of curriculum including from before the students apply to after they graduate (Forensic Education Programs Accreditation Commission, 2014b). Each graduate program must define methods by which they are evaluating the quality of education provided to the students. The methods should include: a capstone experience, an exit interview to allow students the opportunity to express their thoughts, and an assessment of student success after graduating (Forensic Education Programs Accreditation Commission, 2014). Programs should demonstrate how they are utilizing the information gathered through the assessment process to improve their curriculum (Forensic Education Programs Accreditation Commission, 2014). Additionally, fifty percent of the forensic science faculty members must possess a relevant doctoral degree and oversee all the coursework, meaning no more than fifty percent of the coursework may be taught by adjunct or part-time faculty (Forensic Education Programs Accreditation Commission, 2014b).

Applicants to a FEPAC accredited graduate program must have a bachelor's degree in forensic science, a natural science, a relevant field in computers, or relevant coursework (Forensic Education Programs Accreditation Commission, 2014b). While progressing through their coursework, students should also be provided with adequate support by mentorship, academic advising, and career services (Forensic Education Programs Accreditation Commission, 2014b). The curriculum must include at least ten instructional hours on: "crime scene investigation, physical evidence concepts, law/science interface, ethics and professional

responsibilities, quality assurance, analytical chemistry and instrumental methods of analysis, drug chemistry/toxicology, microscopy and materials analysis, forensic biology, and pattern evidence" (Forensic Education Programs Accreditation Commission, 2014b, p. 12). Students are also required to present in written and oral format results from their independent research project (Forensic Education Programs Accreditation Commission, 2014b). Graduate programs must assess and document students' successful achievement of the programs objectives (Forensic Education Programs Accreditation Commission, 2014b).

The use of the FEPAC standards should assist the graduate program in identifying areas that need curricular improvement. Overall, the standards put forth by FEPAC should provide a benchmark that all accredited institutions have met or exceeded. This allows crime laboratory directors a point of reference to determine the level of knowledge and skills a graduate of a FEPAC accredited graduate program should possess.

Comparison of TWGED Guidelines and FEPAC Standards

The TWGED Guidelines were created as a recommendation of what should be included in a model forensic science graduate program. FEPAC Accreditation Standards are the implementation of these guidelines (Technical Working Group for Education and Training in Forensic Science, 2004; Forensic Education Programs Accreditation Commission, 2014b). How closely do the current FEPAC Standards match the original TWGED Guidelines? Most of the TWGED Guidelines transferred directly into the FEPAC Standards with minor modifications; however, some elements of curriculum present in the FEPAC Standards were not mentioned in the TWGED Guidelines (Appendix B).

Each FEPAC accredited graduate forensic science program can create its own specialized tracks or concentrations within its degree program; however, both TWGED (2004) and FEPAC (2014b) agreed that accredited curricula should include core topics: "crime scenes, physical evidence concepts, law/science interface, ethics and professional responsibility, and quality assurance" (Technical Working Group for Education and Training in Forensic Science, 2004; Forensic Education Programs Accreditation Commission, 2014b). Specific topics to be covered are: "analytical chemistry and instrumental methods of analysis; drug chemistry/toxicology; microscopy and materials analysis; forensic biology; pattern evidence" (Technical Working Group for Education and Training in Forensic Science, 2004; Forensic Education Programs Accreditation Commission, 2014b). TWGED Guidelines suggested the ten topics be covered in a minimum of 30 semester credit hours (Technical Working Group for Education and Training in Forensic Science, 2004), while FEPAC Standards require a minimum of ten instructional hours be utilized to cover each of the ten topics (Forensic Education Programs Accreditation Commission, 2014b). FEPAC Standards (2014) also address assessment of the student's mastery of the material covered in courses; TWGED Guidelines do not. Mastery of the material is not defined in the FEPAC Standards; this allows graduate forensic science programs to define mastery for their students in alignment with their curriculum.

Both TWGED Guidelines and FEPAC Standards require interaction with operational forensic science laboratories and professional organizations, but they do not prescribe how the interaction is to occur. One way they encourage interaction is through graduate seminar (Technical Working Group for Education and Training in Forensic Science, 2004; Forensic Education Programs Accreditation Commission, 2014b). FEPAC specifically requires a seminar

course in which faculty and students, as well as forensic science practitioners, present information on relevant topics and research (Forensic Education Programs Accreditation Commission, 2014b).

The TWGED Guidelines place a greater emphasis on the laboratory component of a graduate curriculum than the FEPAC Standards. FEPAC accredited forensic science graduate programs require an appropriate laboratory experience in addition to a capstone experience (Forensic Education Programs Accreditation Commission, 2014). Also, both TWGED Guidelines and FEPAC Standards require students to conduct independent research and present their findings in both written and oral format (National Institute of Justice, 2004; Forensic Education Programs Accreditation Commission, 2014b). The oral presentation must be made at a public forum (Technical Working Group for Education and Training in Forensic Science, 2004; Forensic Education Programs Accreditation Commission, 2014); however, FEPAC standards specifically exclude oral presentations at professional meetings (Forensic Education Programs Accreditation Commission, 2014b).

TWGED listed several benefits of accreditation: "an external means of program validation; a valuable tool to help student select a program; a means for forensic scientists and potential employers to judge the credentials of graduates; improvement of program quality; a high level of competency for graduates" (Technical Working Group for Education and Training in Forensic Science, 2004, p. 23). TWGED defined the standards necessary to build an accreditation process; FEPAC is the end result of the work of TWGED. Approximately five years after the completion of TWGED and implementation of FEPAC, the government asked the National Academy of Sciences to review the needs of the forensic science community.

FEPAC Accreditation Process

Forensic science graduate programs seeking FEPAC accreditation must meet eligibility requirements prior to applying for accreditation (Forensic Education Programs Accreditation Commission, 2015). Graduate programs "must conduct an in-depth self-study of its compliance with FEPAC's Accreditation Standards" (Forensic Education Programs Accreditation Commission, 2015, p. 9). After the self-study has been reviewed, two representatives of FEPAC conduct an on-site review of the programs (Forensic Education Programs Accreditation Commission, 2015). The recommendations of the on-site team are submitted to the commission who render a decision on whether to grant accreditation (Forensic Education Programs Accreditation Commission, 2015).

The Commission's possible decisions are: accreditation, conditional accreditation, probation, denial of accreditation, or revocation of accreditation (Forensic Education Programs Accreditation Commission, 2015). Accreditation signifies that all the standards were met (Forensic Education Programs Accreditation Commission, 2015). Conditional accreditation means a weakness in the program was identified but may be corrected in less than two years (Forensic Education Programs Accreditation Commission, 2015). A program is placed on probation when one or more of the standards have not been met but may be corrected in less than two years (Forensic Education Programs Accreditation Commission, 2015). A program is denied accreditation when FEPAC determines the standards were not met (Forensic Education Programs Accreditation Commission, 2015). Accreditation will be revoked if a program no longer meets FEPAC standards (Forensic Education Programs Accreditation Commission, 2015). FEPAC specifically states on their website (http://www.fepac-edu.org/accreditation), "All

information conveyed through the online application and self-study system is confidential and assessable to only the user/institution, the FEPAC Commission, and its designees (i.e. On-Site Evaluation Team, FEPAC Administrative Assessment Team)."

National Academy of Sciences Committee Report

The Science, State, Justice, Commerce, and Related Agencies Appropriations Act of 2006 required the National Academy of Sciences to create a Forensic Science Committee to study the needs of the forensic science community excluding the discipline of DNA which had already been studied (National Academy of Sciences, 2009). The Senate statue instructed the committee to "make recommendations for programs that increase the number of qualified forensic scientists … available to work in public crime laboratories…" (National Academy of Sciences, 2009, p. 2). Members of the committee represented all facets of the forensic science community. The committee held hearings and discussed reports on a variety of forensic science community needs which included training and education (National Academy of Sciences, 2009). Ultimately the committee recommended thirteen policy initiatives in their report *Strengthening Forensic Science in the United States: A Path Forward* (National Academy of Sciences, 2009). The tenth recommendation specifically addressed forensic science education and training: "Recommendation 10: To attract students in the physical and life sciences to pursue graduate studies in multidisciplinary fields critical to forensic science practice, … to improve and develop graduate education programs…"(National Academy of Sciences, 2009, p. 28).

To increase the number of qualified forensic scientists, forensic science education must be based on knowledge and skills established in the scientific community and learned through

formal education. Apprentice style training has a place in the laboratory but it cannot replace knowledge and skills gained through higher education (National Academy of Sciences, 2009). However, forensic science education also needs to correct some deficiencies as well. The Forensic Science Committee identified inconsistency among graduate programs' curricula and lack of funding as the two primary challenges facing forensic science education (National Academy of Sciences, 2009). Crime laboratory directors indicated that several forensic science degrees were essentially criminal justice degrees with a few science courses (Seigel, 1988) and that although they prefer an applicant to possess a graduate degree in forensic science, some crime lab directors saw no advantage for applicants to obtain it, although both of these studies were conducted prior to the inception of FEPAC Standards (Higgins & Selavka, 1988).

The Forensic Science Committee determined that uniform and scientifically rigorous forensic science core and discipline-specific curricula are necessary to produce the scientists needed in the crime laboratories. The report cited pre-FEPAC studies to substantiate their position as no post-FEPAC studies were available prior to 2009. The committee promoted accreditation by FEPAC as a "seal of quality" for a forensic science program (National Academy of Sciences, 2009, p. 228). The committee concluded, "… more information is required on the number of programs that are available and the depth and breadth of the course offerings" (National Academy of Sciences, 2009, p. 237).

Continued Shortfalls in Forensic Science Education

With the implementation of accreditation for forensic science programs, the NIJ released a report titled *Addressing Shortfalls in Forensic Science Education* (2007). The report stated that the increased number of forensic science programs necessitated a standardized curriculum to provide competent applicants for crime laboratories (National Institute of Justice, 2007). With the implementation of FEPAC accreditation standards, forensic science education has been standardized which will assist crime laboratory directors saving time and resources when evaluating and training new hires (National Institute of Justice, 2007). However, no studies are cited in the report to support this.

Post-FEPAC studies conducted by Tregar and Proni (2010) and Springer and Melino (2011) found that the degree preferred by crime laboratory directors remained the same as those identified by Siegel (1988), Higgins and Selavka (1988), and Furton, Hsu, and Cole (1999). Tregar and Proni (2010) reviewed forensic science programs as well. Like Peterson and DeForest (1977) and Hooker (1984), Tregar and Proni (2010) found significant variation among forensic science programs. However, much of the variation found by their study could possibly be attributed to the survey itself. Tregar and Proni surveyed both accredited and non-accredited forensic science programs. Also, their survey did not ask where in the respective institutions the forensic science programs were housed or whether the resources (facilities, funding, and faculty) of that location were being considered. Potentially the investigators were comparing a chemistry department with an emphasis or degree in forensic science to a stand-alone forensic science program. Springer and Melino (2011) found the level of education

required of crime laboratories' new hires had not changed since Siegel (1988), Higgins and Selavka (1988), and Furton, Hsu, and Cole (1999).

Tregar and Proni (2010) and Springer and Melino (2011) still did not provide the data requested by the NAS report regarding "…the depth and breadth of the course offerings" (National Academy of Sciences, 2009, p. 237). However, the FEPAC Standards provide guidance in the Graduate Program Standards on Curriculum regarding core course and discipline specific material to be provided by each institution (Forensic Education Programs Accreditation Commission, 2014).

FEPAC Graduate Program Standards on Curriculum

FEPAC Accreditation Standards are divided into five sections: Introduction, Overview of the Standards, General Standards for All Programs, Undergraduate Program Standards, and Graduate Program Standards (Forensic Education Programs Accreditation Commission, 2014b). The Introduction and Overview of the Standards sections provide information on the origin of the standards and a summary of all the standards (Forensic Education Programs Accreditation Commission, 2014b). The third section, General Standards for All Programs, outlines the standards that all programs must fulfill regardless of the level of degree offered (Forensic Education Programs Accreditation Commission, 2014b). The fourth section, Undergraduate Program Standards, outlines the additional standards specific to undergraduate programs that must be achieved in order to be accredited (Forensic Education Programs Accreditation Commission, 2014b). The final section, Graduate Program Standards, outlines the additional standards that graduate programs must achieve in order to be accredited (Forensic Education

Programs Accreditation Commission, 2014b). All of the FEPAC Accredited Graduate Forensic Science Programs utilized the General and Graduate specific standards.

Each year FEPAC revises the accreditation standards (Forensic Education Programs Accreditation Commission, 2014b). Because each graduate program is re-accredited every five years, the programs may be accredited under different versions of the standards. The eighteen accredited Masters' degree programs received their most recent accreditation between the years of 2012 and 2016 which would have required the use of the 2010 through 2014 standards (Forensic Education Programs Accreditation Commission, 2014b). Although FEPAC revised the standards each year, there were minimal changes to the standards between the versions each graduate program would have used (Appendix C). The Graduate Program Standards in 2010 consisted of seven standards. Over time the standards were realigned and sections contained in both the undergraduate and graduate standards were shifted to the General Standards for All Programs (Forensic Education Programs Accreditation Commission, 2014b). This resulted in a reduction of the Graduate Program Standards to three primary standards. The 2014 Graduate Program Standards consists of three sections: Graduate Admission Requirements, Curriculum, and Program Director. This study is concerned with standards contained in the Curriculum section, which provides the minimum criteria graduate programs need to meet to demonstrate the scientific rigor of their curriculum.

Three minor changes occurred to the Graduate Program Standards section on Curriculum between the 2010 and 2014 versions. In the 2014 version, the Faculty section moved from the Graduate Standards to the General Standards. This triggered a re-numbering of the Graduate Standards which changed Curriculum from Standard 5.3 to 5.2 (Forensic

Science Education Programs Accreditation Commission, 2010; Forensic Science Education Programs Accreditation Commission, 2014b). The section names stayed the same regardless of the standard number. The Core Forensic Science Topics section lists the ten core topics that must be covered in each program; however, FEPAC initially did not define how much instructional time must be devoted to those topics (Forensic Science Education Programs Accreditation Commission, 2014b). The additional requirement of "a minimum of ten instructional hours must be spent on each topic" clarified this (Forensic Science Education Programs Accreditation Commission, 2011, p. 12). Programs were also instructed to provide the material in multiple modalities and demonstrate student mastery of the core topics utilizing different assessment tools (Forensic Science Education Programs Accreditation Commission, 2011). However, mastery has not been defined; it is left to each graduate program to define student mastery of the material based on the level of instruction for each topic. Each graduate program must also document that the material was covered and assessed in the syllabi (Forensic Science Education Programs Accreditation Commission, 2013). Within the Research Standard, FEPAC standards stated that student research must be reviewed by a committee of at least three individuals (Forensic Science Education Programs Accreditation Commission, 2010). The individuals on the committee can "include faculty, forensic practitioners, and others with specialized knowledge" (Forensic Science Education Programs Accreditation Commission, 2010, p. 13). Later FEPAC further defined the composition of the committee for mentoring and reviewing a student's research to require at least one of the members to be a full-time faculty member of the forensic science graduate program (Forensic Science Education Programs Accreditation Commission, 2011). Additionally, the Research Standard states that the results of

the students' research must be presented in a public forum. Later this was clarified to disqualify oral presentations at professional meetings as a public forum (Forensic Science Education Programs Accreditation Commission, 2011).

The General Curricular Requirements define the basic knowledge and skills that graduate students should receive throughout the programs' curricula (Forensic Science Education Programs Accreditation Commission, 2014b). The topics are part of more than one discipline and therefore instruction on the topics could occur in more than one class (Forensic Science Education Programs Accreditation Commission, 2014b). Although at least ten instructional hours must be devoted within the curriculum to each topic, the method of instruction, method of assessment, and depth of coverage must be defined by each graduate program based on the objectives of that program (Forensic Science Education Programs Accreditation Commission, 2014b). The ten core topics consist of crime scene investigation, physical evidence concepts, law/science interface, ethics and professional responsibilities, quality assurance, analytical chemistry and instrumental methods of analysis, drug chemistry/toxicology, microscopy and materials analysis, forensic biology, and pattern evidence (Forensic Science Education Programs Accreditation Commission, 2014b). The standard for discipline specific knowledge and skills are in the Curriculum Standard on Courses in Specialized Areas. A list of required topics and hours of instruction is not provided since programs can offer numerous different "specialization, track(s), and/or concentration(s)" (Forensic Science Education Programs Accreditation Commission, 2014b, p. 12). Another required course specified in the Curriculum Standard is graduate seminar. Material presented should include "published work, original research, and other relevant topics" (Forensic Science Education

Programs Accreditation Commission, 2014b, p. 12). The presenters should be "invited experts, faculty, and/or students" (Forensic Science Education Programs Accreditation Commission, 2014b, p. 12).

As part of the curriculum, each student must conduct an independent research project (Forensic Science Education Programs Accreditation Commission, 2014b). The research topic should contribute to the forensic science profession and cannot merely be a literature review or validation study (Forensic Science Education Programs Accreditation Commission, 2014b). The project must include "original data analysis, interpretation, and falsifiable hypothesis" (Forensic Science Education Programs Accreditation Commission Glossary, 2014b, p. 9). At least one full-time faculty member should provide mentorship to the students while they are conducting their research (Forensic Science Education Programs Accreditation Commission, 2014b). At the completion of their research, students will produce a written report of their work that is of publishable quality and orally present their work in a public forum excluding professional meetings (Forensic Science Education Programs Accreditation Commission, 2014b). Graduate programs must provide the students with guidelines for assessment (Forensic Science Education Programs Accreditation Commission, 2014b). The assessment of the student's paper and presentation will be conducted by a committee with at least three members including the student's faculty mentor (Forensic Science Education Programs Accreditation Commission, 2014b). Other members of the committee can include other faculty members including adjunct faculty and other members of the forensic science community outside the graduate program (Forensic Science Education Programs Accreditation Commission, 2014b).

Just as accreditation of the graduate forensic science program provides documentation of the level of scientific rigor in the curriculum, accreditation of crime laboratories demonstrates to the public the laboratory's utilization of best practices (National Science Academies, 2009). Ultimately the curriculum of FEPAC Accredited Graduate Forensic Science Programs should be preparing the student to perform their duties as a forensic scientist in an accredited crime laboratory. The Bureau of Justice Statistics reported that in 2005, 78% of the crime laboratories were accredited by the American Society of Crime Laboratory Directors (Durose, 2008).

American Society of Crime Laboratory Directors

As forensic science laboratories strive to move away from apprentice-based training models, the need for quality formal education has increased, which the National Academy of Sciences' report *Strengthening Forensic Science in the United States* (2009) identified as a key objective for forensic science education. However, crime laboratories have still been reluctant to rely upon higher education training due to the high degree of variability between forensic science higher education curricula (Furton, HSU, & Cole, 1999; NIJ, 2009).

In order to provide a more accurate picture of what knowledge and skills a graduate of a FEPAC Accredited Graduate Forensic Science Program possesses, the programs' curricula need to align with the crime laboratories' needs, particularly to laboratories' accreditation standards. The alignment between the program and laboratory standards would provide a reference point for laboratory directors when appraising an applicant's level of education. Alignment would provide an accountability mechanism ensuring the FEPAC Accredited Graduate Forensic Science Programs produce graduates with the desired knowledge and skills (DeLuca & Bellara, 2013).

Alignment between objectives, assessment, and standards assures the stakeholders that the appropriate knowledge and skills are being taught, and they are being assessed at an appropriate level (DeLuca & Bellara, 2013). Although only FEPAC accredits forensic science academic programs, there are several agencies available that accredit crime laboratories.

Congress passed the Omnibus Crime Control and Safe Streets Act of 1968 which created the Law Enforcement Assistance Administration (LEAA) (Robinson, 1996). The purpose of LEAA was to provide seed grant money to state and municipal governments in order to improve their criminal justice system and therefore reduce crime (Congressional Budget Office, 1978). The Forensic Science Foundation, utilizing funds from LEAA, initiated a proficiency testing program in the 70's for crime laboratories on a volunteer basis (American Society of Crime Lab Directors, n.d.). The results of the proficiency tests identified issues with the testing of evidence in the crime laboratories (American Society of Crime Lab Directors, n.d.). A group of crime laboratory directors in conjunction with the Federal Bureau of Investigation began meeting to discuss a collaborative effort to improve the quality of crime laboratories (American Society of Crime Lab Directors, n.d.). In 1974, the American Society of Crime Laboratory Directors (ASCLD) was formed (American Society of Crime Lab Directors, n.d.).

Members of ASCLD were appointed to a committee to consider ways to improve crime laboratories (American Society of Crime Lab Directors, n.d.). One of the methods they considered was creation of standards for accreditation of crime laboratories called American Society of Crime Laboratory Directors / Laboratory Accreditation Board (ASCLD/LAB) (American Society of Crime Lab Directors, n.d.). In 1982, ASCLD/LAB accredited eight crime laboratories in the Illinois State Police laboratory system. Other federal, state, and municipal crime

laboratories as well as international and private crime laboratories have received ASCLD/LAB accreditation over the years. The Bureau of Justice Statistics' 2009 survey established that 83% of crime laboratories (federal, state, and municipal) were accredited; 74% of the accredited crime laboratories were accredited by ASCLD/LAB.

The initial ASCLD/LAB accreditation standards were developed by members of the ASCLD Delegate Assembly (Neuner, 2010). After twenty-two years, ASCLD/LAB began the process to align their accreditation standards with International Organization for Standardization / International Electrotechnical Commission (ISO/IEC) 17025 (Neuner, 2010). ISO/IEC standards are developed by a world-wide committee of subject matter experts (Neuner, 2010). Once the standards are drafted, put out for public comment, and accepted, the areas that are impacted by the standard may develop supplemental requirements for their field in addition to the standards (Neuner, 2010). The International Laboratory Accreditation Cooperation (ILAC) published revised supplemental requirements for forensic science application in 2014 (Neuner, 2010). As ASCLD/LAB's focus has shifted to international standards, ASCLD/LAB entered into agreements to recognize accreditation of another crime laboratory that aligns with ISO/IEC 17025 and ILAC G19 (American Society of Crime Lab Directors, n.d.). In 2016, ASCLD/LAB merged with ANSI-ASQ National Accreditation Board (ANAB) (ANAB, 2016).

Conclusions

Following TWGED's recommendations, the AAFS began the process of implementing accreditation of forensic science academic programs via the FEPAC (National Institute of Justice, 1999; Forensic Education Programs Accreditation Commission, 2014). The forensic science

community thought accreditation of forensic science degree programs would standardize curricula among programs (National Academy of Sciences, 2009). Accreditation would ensure a minimum level of knowledge and skills a graduate of a FEPAC Accredited Graduate Forensic Science Program would possess (National Academy of Sciences, 2009). Accreditation would also assure crime laboratory directors of the rigor of the curriculum in the areas of science, law, quality control, and ethics, allowing the laboratories to spend less time moving a new hire to competency (National Academy of Sciences, 2009). "Crime laboratories would be the beneficiaries of a wave of well-educated workers who would elevate the scientific standards of the field" (National Academy of Sciences, 2009, p. 228). Although accreditation is thought to be a "seal of quality to an institution" (National Academy of Sciences, 2009, p. 228), the Forensic Science Committee's report only cited pre-FEPAC studies. The implementation of accreditation had brought standardization to forensic science programs' curriculum; however, the Forensic Science Committee states: "…more information is required on the number of programs that are available and the depth and breadth of the course offerings" (National Academy of Sciences, 2009, p. 237).

Numerous studies and government reports identified the need for a core curriculum and minimum course requirements. To achieve this TWGED was tasked with creating a model graduate forensic science curriculum which FEPAC implemented. However, no studies have adequately examined FEPAC Accredited Graduate Forensic Science Programs' curricula since implementation of the FEPAC Accreditation Standards to identify the consistencies and inconsistencies among the programs' curricula.

CHAPTER 3: RESEARCH METHODS

Introduction

Qualitative research describes data that cannot be easily defined by statistical procedures or framed within the context of variables (Bogdan & Biklen, 2007). It uses the collection of words and stories to provide meaningful understanding (Bogdan & Biklen, 2007). This study will primarily evaluate Forensic Science Education Programs Accreditation Commission (FEPAC) Accredited Graduate Forensic Science Programs' curricula to assess how the programs implemented the graduate curriculum standards while evaluating the consistencies and inconsistencies among them. Answering these questions will require a qualitative research design.

Research Design

Qualitative research explores the meaning people ascribe to objects, phenomenon, problems, situations, etc. (Creswell, 2009; Patton, 2002). One philosophical framework used to describe this view of meaning is social constructivism (Creswell, 2009). Social constructivism says that the meaning individuals construct is subjective to their surroundings (Creswell, 2009; Patton, 2002). Within the philosophical framework of social constructivism, this study evaluated the curricula of FEPAC Accredited Graduate Forensic Science Programs created by the meaning-making of the graduate programs' faculty members due to their interpretation of required FEPAC Standards. While the FEPAC Standards indicated to graduate programs what must be included in their curriculum, the standards did not dictate how to fulfill each element of the standards. Each individual graduate program subjectively determined how it would incorporate the material into its curriculum based on the meaning the faculty members constructed. This

was influenced by several factors that related to the specific institution such as where the graduate program is housed within the institution, name of the degree program, and names of courses.

The purpose of this study was to determine how the graduate forensic science programs implemented the FEPAC Graduate Curriculum Standard. The study also sought to understand the consistencies and inconsistencies in the curricula of FEPAC Accredited Graduate Forensic Science Programs. A qualitative study would best allow for evaluation of "the breadth and depth" of the FEPAC Accredited Graduate Forensic Science Programs' curricula (National Academy of Sciences, 2009, p.237).

Multiple strategies for inquiry exist. Creswell (2009), Patton (2002), and Bogdan and Biklen (2007) identified one strategy of inquiry as the case study, which they defined as an analysis of an information rich setting, an individual, source of documents, or event. This study conducted a multi-case study using official documents. Official documents, such as the FEPAC Self Study that each accredited program must generate, were a rich source of data (Bogdan & Biklen, 2007). However, Bogdan and Biklen cautioned that researchers must examine how they utilize the documents to ensure that "the process of meaning construction … be examined in each case" (2007, p. 64). This study was a multi-case study because the curricula of seventeen accredited graduate programs were evaluated. The primary sources of information were program websites and the Graduate Curriculum section of the FEPAC self-study report. Each FEPAC Accredited Graduate Forensic Science Program must submit a self-study for accreditation. Technical Working Group for Education and Training in Forensic Science (TWGED) guidelines and FEPAC standards outline what should be contained in the

curricula; they do not specify how the graduate programs are supposed to provide the curricula.

Population

The population for this study was seventeen of the eighteen FEPAC Accredited Graduate Forensic Science Programs listed on FEPAC's website (Appendix D) (Forensic Science Education Programs Accreditation Commission, 2016). One accredited graduate program was excluded from this study because it was a five year combined undergraduate and graduate curriculum which meant some of the curricular assessment criteria would not be comparable to the other programs. The other seventeen programs were located at universities in the United States. FEPAC defined five possible accreditation outcome categories: full accreditation, conditional accreditation, probation, denial of accreditation, and revocation of accreditation (Forensic Science Education Programs Accreditation Commission, 2016). The seventeen FEPAC accredited forensic science graduate programs whose curricula were evaluated had received full accreditation (Forensic Science Education Programs Accreditation Commission, 2016).

Data Collection

Qualitative data were collected from the Graduate Curriculum Standards of the FEPAC self-studies and the websites of FEPAC Accredited Graduate Forensic Science Programs. A program self-study was required from the programs as part of the FEPAC accreditation process (Forensic Science Education Programs Accreditation Commission, 2014b). The Graduate Curriculum section of the FEPAC Self-Study for the accredited graduate programs was requested from FEPAC. The FEPAC administrator reiterated the policy which is on the FEPAC website (http://www.fepac-edu.org/accreditation), that "All information conveyed through the

online application and self-study system is confidential and assessable to only the user/institution, the FEPAC Commission, and its designees." The FEPAC administrator said that the graduate program directors could provide the requested information. Access to the data was accomplished by emailing (Appendix E) the accredited graduate programs' directors (Appendix D) requesting the Graduate Curriculum Standards section of the self-study reports submitted to FEPAC. To assist graduate program directors, a Self-Study Data Collection Template (Appendix F) was created in Microsoft Word so they could simply cut and paste the information from their self-study report into the file. The Self-Study Data Collection Template document was attached to the email request. Graduate program directors who had not responded to the email after one week were contacted by phone to explain the research project and request the data from their FEPAC self-study.

In addition to the FEPAC Self-Study data, data were gathered from FEPAC Accredited Graduate Programs' websites, such as admissions requirements, required coursework for graduation, name of degree, and where within the institution the graduate degree program is housed. The graduate programs' information was recorded on a Website Data Collection Template (Appendix G).

To maintain confidentiality, graduate programs were randomly assigned a letter of the alphabet to denote the program in the tables for the information collected from their websites. Although all information gathered from the graduate programs' websites was considered public information, it was not the intent of this study to single out one program over another. To maintain confidentiality of data gathered from FEPAC Self-Studies, programs were randomly assigned a letter of the Greek alphabet to denote graduate programs' responses in their self-

studies. Since information gathered from the self-studies was not public information, a different designation was used so any information gathered from the websites could not be cross-referenced with the self-study data. Several tables were designed based on studies in the literature and the FEPAC Standards in order to compare numerous aspects of graduate forensic science curriculum.

The Self-Study Data Collection Template (Appendix F) and the Website Data Collection Template (Appendix G) were created based on the FEPAC Accreditation Graduate Curriculum Standards (Forensic Science Education Programs Accreditation Commission, 2014b).

Data Analysis Strategy

Each graduate program had fulfilled the FEPAC Graduate Curriculum Standards in order to receive full accreditation; however, the manner in which they fulfill it may vary among programs. This study sought to understand how the graduate programs fulfilled the FEPAC Standards through the analysis of the programs' websites and self-study documents. Data were collected regarding each major section of the FEPAC Graduate Curriculum Standards and placed into tables. Consistencies, inconsistencies, and trends were analyzed qualitatively noting patterns and coding data.

Limitations

This study used official documents as its source of data to evaluate the curricula of each FEPAC Accredited Forensic Science Graduate Programs. Documents can be a rich source of data; however, some limitations can affect the use of documents (Bogdan & Biklen, 2007; Creswell, 2009; Patton, 2002). Gaining access to the documents can be challenging (Bogdan & Biklen, 2007; Creswell, 2009; Patton, 2002). Knowing how and why the document was

prepared is necessary to put the document in the correct context (Patton, 2002). However, the FEPAC self-studies required little contextualization because they were written for an outside reviewer to make sense of the curricula offered at the graduate programs prior to observing them (Forensic Science Education Programs Accreditation Commission, 2015).

Another limitation can be determining if the document contains accurate information (Patton, 2002). The accuracy of the FEPAC self-studies was substantiated by the on-site reviewers in order for the graduate programs to receive FEPAC accreditation (Forensic Science Education Programs Accreditation Commission, 2015). FEPAC specifically states, "An individual unfamiliar with the program must be able to understand the program's operation, the learning experiences provided, and the program's assessment of its effectiveness in educating students" (Forensic Science Education Programs Accreditation Commission, 18 July 2015).

Also, graduate programs receive FEPAC accreditation for up to five years (Forensic Science Education Programs Accreditation Commission, 2015). The seventeen graduate programs received full accreditation during the last five years, 2012 to 2016 (Forensic Science Education Programs Accreditation Commission, 2016). The process for accreditation required programs to use the most recent version of the FEPAC Standards which are revised each year. A program seeking accreditation in 2017 would complete a self-study in 2016 using the 2015 standards. This meant that different graduate programs used different standards for the accreditation process. The 2010 through 2014 versions of the FEPAC Standards were compared (Appendix C). The Curriculum Standard did change its identifier from Standard 5.3 to 5.2 within the self-study document, but only limited changes occurred to the content of the Curriculum Standard. These changes were explored in Chapter 2. Additionally, because

accreditation was for up to five years, the graduate programs' accreditation would be spread out across five years. This meant some graduate programs' self-studies would be less recent; therefore, the data in the self-studies may not have been as accurate a reflection of the curricula because of changes in the graduate programs over time.

Validity

Validity demonstrates the credibility of the study; that the researcher has taken measures to insure the trustworthiness of the study (Creswell & Miller, 2000; Shenton, 2004). This study was based upon established standards from a national organization, FEPAC. The graduate programs included in this study were accredited by the same national organization, FEPAC, and were deemed conforming to those standards based upon their full accreditation status. The data for the FEPAC Accredited Graduate Forensic Science Program was collected directly from the university via their website. Data collected from the graduate program had been previously submitted to FEPAC as part of the accreditation process.

CHAPTER 4: FINDINGS

Introduction

This study examined how the seventeen Forensic Science Education Programs Accreditation Commission (FEPAC) Accredited Graduate Forensic Science Programs implemented the Graduate Curriculum Standards. It also considered the consistencies and inconsistencies in the curricula among seventeen accredited graduate forensic science programs. The information regarding programs' curricula was gathered from the programs websites and from the Graduate Curriculum Standards section of their FEPAC Accreditation self-study.

The purpose of this chapter is to report the findings of the data gathered utilizing the methods outlined in Chapter 3. The chapter is organized into sections based on the FEPAC Accreditation Standards which include: general curricular requirements, core forensic science topics, courses in specialized areas, graduate seminar, graduate research, graduate admissions requirements, and ancillary findings. The findings are presented in tables which illustrate each graduate program's curriculum. Curricular data for all accredited graduate programs are illustrated in summary tables. The data on individual programs will allow stakeholders to see consistencies and inconsistencies among graduate programs' curricula, while summary tables will allow stakeholders to examine how graduate programs' curricula in general meet the FEPAC Accreditation Standards.

General Curricular Requirements

The FEPAC Graduate Program Standards on General Curricular Requirements state,

The curriculum shall, at a minimum, ensure that each student:

1. Develop an understanding of the areas of knowledge that are essential to forensic science;
2. Acquire skills and experience in the application of basic forensic science concepts and of specialty knowledge to problem solving;
3. Be oriented in professional values, concepts and ethics; and
4. Demonstrate integration of knowledge and skills through a capstone experience, such as a formal, objective tool, (e.g., the American Board of Criminalistics Forensic Science Aptitude Test), or other comprehensive examination, thesis, and/or research projects.

The program shall define clear learning objectives for each discrete component of the curriculum. The program shall have clear procedures for assessing and documenting each student's progress toward the fulfillment of these learning objectives and toward readiness for forensic science practice.

The program shall provide students with the basic knowledge necessary for effective testimony as an expert witness, and each student shall participate in practical experiences where they will render expert testimony, e.g., moot court. (Forensic Science Education Programs Accreditation Commission, 2014b, p. 11)

FEPAC defines "the areas of knowledge that are essential to forensic science" (Forensic Science Education Programs Accreditation Commission, 2014b, p. 11) in the Graduate Curriculum Standards on Core Forensic Science Topics as "crime scene investigation, physical evidence concepts, law/science interface, ethics and professional responsibilities, quality assurance, analytical chemistry and instrumental methods of analysis, drug chemistry/toxicology, microscopy and material analysis, forensic biology, pattern evidence" (Forensic Science Education Programs Accreditation Commission, 2014b, p. 12). However, several of these areas of knowledge apply across disciplines and therefore can be incorporated into several courses. TWGED's report titled *Education and Training in Forensic Science: A Guide for Forensic Science Laboratories, Educational Institutions, and Students* recommended nine forensic science disciplines that should be included in a graduate program curriculum:

controlled substances (drugs), toxicological specimens (tox), trace evidence (trace), biological samples (biology), firearms, fingerprints, impression evidence (impressions), question documents (QD), and crime scene investigation (CSI) (Technical Working Group for Education and Training in Forensic Science, 2004). Table 1 identifies what disciplines recommended by TWGED were covered in each program's curriculum and whether it was a course required for all students (X), a topic in a required course (P), a course required as part of a concentration/track (C), or an elective (E). Furthermore, forensic chemistry can encompass controlled substances (drug), toxicological specimens, and trace evidence in addition to other topics. To address the possible discrepancy, courses in forensic chemistry (chemistry) were included in Table 1. Also, the FEPAC Standard specifically requires graduate programs to "provide students with the basic knowledge for effective testimony as an expert witness" (Forensic Science Education Programs Accreditation Commission, 2014b, p. 11); therefore, courses law/science interface and expert testimony (law) were included in Table 1. Table 2 summarizes the number of graduate programs that either required a course for all students, a topic in a required course, a course required as part of a concentration/track, or an elective for each forensic science discipline.

Table 1. Forensic Science Disciplines Covered by Graduate Program Curricula

Prog	Drugs	Tox	Trace	Biology	Firearms	Fingerprints	Impressions	QD	CSI	Chemistry	Law
G	E	C		C				E			+
H	C	C	+	+		P	P		+	+	+
I		+		+	E					+	E
J		+	P	+	P	P	P	P	+	+	+
K	C	C	C	C	E	E	E	E		C	+
L	+	+		+	P	P	P	P			+
M			+	+	E	E		E		+	+
N	C	C	C	+	P	P	P	P	+	+	+
O	+	+	+	+	P	P	P		+	C	+
P	+	+	+	+	P	P	P	P		+	+
Q			P	+						+	+
R	+	+	+	+	P	P	P		+	+	+
S	C	C	C	+	+	P	P		C	C	+
T	C		C	C					+	C	+
U	C			+						+	E
W	+	+	+	+	P	P	P	P		+	+
X	E	E	E	+	E	E	P		E	P	+

Prog - graduate program
+ – required course in the curriculum
C – part of a concentration
E – elective in the curriculum
P – part of a required course

Table 2. Summary of the Forensic Science Disciplines in Graduate Programs' Curricula

	Required Course in the Curriculum	Part of a Concentration	Elective in the Curriculum	Part of Required Course	Total
Drugs	5	6	2	0	13
Tox	7	5	1	0	13
Trace	6	4	1	2	13
Biology	14	3	0	0	17
Firearms	1	0	4	7	12
Fingerprints	0	0	3	9	12
Impressions	0	0	1	10	11
QD	0	0	3	5	8
CSI	6	1	1	0	8
Chemistry	10	4	0	1	15
Law	15	0	2	0	17

The majority of the graduate programs incorporated most of the disciplines into their curriculum. All but two programs offered forensic chemistry whether as a required course or as part of a concentration. The two programs that did not offer a specific course in forensic chemistry, did offer drug chemistry and toxicology courses. Thirteen of the graduate programs offered a course on trace evidence: eight programs required all students to take the course, four programs required the course as part of a concentration, and one program offered the course as an elective. All of the graduate programs required forensic biology or DNA technologies as part of the core curriculum or a concentration. Twelve of the graduate programs offered lectures on firearms and fingerprints while eleven programs offered lectures on impression evidence as either an elective or part of a larger course. Only eight programs offered lectures on questioned documents as either an elective or part of a larger course. Additionally, only eight programs required a course in crime scene investigation and one program required it as part of a concentration. For graduate programs that did not appear to offer classes in firearms, fingerprints, impression evidence, and questioned documents the topics could be part of a larger course (e.g. criminalistics); however, the topic cannot be clearly identified from the course description. Fifteen of the programs required students to take at least one course on law or expert testimony; the remaining two programs offered it as an elective in the curriculum. In addition to a legal course, seven programs required students to take a course on ethics.

Prior to graduation the students at all graduate programs must complete a capstone experience (Forensic Science Education Programs Accreditation Commission, 2014b). FEPAC defines a capstone experience as “a final assessment designed to help demonstrate that the

graduating student has the knowledge and skills commensurate with the degree awarded" (Forensic Science Education Programs Accreditation Commission, 2014a, p. 2). The Graduate General Curricular Standards suggest the capstone experience be a formal, objective comprehensive exam, a thesis, or a research project. All the graduate programs require graduates to complete some form of independent research project, whether it is part of a thesis or not, as their capstone experience which stems from the Graduate Standards on Research; they require all students to complete an independent research project (Forensic Science Education Programs Accreditation Commission, 2014b). Some programs required an additional assessment, e.g. in-house comprehensive exam, national comprehensive exam (e.g. Forensic Science Assessment Test (FSAT), or internship, as part of the capstone experience. Peterson (1977) stated that "Internships are an essential part of the forensic science education programs and should be given careful attention" (p. 32). Table 3 demonstrates how different programs satisfy the capstone requirement and if they require student to complete an internship. Table 4 summarizes the number of graduate programs that require students to complete a thesis, in-house comprehensive exam, and/or external comprehensive exam for their capstone experience.

Table 3. Graduate Programs' Capstone Experience and Internship Requirements

Graduate Program	Thesis	In-house Comprehensive Exam	National Comprehensive Exam	Internship
G	Yes	Yes	No	No
H	Yes	Yes	Optional	Optional
I	Yes	No	No	No
J	Yes	No	Yes	No
K	No	Yes	No	No
L	Optional	No	No	Optional
M	Yes	No	No	No
N	Optional	Yes	Optional	Yes
O	No	No	No	No
P	Yes	No	No	Optional
Q	Optional	No	No	Non-thesis
R	No	No	Yes	Yes
S	No	No	No	No
T	Yes	No	No	Optional
U	Optional	No	No	Non-thesis
W	No	Yes	No	Yes
X	Yes	No	No	Optional

Table 4. Overall Capstone Experience Requirements for Graduate Programs

	Yes	No	Optional
Thesis	8	5	4
In-House Comprehensive Exam	5	12	0
National Comprehensive Exam	2	13	2

Eight graduate programs required students to complete their independent research project as part of their thesis requirements. Four graduate programs offered students the choice of a thesis or a non-thesis track. If the students chose the non-thesis track, then they were required to complete an independent research project and additional coursework. As part of the non-thesis option, two programs required students to complete an internship as part of their research requirements. Also, seven graduate programs required students either to

pass an in-house comprehensive exam or to take a national comprehensive exam in addition to their research project. Three of the programs required both a thesis and a comprehensive exam.

Although internships do not necessarily satisfy the Standards for Capstone Experience, the majority of crime laboratory directors prefer applicants to have completed an internship (Peterson & DeForest, 1977; Higgins & Selavka, 1988; Lingquist, Lin, Jenkins, & Yates, 1994). Crime laboratory directors noted that internships allowed for decreased time for a new employee to achieve competency and offered an extended time to evaluate a potential future new hire (Lindquist, Lin, Jenkins, & Yates, 1994). Table 5 summarizes whether a graduate program requires a student to complete an internship prior to graduation.

Table 5. Graduate Programs' Internship Requirement

	Yes	No	Optional	Non-thesis Track*
Internship	3	7	5	2

* Students that chose the non-thesis track were required to complete an internship.

Graduate Programs that required students to complete an internship either did not require a thesis or the thesis was optional. Three graduate programs allowed students the option of an internship in addition to the required thesis. Two graduate programs required students on the non-thesis track to complete an internship as part of the graduate requirements.

Core Forensic Science Topics

The FEPAC Graduate Program Standards on Core Forensic Science Topics states:

The following topics must be part of the curriculum:

- Crime scene investigation
- Physical evidence concepts
- Law/science interface
- Ethics and professional responsibilities
- Quality assurance
- Analytical chemistry and instrumental methods of analysis
- Drug chemistry/toxicology
- Microscopy and materials analysis
- Forensic biology
- Pattern evidence

The emphasis on each topic should be appropriate in light of the degrees awarded. However, a minimum of 10 instructional hours must be spent on each topic.

Normally, a topic will involve multiple class meetings and may involve multiple learning modalities, such as lectures, laboratories, and demonstrations. Evaluation of student mastery of each topic may be done through a number of modalities, but the topic material must be specifically addressed in a syllabus and assessed. (Forensic Science Education Programs Accreditation Commission, 2014b, p. 12)

Each graduate program was asked to provide the Graduate Curriculum Standards section of their FEPAC self-study. Eleven of seventeen programs responded. Of the eleven graduate programs that responded, three responded to the initial email request (Appendix E). Eight responded to a phone call that explained the research project and requested the data. The six graduate programs that did not provide data either did not return the researcher's phone call, said they would provide it but did not, or were unable to send it at this time.

Of the eleven responses received, ten included a table with the minimum number of instructional hours they spend on each Core Forensic Science Topic. Table 6 displays the minimum number of instructional hours for the Core Forensic Science Topics each graduate program incorporated into its courses. Of the ten programs, most only included instructional hours for required course, not electives or concentrations. The number of instructional hours

for those graduate programs may in fact be higher with the inclusion of elective courses or courses in a concentration. This would be especially true for graduate programs that include instruction in a concentration that is typically part of a core curriculum. The minimum instructional hours also did not include seminar, research, or thesis courses. Each graduate program is represented by a Greek letter in Table 6.

Table 6. Core Forensic Science Topics by Graduate Program

	PROGRAM'S MINIMUM # OF INSTRUCTIONAL HOURS											
	α	β	γ	δ	ε	θ	λ	μ	π	ϕ	mean	SD
Crime scene investigation	27	10	35	10	15	55	78	51*	18	15	31.4	23.0
Physical evidence concepts	14*	10	110	27	67	26	177	67*	116	30	64.4	54.8
Law/science interface	12	28	93	27	76	57	45	48	42	50	47.8	23.8
Ethics	23	10	28	23	59	17	26	16*	13*	12	22.7	14.2
QA	18	10	64	10	17	10	15	49*	11	15	21.9	18.8
Analytical chemistry	46	10	14*	21	45	27	87	29*	122	30	43.1	35.3
Drug chemistry /toxicology	57*	10	14*	38	13	12	56	12	62*	45	31.9	21.8
Microscopy & materials analysis	38*	10	38	19	63	75	56	40	74	12	42.5	24.1
Forensic biology	49*	10	62	19	55	75	112	17*	87	45	53.1	32.6
Pattern evidence	27	12	32*	11	63	130	43	23*	12*	12	36.5	36.9

* values were rounded

SD – standard deviation

The mean number of instructional hours spent on each core forensic science topic exceeds the FEPAC required minimum of ten instructional hours. The standard deviations calculated were high indicating a high degree of variability among graduate programs for the number of instructional hours spent on the core forensic science topics. The range of instructional hours spent on each topic varies significantly. This amount of variability was not unexpected. A graduate program would not spend as much instruction time on ethics or quality assurance as they would on physical evidence concepts, forensic biology, or analytical

chemistry. Also, if the graduate program's curriculum did not include concentrations, than the number of instructional hours would be higher. For graduate programs that require students to choose a concentration, the overall instructional hours may be significantly less for the core curriculum. However, if the instructional hours for concentration courses were included in their report, than the instructional hours would increase but vary depending on the concentration. Several programs covered the core forensic science topics across multiple courses as well. Table 7 displays the mean, median, and range for the number of instructional hours for each Core Forensic Science Topics.

Table 7. Core Forensic Science Topics Central Tendencies

	MEAN instructional hours	STANDARD DEVIATION	MEDIAN instructional hours	RANGE between instructional hours
Crime scene investigation	31.4	23.0	22.5	68
Physical evidence concepts	64.4	54.8	48.5	167
Law/science interface	47.8	23.8	46.5	81
Ethics	22.7	14.2	20	49
QA	21.9	18.8	15	54
Analytical chemistry	43.1	35.3	29.7	112
Drug chemistry /toxicology	31.8	21.8	26	52
Microscopy & materials analysis	42.5	24.1	39	65
Forensic biology	53.1	32.6	52	102
Pattern evidence	36.5	36.9	25	119

Courses in Specialized Areas

The FEPAC Graduate Program Standards on Courses in Specialized Areas states:

> The curriculum must include graduate-level science courses appropriate to the specialization, track(s) and/or concentration(s) offered by that institution. For example, courses covering the topics of molecular biology and population genetics, advanced

> analytical chemistry, toxicology, and materials analysis may be appropriate. (Forensic Science Education Programs Accreditation Commission, 2014b, p. 12)

The graduate programs' curricula in this study were of two possible types: a general curriculum with electives or a curriculum with concentrations. In the general curriculum with electives, students completed the same curriculum plus electives of the students' choice. In a curriculum with concentrations, students were required to pick a concentration, such as forensic chemistry, and complete a curriculum focused on that subject. Although students in a concentration curriculum could take elective courses, they did not take all the same courses as the other concentrations. Of the seventeen graduate programs reviewed, eight offered a general forensic science curriculum with electives but no concentrations. Seven graduate programs required students to decide on one area of concentration for their coursework. One graduate program allowed students to choose more than one concentration. The type of curriculum did not correspond to whether the students were required to complete a thesis. Table 8 displays the areas of specialization possible in different graduate programs. Table 9 illustrates the number of concentrations offered at graduate programs.

Table 8. Specialization within a Program's Curriculum

Graduate Program	Credit Hours	Research Credit Hours*	Elective Credit Hours	Thesis	Concentration	# of Concentrations
G	39	6	3	Yes	Yes	2
H	38	4	8	Yes	Optional	2
I	41	3	6	Yes	Yes	3
J	40	10	0	Yes	No	NA
K	37	1	6	No	Yes	3
L	42	6	12	Optional	No	NA
M	40	6	10	Yes	No	NA
N	46	5	3	Optional	Yes	4
O	42	6	3	No	Yes	2
P	38	6	9	Yes	No	NA
Q	37	3	6	Optional	No	NA
R	72	12	6	No	No	NA
S	42	3	6	No	Yes	4
T	38	6	10	Yes	Yes	3
U	32	8	12	Optional	Non-thesis	2
W	44	6	11	No	No	NA
X	42	6	9	Yes	No	NA

* If the thesis is optional, than the minimum number of research credit hours for either option is recorded.

Table 9. Number of Concentrations in Graduate Programs' Curricula

	2 Concentrations	3 Concentrations	4 Concentrations
# of Concentrations	4	3	2

The concentrations fell primarily into two possible areas of specialization: forensic biology (molecular biology, DNA analysis, biochemistry) and forensic chemistry (toxicology, drug). Additional areas of specialization include: criminalistics, crime scene, digital, anthropology, and physical analysis. Although one graduate program allowed students to take up to four areas of specialization, students were only required to choose one concentration.

Since the different types of curricula offered students different paths for required courses, table 10 displays the number of total credit hours required, research credit hours required, and elective credit hours required for the various types of curriculum. For the graduate program that allowed students to choose more than one concentration, the number of credit hours and elective credit hours were recorded for one concentration. The two graduate programs that allowed students to choose the type of curriculum, the number of total credit hours, research credit hours, and elective credit hours were not included in table 10.

Table 10. Number of Credit Hours, Research Credit Hours, and Elective Credit Hours Required

	Type of Curriculum	Mean	Standard Deviation	Median	Range
Credit Hours	All Curricula	42.7	8.5	41	35
	General Curriculum	44.7	12.3	40	35
	Curriculum with Concentrations	40.7	3.0	41	9
Research Credit Hours	All Curricula	5.7	8.5	6	11
	General Curriculum	7	3	6	9
	Curriculum with Concentrations	4.3	2.0	6	5
Elective Credit Hours	All Curricula	6.7	3.5	6	12
	General Curriculum	7.3	3.7	9	11
	Curriculum with Concentrations	5.3	2.6	6	7

In general the graduate programs require students to complete a minimum 42.7 credit hours of coursework to graduate with the general curriculum requiring an average of 4 credit hours more than the curriculum with concentrations. However, the high standard deviation for the means indicate a high degree of variability among graduate programs. The graduate programs with a general curriculum tend to require students to complete slightly higher

number of research and elective credit hours. The greater number of elective hours would be expected since the curriculum requires electives instead of concentrations.

Graduate Seminar

The FEPAC Graduate Program Standards on Graduate Seminar states:

> A formal seminar, which is a requirement of a course, presented by invited experts, faculty, and/or students covering topics such as published work, original research, and other relevant topics must be offered. (Forensic Science Education Programs Accreditation Commission, 2014b, p. 12)

All graduate programs required students to attend seminar in some capacity. The number of semesters each graduate program required students to attend was evenly divided between one to four semesters. Three graduate programs did not have a specific seminar course but did require students to attend specified seminars with attendance as part of their research grade. Five graduate programs required students to enroll in one seminar course, which was usually when they were ready to present their research project publicly. Two graduate programs required students to enroll in two semesters of seminar. Four graduate programs required students to enroll in three semesters, while three programs required at least four semesters of seminar courses. Graduate programs that required at least two semesters of seminar typically included outside speakers on forensic science, professional development, and research development to assist students. Also those graduate programs required students to present a topic for a lay audience or literature review to practice their public speaking skills. In a subsequent semester students presented their independent research or thesis seminar. Table 11 illustrates the number of semester graduate programs require students to complete.

Table 11. Number of Semesters of Seminar Requirement

	Attend Seminar	1 Semester	2 Semesters	3 Semesters	4 Semesters
Number of Graduate Programs	3	5	2	4	3

Graduate Research

The FEPAC Graduate Program Standards on Research states:

> Each student is required to complete an independent research project. The research project shall culminate in a thesis or written report of publishable quality. The academic program must have written guidelines for the format of the thesis/report and for the evaluation of the oral presentation.
>
> Each student is required to have a committee of at least three individuals who are responsible for mentoring the project. One member of the student's research committee must be a full-time faculty member of the program. The other two members can include full or part-time faculty, forensic practitioners and others with specialized knowledge. At least one member of the committee must be external to the department sponsoring the research. In addition, each student must present the results of the work orally, in a public forum, before the committee. Presentations at professional meetings do not meet this requirement.
>
> The research shall be conducted in an environment conducive to research and scholarly inquiry, and shall provide the opportunity for faculty and students to contribute to the knowledge base of forensic science, including research directed at improving the practice of forensic science. (Forensic Science Education Programs Accreditation Commission, 2014b, p. 12)

All graduate programs required students to complete an independent research project, either as part of a thesis or as directed research. They also required students to write a research paper of publishable quality and present their research in a public forum. Interestingly, how the graduate programs integrated the research requirements varied a little from program to program depending on how the graduate seminar standard was implemented. Most graduate programs included the presentation of the students' research in the graduate

seminar requirements. Additionally, the process by which students began to investigate their topic and write their proposal may be included in seminar or in a prospectus course. At least one graduate program embedded the students' research as a part of their internship. Regardless, the seventeen graduate programs all required students to complete an independent research project that includes a formal paper and public presentation. Table 12 displays each program's research requirements.

Table 12. Graduate Research Requirements

Graduate Program	Thesis	Research Credit Hours*	Location of Research
G	Yes	6	Internal or External
H	Yes	4	Internal or External
I	Yes	3	Internal
J	Yes	10	Internal or External
K	No	1	Internal or External
L	Optional	6	Internal
M	Yes	6	Internal
N	Optional	5	Internal or External
O	No	6	Internal
P	Yes	6	Internal
Q	Optional	3	Internal or External
R	No	12	Internal or External
S	No	3	Internal or External
T	Yes	6	Internal
U	Optional	8	Internal
W	No	6	Internal or External
X	Yes	6	Internal

Eight graduate programs required all students to complete a thesis as part of the curriculum. Five graduate programs required an independent research project, but with no thesis option. Four graduate programs offered the option of completing a thesis or a directed research project. Two of the graduate programs that offered a choice between thesis or non-

thesis, required non-thesis students to complete additional coursework. There is minimal difference between the number of research hours required for thesis (mean 5.9 research credit hours) compared to non-thesis programs (mean 5.6 research credit hours). Table 13 displays the research credit hours for graduate programs that require a thesis, do not require a thesis (non-thesis), or allow students the option of choosing thesis or non-thesis.

Table 13. Research Credit Hours vs. Thesis

	Research Credit Hours*		
	Thesis	Non-Thesis	Optional
Mean	5.9	5.6	5.5
Standard Deviation	2.0	4.2	2.1

* If the thesis is optional, than the minimum number of research credit hours for either option is recorded.

Students conducted their research either at the program's facilities or at a host agency such as a state or federal forensic laboratory. Nine programs allowed students to conduct research at either the program or at a host agency. Eight required students to conduct their research at the university. There was no relationship between the location students could conduct their research and whether they were thesis students. Table 14 illustrates the thesis versus non-thesis options and whether student research could be conducted external to the university at a host agency.

Table 14. Location of Graduate Research for Thesis Options

	Thesis			Location of Research	
	Yes	No	Optional	Internal	Internal or External
Graduate Programs	8 (47%)	5 (29%)	4 (24%)	8 (47%)	9 (53%)

Internal – internal to the university

External – external to the university with an approved host agency

Graduate Admissions Requirements

The FEPAC Graduate Admission Requirements Standard states,

> A bachelor's degree in a forensic or natural science, computer science, computer electronic or electrical engineering, information systems or information technology (or its equivalent coursework in a relevant field) shall be required for entrance into the appropriate graduate forensic science program. Undergraduate work should be evaluated to determine if the applicant has sufficient scientific or technical background to successfully complete the graduate program. (Forensic Science Education Programs Accreditation Commission, 2014b, p. 11)

The seventeen accredited graduate programs required prospective students to have a bachelor's degree in a forensic or natural science or to have the equivalent coursework; however, each graduate program had additional admissions requirements to determine whether the applicant had the background necessary to successfully complete the graduate program's curriculum. Table 15 identified the graduate programs' admissions requirements including Graduate Record Exam scores (GRE), grade point average (GPA), prerequisite courses students are required to have taken prior to admissions, the number letters of recommendation required, and whether a personal essay was required.

Table 15. FEPAC Accredited Graduate Forensic Science Programs' Admissions Requirements

Prog	GRE*	GPA	Courses Required Prior to Admission	Ltrs of Rec	Personal Essay
G	yes	3.0^	None	3	yes
H	yes	3.0	Biology + lab, cellular & molecular biology, chemistry + lab, organic chemistry, biochemistry	3	yes
I	297	3.0	Biology, chemistry, organic chemistry, calculus, physics, biochemistry, physical chemistry, statistics	3	yes
J	yes	3.0	Chemistry, organic chemistry, calculus, physics, biology	2	no
K	yes	3.0	Chemistry: chemistry degree with instrumental analysis Molecular Biology: biology degree, biochemistry, genetics, molecular biology and/or molecular genetics, and statistics and/or population statistics Toxicology: chemistry or biology degree with instrumental analysis	1+	yes
L	300	3.0	Quantitative chemistry, instrumental chemistry, biochemistry, molecular biology, statistics	2+	yes
M	300	3.0	Chemistry + lab, organic chemistry + lab, biology + lab, physics, calculus	2	yes
N	300	3.0	Biology + lab, chemistry + lab, organic chemistry + lab, physics + lab	3	yes
O	306	3.0	Biology: biochemistry, molecular biology, genetics, statistics Chemistry: chemistry, organic chemistry	3	yes
P	310/ 340	3.0	none	3	yes
Q	no	3.0	Chemistry, organic chemistry, physics, biology, analytical chemistry, stats, biochemistry, molecular biology, & genetics	no	no
R	yes	3.0	Chemistry + lab, organic chemistry + lab, biology + lab	3	no
S	yes	3.0	Organic chemistry + lab, biology + lab	3	no
T	yes	3.0	none	3	yes
U	298	3.0	Biology + lab, physics + lab, chemistry + lab, organic chemistry + lab, calculus, statistics Chemistry: quantitative analysis, instrumental analysis, physical chemistry Biochemistry: genetics, molecular biology, biochemistry	2	no
W	yes	3.0^	Instrumental analysis, molecular biology	3	yes
X	yes	3.0^	Chemistry + lab, organic chemistry + lab, instrumental analysis or analytical chemistry + lab	no	no

Prog – Graduate Program

* GRE requirements were reported without the writing component or minimum scores for the verbal and quantitative sections.

^recommended not required

All the graduate programs required some form of a bachelor's degree in a field of natural science or the appropriate coursework. Each also considered other requirements for admissions such as GRE, GPA, and specific undergraduate coursework. One graduate program did not require GRE scores for admissions. The remaining sixteen graduate programs required applicants to submit GRE scores when applying to their program. Eight of the sixteen graduate programs required applicants to take the GRE, but did not have a set minimum score necessary for admission. These graduate programs considered the overall strength of the applicant based on all the admissions requirements. The remaining seven graduate programs required applicants to obtain a minimum score in order to be considered for admission. The minimum required scores ranged between 297 and 306; four programs even required specific minimums for each section of the exam. Table 16 illustrates the GRE requirements for the graduate programs.

Table 16. GRE Requirements for Admission to Graduate Programs

	GRE		
	Yes – no specific score	Yes – specific score	No
Graduate Programs	9 (53%)	7 (41%)	1 (6%)

When evaluating applicants for admission, another consideration was applicants' overall undergraduate GPA. Applicants submitted their undergraduate transcripts as part of their admissions packet to the seventeen accredited graduate programs. Fourteen of the graduate programs required at least 3.0 GPA on a 4.0 scale. The remaining three graduate programs considered GPA in conjunction with other admissions requirements when considering the strength of the applicant. They recommended applicants have a 3.0 GPA in order to strengthen

their overall application; however, they would consider applicants with a GPA less than the recommended score. Table 17 displays the number of graduate programs recommending or requiring a 3.0 GPA for admission to the program.

Table 17. GPA Requirement for Admission to Graduate Programs

	GPA ->3.0	
	Required	Recommended
Graduate Programs	14 (82%)	3 (16%)

Additional admissions requirements for several graduate programs included: letters of recommendation, personal statements or essays, and interviews. Fifteen of seventeen graduate programs required applicants to provide letters of recommendation. The minimum number of letters required ranged from one to three, with ten of graduate programs requiring three letters of recommendation. Table 18 displays the number letters of recommendation required by graduate programs for admissions.

Table 18. Letters of Recommendation Requirements

	Letters of Recommendation			
Number of Letters Required	0 Letters	1 Letter	2 Letters	3 Letters
Number of Graduate Programs	2 (12%)	1 (6%)	4 (23%)	10 (59%)

In addition, nine of the seventeen graduate programs required applicants to submit a personal statement regarding why the applicant wanted to pursue a forensic science graduate degree at that institution. One graduate program went a step further by requiring an interview as part of the admissions process, while two other graduate programs reserved the option of

conducting an interview with an applicant. Table 19 displays the graduate programs' personal essay requirements for admissions.

Table 19. Personal Essay Requirements

	Personal Essay	
	Yes	No
Number of Graduate Programs	11 (65%)	6 (35%)

Graduate programs also assessed the academic strength of the applicant as demonstrated by the courses they completed in their undergraduate degree as the forensic science graduate curriculum builds upon the foundation laid by their undergraduate coursework. There are several reasons for the selection of some of the prerequisite course: foundational science courses, Federal Bureau of Investigation's Quality Assurance Standards for personnel in Forensic DNA testing laboratories (QAS) (Federal Bureau of Investigation, 2011), and federal forensic laboratory requirements for chemistry positions. Table 20 identifies the prerequisite courses for each graduate program and how the courses fit with QAS and chemistry laboratory requirements.

Table 20. Required Prerequisite Courses

Prog	# of QAS courses	# of Chem credit hours	Chem	Organic Chem	Addi-tional Chem	Bio-chem	Biology	Molec-ular Biology	Genetics	Physics	Stats
G	0	0									
H	1	16		+		+	+	+			
I	2	20	+	+	+	+	+			+	+
J	0	16	+	+			+			+	
K*	0	20+			+						
	4	0				+		+	+		+
	0	4+			+	+					
L	3	16+			++	+		+			+
M	0	16	+	+			+			+	
N	0	16	+	+			+			+	
O*	4	0				+		+	+		+
	0	16	+	+							
P	0	0									
Q	4	20	+	+	+	+	+	+	+		+
R	0	16	+	+			+				
S	0	16		+			+				
T	0	0									
U*	1	16	+	+			+			+	+
	0	28			+++						
	+3	0				+		+	+		
W	1	4			+			+			
X	0	16	+	+	++						

Prog – Graduate Program

Chem – chemistry

Stats - statistics

* Graduate program has different prerequisite courses based on concentration

+ - Completed course in that topic required by graduate program prior to admission. Additional "+" signs indicate multiple courses required for that topic.

FEPAC Accredited Undergraduate Forensic Science Programs' curricula required students to successfully complete one semester of biology with an associated laboratory, two semesters of chemistry with associated laboratories, two semesters of organic chemistry with

associated laboratories, and two semesters of physics with associated laboratories (Forensic Science Education Programs Accreditation Commission, 2014b). These are also similar to the courses that most natural science degrees require for completion. Of the seventeen FEPAC Accredited Graduate Forensic Science Programs, three did not specify that they required any prerequisite courses for admission. Only five graduate programs required all four natural science courses be completed before admission. There were four graduate programs that only required three of the four courses; all four of these graduate programs did not require physics. Table 21 displays the total number of graduate programs that require a particular course for admission.

Table 21. Graduate Programs Required Prerequisite Course Total Numbers

Required Prerequisite Courses	Number of Graduate Programs that Require Course
Chemistry	9
Organic Chemistry	11
Additional Chemistry	8
Biochemsitry	8
Biology	9
Molecular Biology	7
Genetics	4
Physics	5
Statistics	6

The FBI QAS required personnel in forensic DNA testing laboratories to have successfully completed courses at the undergraduate level in biochemistry, genetics, molecular biology, and statistics (Federal Bureau Investigation, 2011). Four of the seventeen FEPAC Accredited Graduate Forensic Science Programs required students to have completed the FBI QAS DNA analyst- required courses prior to admission. Nine graduate programs did not require applicants to have completed any of the courses required by the FBI QAS prior to admittance to

the graduate program. The FBI QAS states that a DNA analyst can complete all these courses at the undergraduate level; however, a DNA technical leader must have a master's degree and have complete at least one of the courses at the graduate level (Federal Bureau investigation, 2011). A student who completed all the courses prior to enrollment in a graduate program would need to complete one of the courses at the graduate level in order to be eligible for promotion to technical leader. Table 22 displays the number of QAS required courses that the graduate programs require. The three graduate programs that had different requirements for the different concentrations offered were included in the totals independently.

Table 22. QAS Required Prerequisite Courses by Graduate Program Concentration

	Number of QAS Required Courses				
	0 courses	1 courses	2 courses	3 courses	4 courses
Number of Graduate Programs by Concentration*	13	3	1	2	3

* There were 22 sets of admissions requirements when including concentrations with different admissions requirements for the same graduate program.

Many federal laboratories such as the Federal Bureau of Investigation (FBI) and the Drug Enforcement Agency (DEA) require applicants for employment in chemistry positions to have 30 semester credit hours of chemistry courses at either the undergraduate or graduate level. Generally, a chemistry course consists of three credit hours of lecture and one credit hour of laboratory which translates into four credit hours per semester per course. Based on this, the nine programs that require applicants to have one year of chemistry and one year of organic chemistry were requiring sixteen chemistry credit hours for admission. Five graduate programs required an additional higher level chemistry course which meant the applicants accepted to their program have a minimum of twenty credit hours of chemistry completed. One graduate

program required applicants to the chemistry concentration to have already completed twenty-eight credit hours of chemistry prior to admission. Biochemistry credit hours were not included in the total number of chemistry credit hours. Table 23 displays the number of chemistry credit hours that concentrations in graduate programs require for admissions.

Table 23. Prerequisite Chemistry Credit Hours for Admissions by Concentration

	Number of Chemistry Credit Hours		
	<16 credit hours	16 credit hours	>16 credit hours
Number of Graduate Programs by Concentration*	8	10	4

* There were 22 sets of admissions requirements when including concentrations with different admissions requirements for the same graduate

Ancillary Findings

Previous studies noted that many forensic science programs were merely a criminal justice curriculum with a forensic science class or internship (Quarino & Bretell, 2009). Of the seventeen FEPAC Accredited Graduate Forensic Science Programs reviewed, only two were housed in the College of Criminal Justice's Department of Forensic Science. Eleven graduate programs were in some form of a College of Science, such as College of Arts and Sciences. The remaining four programs were in various colleges, such as College of Pharmacy. The majority of the FEPAC accredited programs are in science or healthcare related colleges, rather than criminal justice.

FEPAC Standards require undergraduate and graduate programs to incorporate Professional Involvement, specifically interaction with forensic science laboratories and organizations (Forensic Science Education Programs Accreditation Commission, 2014b). The interactions can include student internships, training, coordinated research, or advisory

positions (Forensic Science Education Programs Accreditation Commission, 2014b). Several of the graduate programs have close affiliations with other organizations that are integral to their curriculum. Some of the affiliated institutions provide institutional and educational support such as: Fredric Rieders Family Renaissance Foundation Facility, International Forensic Research Institute, NMS Labs, Center for Improvised Explosives, Southeast Texas Applied Forensic Science Facility, and Institute for Forensic Research, Training, and Innovation. Other programs have close affiliations with state crime laboratories such as: Michigan State Police Forensic Science Division, Virginia Department of Forensic Science Central Laboratory, and West Virginia State Police Forensic Laboratory. Bode Cellmark Forensics provides a Fellowship Program to one program that allows a student from that program to work at Bode Cellmark Forensics while earning their degree. Opportunities such as crime laboratory internships and fellowships allow students to gain valuable practical experience while completing their degrees.

Summary of Findings

Although there are differences between how the FEPAC Accredited Graduate Forensic Science Programs fulfill the Graduate Curriculum Standards, there are limited if any inconsistencies between the graduate programs' curricula. Although FEPAC defined "the area of knowledge that are essential to forensic science" (Forensic Science Education Programs Accreditation Commission, 2014b, p. 11) in the Core Forensic Science Topics; the TWGED model graduate curriculum's list of foundational forensic science disciplines was the basis for analysis of the courses offered for each program. The programs incorporated the majority of the forensic science disciplines listed plus a few others such as law/science interface or expert

testimony as required by FEPAC (Forensic Science Education Program Programs Accreditation Commission, 2014b).

Eleven graduate programs provided their response to the FEPAC's Graduate Curriculum Standards which was used to analyze the number of instructional hours each program reports for the Core Forensic Science Topics. The graduate programs met or exceeded the minimum number of instructional hours mandated by the FEPAC Accreditation Standards. Many of the graduate programs only reported the number of instructional hours for their core coursework; however, the students possibly receive increased number of hours with the incorporation of the concentration and elective courses.

All seventeen graduate programs required students to complete an independent research project which satisfies the capstone experience and graduate research standards. This was accomplished through different avenues such as thesis, internship, or directed research. Most of the graduate programs utilized the students' public presentation of their research as part of their seminar requirement.

The seventeen accredited graduate programs met and exceeded the Graduate Curriculum Standards in different but not inconsistent ways, including the graduate program's overall curriculum structure such as thesis, non-thesis, general curriculum, or concentration-based curriculum.

CHAPTER 5: CONCLUSIONS, IMPLICATIONS, RECOMMENDATIONS

This chapter begins with a review of the purpose of the study, the methods used, and a summary of the findings. Following this, the conclusions for the major and ancillary findings will be presented which will address the study's research questions. The chapter concludes with suggestions for further studies.

Introduction

In their report, *Forensic Sciences: Review of Status and Needs* (1999), the National Institute of Justice (NIJ) identified training of laboratory personnel as a significant need in the forensic science community. To address this need, the committee recommended a system of accreditation be instituted to ensure that forensic science education can meet the training needs for forensic science laboratory personnel (National Institute of Justice, 1999). Based on this recommendation the NIJ in conjunction with other organizations formed the Technical Working Group on Education and Training in Forensic Science (TWGED) "to establish best practices for training and education in forensic science" (National Academy of Sciences, 2009, p. 3). The American Academy of Forensic Sciences (AAFS) created the Forensic Science Accreditation Commission (FEPAC) to implement a system of accreditation based on the recommendations of TWGED (Forensic Education Programs Accreditation Commission, 2014b). FEPAC accredited the first programs in 2004 (Forensic Education Programs Accreditation Commission, 2014b).

In 2009 the National Academy of Sciences (NAS) stated that "training should move beyond apprentice-like transmittal of practices to education based on scientifically valid principles" (National Academy of Sciences, 2009, p. 26). To facilitate this they recommended

the improvement and development of graduate forensic education programs (National Academy of Sciences, 2009). They did not advocate for apprenticeships to be replaced entirely but rather founded upon formal education at the undergraduate and graduate level. Several studies indicated that crime laboratory directors found forensic science education to be highly inconsistent among the different programs (Peterson & DeForest, 1977; Hooker, 1984; Higgins & Selavka, 1988; Siegel, 1988; Furton, Hsu, & Cole, 1999). However, the studies cited in the NAS's report to substantiate the inconsistencies in forensic science education were conducted prior to the implementation of FEPAC Accreditation.

Purpose of the Study

No studies have been conducted since the institution of FEPAC Accreditation Standards to determine to what extent consistency exists among FEPAC Accredited Graduate Forensic Science Programs' curricula. This study sought to determine how FEPAC Accredited Graduate Forensic Science Programs fulfill the FEPAC Graduate Curriculum Standards and evaluate the consistencies and inconsistencies among FEPAC Accredited Graduate Forensic Science Programs.

Conclusions

Historically, forensic science programs developed in relative isolation without a set of curricular standards for guidance (Peterson & DeForest, 1977). They had interaction with nearby crime laboratories but they experienced limited to no interaction at a national level (Peterson & DeForest, 1977). The curricula created at the programs may have generally been in response to the needs of the neighboring laboratory; however, different crime laboratories

have different needs (Hooker, 1984). Logically, the various forensic science programs would have created different curricula to address those needs.

To address the concerns of the crime laboratories regarding the lack of a core forensic science curriculum, the TWGED was formed "to establish best practices for training and education in forensic science" which led to the formation of FEPAC (National Institute of Justice, 2004, p. 3). In 2004 FEPAC accredited the first forensic science education programs (Forensic Science Education Programs Accreditation Commission, 2014b). FEPAC provided standards to guide forensic science curriculum and ensure a measure of uniformity across programs (Forensic Science Education Programs Accreditation Commission, 2014b).

Limited studies have been conducted to evaluate forensic science education since the implementation of FEPAC accreditation. Tregar and Proni (2010) surveyed undergraduate and graduate forensic science programs. Of the twelve graduate programs that responded to their survey, only one was FEPAC accredited (Tregar & Proni, 2010). Springer and Melino (2011) evaluated the degree and educational requirements for employment at crime laboratories and concluded they had not changed; crime laboratories in 2008 still preferred an undergraduate degree in chemistry.

This study addressed two research questions: RQ1 - How are the accredited graduate forensic science programs implementing the Forensic Science Education Programs Accreditation Commission Graduate Curriculum Standards? RQ2 - What are the consistencies and inconsistencies in curriculum across Forensic Science Education Programs Accreditation Commission Accredited Graduate Forensic Science Programs? The answers to the two research questions were intertwined. By evaluating Graduate Forensic Science Programs' FEPAC

Accreditation Graduate Curriculum Standards from their self-study reports and program websites, this study's findings demonstrated the conclusions to these questions.

RQ1 - How are the accredited graduate forensic science programs implementing the Forensic Science Education Programs Accreditation Commission Graduate Curriculum Standards?

Major Findings

After reviewing the seventeen FEPAC Accredited Graduate Forensic Science Programs' course offerings and course descriptions, three conclusions were reached. The graduate programs all cover the natural science areas of forensic science, such as forensic chemistry and forensic biology, and legal issues (expert testimony, moot court) in the core course requirements, concentrations, or electives. However, only limited course time was spent covering the areas of fingerprints, firearms, questioned documents, impression evidence, and crime scene investigation. Lindquist, Liu, Jenkins, and Yates (1994) found that crime directors considered these topics useful for a new hire and should be included in the curriculum. Historically, these areas have not required forensic scientists to have a degree; however, that has changed (Technical Working Group for Education and Training in Forensic Science, 2004). Catch-all courses such as Survey of Forensic Science and Advanced Criminalistics, demonstrated the greatest inconsistency among graduate programs in this study. Course descriptions listed different topics covered by different programs in the same titled course or the course description offered no indication as to the content of the course. Survey courses are recommended by TWGED in an undergraduate curriculum; however, a discipline specific curriculum is recommended for a graduate curriculum (Technical Working Group for Education and Training in Forensic Science, 2004).

All students completed at least one capstone experience in the seventeen graduate programs in this study; some programs required more than one capstone experience. An independent research project was the primary capstone experience that all seventeen graduate programs require. This was due to the FEPAC Research Standards that all accredited graduate programs are required to include in their curriculum (Forensic Science Education Programs Accreditation Commission, 2014b). The research requirement manifested itself in the curriculum with different names and in differing ways. Over half of the graduate programs utilized a traditional thesis for students' independent research. Other graduate programs in this study utilized directed research or internship. One program embedded non-thesis students' research project in their internship requirements, so research was not listed as a specific course. Lindquist, Liu, Jenkins, and Yates (1994) surveyed crime laboratory directors who recommended students, especially in the areas of fingerprints, firearms, questioned documents, and impression evidence, complete an internship of a median length of 200 hours. Additionally, a few programs in this study required students to either take an in-house comprehensive exam or a national comprehensive exam. Presley, Haas, and Quarino (2009) recommended that programs utilize an external exam rather than an in-house comprehensive exam as an unbiased means to assess student achievement. The combination of the two capstone experiences by graduate programs in this study assessed both skills/abilities (research) and knowledge (exam).

The differences in curricula afforded a means of meeting the wide variety of laboratory needs identified by Hooker (1984) if the graduate programs in the literature provided the same foundational core forensic science topics. The seventeen graduate programs reviewed in this

study covered the core forensic science topics identified in the FEPAC Graduate Curriculum Standards. Additionally, graduate programs' curricular design allowed for some programs to cover certain topics in greater depth. The graduate programs' design was either a general curriculum where all students took the same courses plus electives, or the programs required students to take a few foundational courses and then follow a track or concentration-specific curriculum. A few graduate programs in this study offered both types of curricula depending on whether the student chose a thesis option or a non-thesis option.

Another means of addressing a variety of needs in the crime laboratories (Hooker, 1984), was the use of Graduate Seminar courses. All seventeen graduate programs in this study required students to attend seminars throughout their coursework. The seminars included professional development presentations, outside guest speakers from various forensic disciplines, and student presentations of their independent research. Additionally, all seventeen graduate programs required students to complete an independent research project in some form. The FEPAC Graduate Curriculum Standards defined the composition of the research committee to guide and assess the student; however, the graduate program defined the parameters of the research project. Research as a part of the curriculum teaches practical aspects of forensic science such as problem solving and troubleshooting, particularly because experiments do not always go as planned (Higgins, 1986).

The FEPAC Graduate Admission Requirements Standards required perspective students to have a natural science degree or equivalent coursework; however, they did not define what that coursework should be (Forensic Education Programs Accreditation Commission, 2014b). All seventeen graduate programs required perspective students to have a natural science

degree and specific coursework to apply for admission. However, there was some variation between programs as to what prerequisite courses were required for admissions. The preferred coursework for programs in this study followed three possible tracks: chemistry/trace track, biochemistry/DNA track, and firearms/document/fingerprint track. Within the tracks, the recommended courses include general chemistry, organic chemistry, analytical chemistry, and biology. In general, the required courses aligned with the results of a survey Almirall and Furton (2003) conducted with crime laboratory directors regarding what courses the crime laboratory directors preferred new hires to have completed. The courses recommended by the crime laboratory directors were the same courses that many graduate programs of this study required applicants to have completed. The required prerequisite courses for the different programs also followed the courses required for employment in a DNA position based on the Federal Bureau of Investigation's Quality Assurance Standards for personnel in Forensic DNA testing laboratories (FBI QAS) and a chemistry position based on the FBI and the Drug Enforcement Agency (DEA) chemistry job requirements (Federal Bureau investigation, 2011).

Ancillary Findings

Curriculum includes not only the courses but other areas such as admissions and research. Some of these areas are addressed in FEPAC's Graduate Curriculum Standards while other related areas are included in other parts of the FEPAC standards, such as Graduate Admissions. One area, Professional Involvement, directly impacts the curriculum by strengthening the relationship between the graduate program and the forensic science laboratories including professional organizations. At least eight graduate programs of this

study have a formal, close relationship with a professional organization or forensic laboratory. The other nine may also have relationships with professional organizations or forensic laboratories, but it could not be determined from the program's website or the Graduate Curriculum Standards section of their FEPAC self-study.

The FEPAC Graduate Curriculum Standards on Core Forensic Science Topics required that "a topic … may involve multiple learning modalities," and "student mastery of each topic" should be assessed through multiple means (Forensic Science Education Programs Accreditation Commission, 2014b, p. 12). The General Curricular Requirements also state that students should "acquire skills and experience in the application of basic forensic science concepts and of specialty knowledge to problem solving" (Forensic Science Education Programs Accreditation Commission, 2014b, p. 11). Active learning pedagogies such as problem-based and project-based learning allow students to actively engage with the material (Ozel, 2009). This provides students with another learning modality that goes beyond the lecture and laboratory model. Problem-based learning allows students to utilize real world problems to promote critical thinking, problem solving, and metacognition (Smith, 2014). Graduate programs of this study incorporated different pedagogical ideas into their curriculum that promote active learning, in areas such as a mock crime scene analysis and moot court.

RQ2 - What are the consistencies and inconsistencies in curriculum across Forensic Science Education Programs Accreditation Commission Accredited Graduate Forensic Science Programs?

The FEPAC Accredited Graduate Forensic Science Programs exhibited consistency in their implementation of the Graduate Curriculum Standards. The programs exhibited

differences (distinguishing characteristics) in how they fulfilled the different standards, but they agreed on the foundational curriculum (Differences, n.d.). When the curricula were analyzed at a foundational level what seemed like inconsistencies (lack of agreement) turned out to be merely distinguishing characteristics (differences) such as the name of the course, or whether electives are included in the estimation of the number of instructional hours that are devoted to the core curriculum topics (Differences, n.d.; Inconsistencies, n.d.).

The FEPAC Standards for Core Forensic Science Topics required graduate programs to include in the curriculum a minimum of ten instructional hours for each of the ten forensic science topics listed in the standard (Forensic Science Education Programs Accreditation Commission, 2014b). Ten graduate programs provided a table from their FEPAC Self-Study that indicated how many instructional hours were included in various courses in their curriculum. The standard deviation for the average number of instructional hours graduate programs included was high indicating an increased amount of variability among programs. The amount of variability could be due to interpretation of the standard. Some graduate programs indicated that they only included instructional hours from core courses in the curriculum; courses in a concentration or electives were not included. However, some programs did include concentration and elective courses. Graduate Programs with lower number of instructional hours in the core forensic science topics may increase the number of instructional hours by including concentration courses and electives. The FEPAC Standards on Core Forensic Science Topics and FEPAC's (2015) publication titled *Guidance on Preparing the FEPAC Self-Study* indicated that graduate programs may include instructional hours from concentrations.

The graduate programs have implemented the FEPAC Graduate Standards on seminar and on research; however, the implementations appear to intertwine among the programs which could appear to be inconsistent. Many graduate programs implemented clearly defined seminar courses and research courses. Some graduate programs have included the seminar requirement in the research course assessment, while other programs have included the research proposal process in the seminar courses. The difference in the minimum number of credit hours of research among programs may provide an inaccurate picture of how much time a graduate spent on research.

On the surface the graduate programs of this study appear very inconsistent. However, when the curricular design and pedagogy are stripped away, the accredited graduate programs offer a consistent, rigorous scientific foundation in the core forensic science disciplines as outlined in the FEPAC Graduate Curriculum Standards. Based on the findings of this evaluation of FEPAC Accredited Graduate Forensic Science Programs, there are characteristic differences among the curricula of the graduate programs; however, they do not translate into a lack of agreement. Peterson and DeForest found that crime laboratory directors were not satisfied with the caliber of graduate forensic science programs in 1977. This dissatisfaction summarized the primary reason for the implementation of FEPAC Accreditation Standards, to measure "the quality of forensic science educational programs" (National Institute of Justice, 2007, p. 2).

Discussion and Implications

Unlike the natural science degree curricula, forensic science graduate programs must educate students in multiple areas of science and teach the application of that knowledge of forensic science to the investigation of crime (Allen, 2012). This task requires a wide variety of

topics and disciplines to be included in a graduate forensic science curriculum which can lead to differences among graduate programs.

The diversity of curricula may be in part due to graduate programs' relationships with neighboring crime laboratories. This study identified several graduate programs that have close relationships with state crime laboratories, professional organizations, and forensic science foundations. Hooker (1984) surveyed crime laboratory directors regarding what courses they would include in a graduate forensic science program. Crime laboratory directors recommended a wide variety of courses and topics to be included in the curricula, which indicated that different crime laboratories experienced different needs (Hooker, 1984). The educational needs of the crime laboratories may have led them to reach out to the neighboring forensic science program to add courses or topics to the curriculum. The needs of the neighboring crime laboratory would not have been the same; therefore, the courses incorporated into the curriculum would not have been the same.

Different types of graduate programs' curricula will produce different types of graduates that may be better prepared for various types of employment. General curriculum graduate programs may produce graduates with more breadth of knowledge and skills. This type of graduate would be prepared to function in an administrative capacity in a crime laboratory, such as a laboratory director or quality assurance manager, because of their diverse knowledge. Graduate programs that employ a curriculum with concentrations may produce graduates with a greater depth of knowledge in a specific discipline in forensic science, such as forensic chemistry. A graduate from these programs may be better suited for research, in addition to casework, because of their specific depth of knowledge on the topic. The profession has many

differing needs and a single curriculum cannot produce graduates for all those needs. A single curriculum also does not allow for innovation and creativity, which is necessary to propel the profession forward. Because students learn by different modalities, teaching requires the use of different teaching methods and design. The graduate program curricula must be built on a foundation of rigorous science, but there needs to be unique characteristics to the programs in order to meet the needs of the profession.

The number of instructional hours Graduate Programs spent on the Core Forensic Science Topics varied significantly among graduate programs. Some of the variability may have arisen from what courses graduate programs included when identifying the number of instructional hours for each topic. A few graduate programs included courses from the concentrations or electives in the curriculum, while other programs may not have. However, the information necessary to identify the variability is confidential and not available to stakeholders.

In some graduate programs the implementation of the Graduate Seminar and Graduate Research Standards appeared to overlap. Many graduate programs had clearly defined seminar and research courses; however, some programs did not. Graduate programs may have included the seminar requirements as part of the research course assessment, while other programs included the research development and proposal in the seminar course. Because of the differences in the implementation of the Seminar and Research Standards, it may appear that a graduate at one graduate program has completed more hours of research than a graduate of a different program. When a crime laboratory director is evaluating the knowledge

and skills of an applicant, this could cause some directors to make an erroneous assumption regarding the amount of research an applicant has completed.

Undergraduate forensic science programs should "provide a basic foundation in the scientific and laboratory problem-solving skills necessary success in a modern forensic laboratory" (Forensic Science Education Programs Accreditation Commission, 2014b, p. 7). This can be accomplished through natural science courses and forensic science survey courses. Graduate forensic science programs "provide advanced education in the scientific and laboratory problem-solving skills necessary for success in a modern forensic laboratory" (Forensic Science Education Programs Accreditation Commission, 2014b, p. 11). The graduate curriculum should include discipline specific courses (National Institute of Justice, 2004). Courses such as Criminalistics may not cover the same material at different programs. Course descriptions indicated that different graduate programs covered different topics or instruments in similarly titled courses. Some course descriptions were too vague to offer guidance to crime laboratory directors evaluating an applicant's knowledge and skills.

The FEPAC Accredited Graduate Forensic Science Programs provide similar curricula that are discipline specific with a rigorous, scientific foundation. This study should provide program directors of FEPAC Accredited Graduate Forensic Science Programs an idea of where their graduate program stands in relation to other accredited graduate programs. The study might also assist graduate program directors in identifying gaps in their curriculum by indicating how their program may appear to crime laboratory directors unfamiliar with their curriculum. Questions to be answered by the graduate program directors may include: Are the course descriptions detailed enough for crime laboratory directors to identify the knowledge and skills

a graduate from their program may possess? Do the research hours reflect the work completed by a graduate of that program?

Recommendations for Further Research

The analysis of the accredited graduate programs' curricula could only go so far with information gathered off their websites and FEPAC Self-Study's Graduate Curriculum Standards. Future research should seek to further flesh out the curricula by gathering documents from the graduate programs such as course syllabi, conducting interviews with the program director or their designee, and administering surveys. Analysis of the courses within each curriculum was based on the course description; however, course syllabi and discussions with the course instructor would provide deeper, meaningful information on actual content of the course. This would allow for a greater analysis of consistencies and inconsistencies among courses at FEPAC Accredited Graduate Forensic Science Programs. A deeper analysis of students' independent research requirement would also be of benefit.

An interesting pedagogical idea was described in the course description of a crime scene practicum course from one of the graduate programs. In this course students participate in multiple mock crime scenes, but with a twist. Each student has the opportunity to serve as the crime scene leader with their classmates performing as their crime scene team members. The leader assigns responsibilities to the members of their teams such as photography, sketching, evidence collection, etc. The team leader collects all the reports from their team and compiles the case report to be used for a moot court. Although the faculty set up the crimes scenes, they are not present for the processing of the scene by the student. The professors do conduct the moot court based on the scene they created. Mock crime scenes are an excellent example

of problem-based learning. Each crime scene that students encounter presents a new problem to solve. It is probable that more graduate programs have innovative pedagogical ideas that other programs might benefit from learning about.

The FEPAC Graduate Curriculum Standards require graduate programs to cover the essential forensic science knowledge. This essential knowledge could be defined by the Core Forensic Science Topics listed later in the standards; however, the topics do not necessarily represent the needs of the crime laboratories. A study between the knowledge, skills, and abilities personnel in an accredited forensic science laboratory need and the knowledge, skills, and abilities a graduate can gain from an accredited graduate forensic science program, can identify any gaps between the two and allow academic leaders to strategize how to close that gap. Additionally, the information gathered can be used to create a Body of Knowledge for the Forensic Science field.

Accreditation provides evidence of what students have learned. This is used to demonstrate to stakeholders the quality of the graduate program and assist programs with improvement to their curricula (Ewell, 2008).There are two paradigms for accreditation: improvement and accountability (Ewell, 2008). Accreditation should not only demonstrate that a program meets certain standards but also improve or enhance teaching and learning in that program (Ewell, 2008). The question becomes, do the FEPAC standards provide a balance between the two paradigms? Programmatic accreditation tends to gravitate to the accountability paradigm (Ewell, 2008). As “keepers of a profession”, the accreditors seek to ensure the programs have met the “minimum professional standards of instruction and graduate performance” (Ewell, 2008; p. 119). This aligns with the original call for the creation

of FEPAC Standards, to ensure consistency in forensic science education (National Institute of Justice, 1999). This study's findings supports the conclusion that on a curricular level graduate forensic science education is consistent without stripping programs of their unique characteristics. The natural evolution and growth for graduate forensic science programs may include the evaluation of the FEPAC Standards *in toto* to explore how to utilize the FEPAC Standards to further enhance teaching and learning in the programs which would ultimately strengthen the forensic science profession.

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APPENDIX A: IRB APPROVAL LETTER

MARSHALL UNIVERSITY
www.marshall.edu

Office of Research Integrity
Institutional Review Board
One John Marshall Drive
Huntington, WV 25755

FWA 00002704

IRB1 #00002205
IRB2 #00003206

August 3, 2016

Edna Meisel, Ed.D.
Elementary and Secondary Education

RE: IRBNet ID# 942189-1
At: Marshall University Institutional Review Board #2 (Social/Behavioral)

Dear Dr. Meisel:

Protocol Title:	[942189-1] A Study of the Accredited Forensic Science Graduate Programs' Curricula
Expiration Date:	August 3, 2017
Site Location:	MUGC
Submission Type:	New Project APPROVED
Review Type:	Exempt Review

In accordance with 45CFR46.101(b)(4), the above study was granted Exempted approval today by the Marshall University Institutional Review Board #2 (Social/Behavioral) Designee for the period of 12 months. The approval will expire August 3, 2017. A continuing review request for this study must be submitted no later than 30 days prior to the expiration date.

This study is for student Catherine Rushton.

If you have any questions, please contact the Marshall University Institutional Review Board #2 (Social/ Behavioral) Coordinator Bruce Day, ThD, CIP at 304-696-4303 or day50@marshall.edu. Please include your study title and reference number in all correspondence with this office.

APPENDIX B: TWGED Guidelines (2004) Compared with FEPAC Standards (2014b)

Technical Working Group for Education and Training in Forensic Science (2004)	Forensic Science Education Programs Accreditation Commission (2014b)	DISCUSSION
	5.2.1 clear procedures for assessing and documenting each student's progress toward the fulfillment of these learning objectives and toward readiness for forensic science practice	
Forensic science topics	5.2.1.1 Develop an understanding of the areas of knowledge that are essential to forensic science	
Rigorous academic coursework in a specialized area(s)	5.2.1a-d Specific topic requirements within the curriculum	
Research component – conduct a research project; prepare a written report; present the results in a public forum	5.2.1.4 Demonstrate integration of knowledge and skills through a capstone experience, such as a formal, objective tool, or other comprehensive examination, thesis, and/or research projects. 5.2.1d Research: complete an independent research project; with written report of publishable quality; oral presentation in a public forum (not at a professional meeting)	Both TWGED and FEPAC require students to conduct independent research and present their findings in both written and oral format. The oral presentation must be made at a public forum; however, FEPAC specifically excludes oral presentations at professional meetings.
Laboratory component – anticipate, recognize, and respond properly to chemical and biological hazards; keep legible and complete laboratory records; conduct qualitative and quantitative analyses;	3.9 Distance learning and other alternative delivery mechanisms – includes appropriate laboratory experience for all students 5.2.1.2 Acquire skills and experience in the application	TWGED placed a greater emphasis on the laboratory component to a graduate curriculum. Although FEPAC recognizes alternative delivery methods for course content, it does not negate the need for hands-on

use and understand instrumentation and fundamental techniques; analyze data and evaluate experimental results; assess reliability of results and draw reasonable conclusions; communicate effectively through oral and written reports	of basic forensic science concepts and of specialty knowledge to problem solving	laboratories.
Interaction with operational forensic science laboratories and professional societies – could be in the form of: internships; adjunct faculty interaction; staying current in the discipline; collaborative programs; seminars; residency or fellowship	3.10 Professional involvement – Interaction with forensic science laboratories; interaction with forensic science organizations 5.2.1c Graduate seminar: presented by invited experts, faculty, and/or students	Both require interaction with operational forensic science laboratories and professional organizations, but they do not prescribe how the interaction is to occur. One way they encourage interaction is through graduate seminar. FEPAC specifically requires "a formal seminar" in which faculty and students as well as forensic science practitioners present information on relevant topics and research. TWGED, more so than FEPAC, suggests ways in which the graduate forensic science program, crime laboratories, and professional organizations can interact with each other.
Qualified faculty with appropriate forensic science experience – 75% full-time faculty should have doctoral degree,	3.5 Faculty 5.3 Program Director	Although both TWGED and FEPAC address what constitutes an appropriately qualified faculty, FEPAC also addresses the necessary qualifications for the program director.
Sufficient faculty-to-student ratio and support personnel	3.6 Student support services	FEPAC places a greater emphasis on providing support services to assist students in preparing for the

		job market such as mock job interviews, resume building, and professionalism.
Adequate academic resources (library, journal subscriptions, laboratory space, equipment, etc.)	3.4 Institutional support	Both TWGED and FEPAC recognize that without adequate institutional support the degree programs cannot provide a quality education.
Student support in the form of assistantships and /or fellowships		TWGED recognized the need for financial support for students pursuing a degree in forensic science, either undergraduate or graduate, by recommending the inclusion of financial assistance through assistantships and/or fellowships. FEPAC standards do not evaluate funding for students in any form for either undergraduate or graduate degrees.
A bachelor of science degree in a forensic or natural science (or its equivalent coursework in a relevant field	5.1 Graduate admissions requirements – bachelor's degree in a forensic or natural science, computer science, computer electronic or electrical engineering, information systems or information technology, or equivalent coursework in a relevant field	[no fundamental difference]
30 semester credit hour minimum	5.2.1a … minimum of 10 instructional hours must be spent on each topic (= min. 100 hrs)	TWGED Guidelines specified that 30 semester hours be spent instructing students in 10 core and discipline specific topics. A semester hour refers to the number of credit hours a course is scheduled per week during the semester – it is not the number of hours spent in

		direct instruction for the semester. Assuming the average semester is 15 weeks long, 30 semester hours would translate to 420 instructional hours. FEPAC Standards requires a minimum of 10 instructional hours for each of 10 topics which translates to a minimum of 100 instructional hours on various core and discipline specific time spent in formal classes. This is significantly less hours students spend in class than recommended by TWGED.
Syllabi are expected to be current and describe the course content and text(s)	5.2.1a Evaluation of student mastery of each topic may be done through a number of modalities, but the topic material must be specifically addressed in a syllabus and assessed.	Both TWGED and FEPAC utilize syllabi as a method for documenting material covered in courses. FEPAC also addresses assessment of the student's mastery of the material covered in courses. TWGED does not.
Curriculum will contain the following topics: crime scene; physical evidence concepts; law/science interface; ethics and professional responsibility; quality assurance	5.2.1.3 be oriented in professional values, concepts, and ethics 5.2.1 basic knowledge necessary for effective testimony as an expert witness, and each student shall participate in practical experiences where they will render expert testimony, e.g., moot court 5.2.1a Core forensic science topics: crime scene investigation; physical evidence concepts; law/science interface; ethics	[no difference]

	and profession responsibilities; quality assurance; … minimum of 10 instructional hours must be spent on each topic	
Specific course(s) covering the following topics: analytical chemistry and instrumental methods of analysis; drug chemistry/toxicology; microscopy and materials analysis; forensic biology; pattern evidence	5.2.1a Core forensic science topics: … analytical chemistry and instrumental methods of analysis; drug chemistry/toxicology; microscopy and materials analysis; forensic biology; pattern evidence … minimum of 10 instructional hours must be spent on each topic 5.2.1b Courses in specialized areas	[no difference]
Written and oral communication	5.2.1d Research	TWGED recommends that students demonstrate written and oral communication skills. FEPAC not only recommends that students demonstrate written and oral communication skills, they recommend that students provide a written and oral presentation of their original research.
Adequate funding	3.4 Institutional support	
Accreditation (benefits of accreditation: "an external means of program validation; a valuable tool to help student select a program; a means for forensic scientists and potential employers to judge the credentials of graduates; improvement of program quality; a high level of competency for graduates"		TWGED was created to define the standards necessary to build an accreditation process. FEPAC is the end result of the work of TWGED.

APPENDIX C: COMPARISON OF FEPAC GRADUATE CURRICULUM STANDARD BY YEAR

YEAR	# TITLE	STANDARD	DISCUSSION
2010	5.3 Curriculum	The graduate program in forensic science shall offer a coherent curriculum that reflects the mission and goals of the program.	**Coherent Curriculum (std. 4.3.1, 5.3)** A curriculum that is relevant, orderly, and consistent within the structure of the educational program and appropriately addresses the program's missions, goals, and objectives. (Forensic Science Education Programs Accreditation Commission, 2014a, p. 2) **Curriculum** An educational program consisting of a set of required and elective courses with credits that can be applied to an associate's, bachelors, masters, or doctoral degree. 2) a set of courses constituting an area of specialization. (Forensic Science Education Programs Accreditation Commission, 2014a, p. 3) **Graduate Program Standards (Std 2.0, 5.0)** An acknowledged measure of comparison for quantitative or qualitative value; a criterion. For FEPAC purposes, Graduate Program Standards are the criteria that all Master's level or higher programs must meet in order to achieve accreditation. (Forensic Science Education Programs Accreditation Commission, 2014a, p. 5)
2011	5.3 Curriculum	The graduate program in forensic science shall offer a coherent curriculum that reflects the mission and goals of the program.	
2012	5.3 Curriculum	The graduate program in forensic science shall offer a coherent curriculum that reflects the mission and goals of the program.	
2013	5.3 Curriculum	The graduate program in forensic science shall offer a coherent curriculum that reflects the mission and goals of the program.	
2014	5.2 Curriculum	The graduate program in forensic science shall offer a coherent curriculum that reflects the mission and goals of the program.	
2015	5.2 Curriculum	The graduate program in forensic science shall offer a coherent curriculum that reflects the mission and goals of the program.	

YEAR	# TITLE	STANDARD	DISCUSSION
2010	5.3.1 General Curricular Requirements	The curriculum shall, at a minimum, ensure that each student: 1. develop an understanding of the areas of knowledge that are essential to forensic science; 2. acquire skills and experience in the	**Capstone Experience (std 3.2, 4.3.2b, 5.3.1.4)** A final assessment designed to help demonstrate that the graduating student has the knowledge and skills commensurate with the degree awarded. (Forensic

		application of basic forensic science concepts and of specialty knowledge to problem solving; 3. be oriented in professional values, concepts and ethics; and, 4. demonstrate integration of knowledge and skills through a capstone experience, such as a formal, objective tool, (e.g., the American Board of Criminalistics Forensic Science Aptitude Test), or other comprehensive examination, thesis, and/or research projects. The program shall define clear learning objectives for each discrete component of the curriculum. The program shall have clear procedures for assessing and documenting each student's progress toward the fulfillment of these learning objectives and toward readiness for forensic science practice. The program shall provide students with the basic knowledge necessary for effective testimony as an expert witness, and each student shall participate in practical experiences where they will render expert testimony, e.g. moot court. For general forensic science programs with emphasis in chemistry, biology, or toxicology, standards 5.3.2.1 through 5.3.2.4 should be followed. For forensic science programs with an emphasis on digital evidence, standards 5.3.3.1 through 5.3.3.4 should be followed.	Science Education Programs Accreditation Commission, 2014a, p. 2) **Ethics** The rules or standards governing the conduct of a person or the members of a profession: for example, medical ethics. (Forensic Science Education Programs Accreditation Commission, 2014a, p. 4)
2011	5.3.1 General Curricular Requirements	The curriculum shall, at a minimum, ensure that each student: 1. Develop an understanding of the areas of knowledge that are essential to forensic science; 2. Acquire skills and experience in the application of basic forensic science concepts and of specialty knowledge to problem solving; 3. Be oriented in professional values, concepts and ethics; and	

		4. Demonstrate integration of knowledge and skills through a capstone experience, such as a formal, objective tool, (e.g., the American Board of Criminalistics Forensic Science Aptitude Test), or other comprehensive examination, thesis, and/or research projects. The program shall define clear learning objectives for each discrete component of the curriculum. The program shall have clear procedures for assessing and documenting each student's progress toward the fulfillment of these learning objectives and toward readiness for forensic science practice. The program shall provide students with the basic knowledge necessary for effective testimony as an expert witness, and each student shall participate in practical experiences where they will render expert testimony, e.g., moot court. For general forensic science programs with emphasis in chemistry, biology, or toxicology, standards 5.3.1a-d should be followed. For forensic science programs with an emphasis on digital evidence, standards 5.3.3.1 through 5.3.3.4 should be followed.	
2012	5.3.1 General Curricular Requirements	The curriculum shall, at a minimum, ensure that each student: 1. Develop an understanding of the areas of knowledge that are essential to forensic science; 2. Acquire skills and experience in the application of basic forensic science concepts and of specialty knowledge to problem solving; 3. Be oriented in professional values, concepts and ethics; and 4. Demonstrate integration of knowledge and skills through a capstone experience, such as a formal, objective tool, (e.g., the American Board of Criminalistics Forensic Science Aptitude Test), or other	

		comprehensive examination, thesis, and/or research projects. The program shall define clear learning objectives for each discrete component of the curriculum. The program shall have clear procedures for assessing and documenting each student's progress toward the fulfillment of these learning objectives and toward readiness for forensic science practice. The program shall provide students with the basic knowledge necessary for effective testimony as an expert witness, and each student shall participate in practical experiences where they will render expert testimony, e.g., moot court. For general forensic science programs with emphasis in chemistry, biology, or toxicology, standards 5.3.1a-d should be followed. For forensic science programs with an emphasis on digital evidence, standards 5.3.3.1 through 5.3.3.4 should be followed.	
2013	5.3.1 General Curricular Requirements	The curriculum shall, at a minimum, ensure that each student: 1.Develop an understanding of the areas of knowledge that are essential to forensic science; 2.Acquire skills and experience in the application of basic forensic science concepts and of specialty knowledge to problem solving; 3.Be oriented in professional values, concepts and ethics; and 4. Demonstrate integration of knowledge and skills through a capstone experience, such as a formal, objective tool, (e.g., the American Board of Criminalistics Forensic Science Aptitude Test), or other comprehensive examination, thesis, and/or research projects. The program shall define clear learning objectives for each discrete	

		component of the curriculum. The program shall have clear procedures for assessing and documenting each student's progress toward the fulfillment of these learning objectives and toward readiness for forensic science practice. The program shall provide students with the basic knowledge necessary for effective testimony as an expert witness, and each student shall participate in practical experiences where they will render expert testimony, e.g., moot court. For general forensic science programs with emphasis in chemistry, biology, or toxicology, standards 5.3.1a-d should be followed. For forensic science programs with an emphasis on digital evidence, standards 5.3.2a-d should be followed.	
2014	5.2.1 General Curricular Requirements	The curriculum shall, at a minimum, ensure that each student: 1. Develop an understanding of the areas of knowledge that are essential to forensic science; 2. Acquire skills and experience in the application of basic forensic science concepts and of specialty knowledge to problem solving; 3. Be oriented in professional values, concepts and ethics; and 4. Demonstrate integration of knowledge and skills through a capstone experience, such as a formal, objective tool, (e.g., the American Board of Criminalistics Forensic Science Aptitude Test), or other comprehensive examination, thesis, and/or research projects. The program shall define clear learning objectives for each discrete component of the curriculum. The program shall have clear procedures for assessing and documenting each student's progress toward the fulfillment of these learning	

		objectives and toward readiness for forensic science practice. The program shall provide students with the clear procedures for assessing and documenting each student's progress, and each student shall participate in practical experiences where they will render expert testimony, e.g., moot court. For general forensic science programs with emphasis in chemistry, biology, or toxicology, standards 5.2.1a-d should be followed. For forensic science programs with an emphasis on digital evidence, standards 5.2.2a-d should be followed.	
2015	5.2.1 General Curricular Requirements	The curriculum shall, at a minimum, ensure that each student: 1. Develop an understanding of the areas of knowledge that are essential to forensic science; 2. Acquire skills and experience in the application of basic forensic science concepts and of specialty knowledge to problem solving; 3. Be oriented in professional values, concepts and ethics; and 4. Demonstrate integration of knowledge and skills through a capstone experience, such as a formal, objective tool, (e.g., the American Board of Criminalistics Forensic Science Aptitude Test), or other comprehensive examination, thesis, and/or research projects. The program shall define clear learning objectives for each discrete component of the curriculum. The program shall have clear procedures for assessing and documenting each student's progress toward the fulfillment of these learning objectives and toward readiness for forensic science practice. The program shall provide students with the basic knowledge necessary for effective testimony as an expert witness,	

		and each student shall participate in practical experiences where they will render expert testimony, e.g., moot court. For general forensic science programs with emphasis in chemistry, biology, or toxicology, standards 5.2.1a-d should be followed. For forensic science programs with an emphasis on digital evidence, standards 5.2.2a-d should be followed.	

YEAR	# TITLE	STANDARD	DISCUSSION
2010	5.3.2.1 Core Forensic Science Topics	The following topics must be part of the curriculum: • Crime scene investigation • Physical evidence concepts • Law/science interface • Ethics and professional responsibilities • Quality assurance • Analytical chemistry and instrumental methods of analysis • Drug chemistry/toxicology • Microscopy and materials analysis • Forensic biology • Pattern evidence The emphasis on each topic should be appropriate in light of the degrees awarded.	**Contact hours (std. 4.3.1c)** A unit of measure that represents an hour of scheduled instruction given to students, and is related to the number of academic credits that will be awarded. (Forensic Science Education Programs Accreditation Commission, 2014a, p.3) **Credit Hours (Std 3.12)** A unit of measure representing the equivalent of an hour (50 or 60 minutes) of lecture instruction per week over the entire term. It is applied toward the total number of credit hours needed for completing the requirements of a degree, diploma, certificate or other award. Credit hours for instruction other than lecture (such as lab, recitation, practicum, etc.) may require different numbers of hours per week as defined by each institution. (Forensic Science Education Programs Accreditation Commission, 2014a, p. 3) **Multiple learning modalities (std 4.3.1, 4.3.2, 5.3.1a)** Differing methods of delivering instructional
2011	5.3.1a Core Forensic Science Topics	The following topics must be part of the curriculum: • Crime scene investigation • Physical evidence concepts • Law/science interface • Ethics and professional responsibilities • Quality assurance • Analytical chemistry and instrumental methods of analysis • Drug chemistry/toxicology • Microscopy and materials analysis • Forensic biology	

		• Pattern evidence The emphasis on each topic should be appropriate in light of the degrees awarded. However, a minimum of 10 instructional hours must be spent on each topic. Normally, a topic will involve multiple class meetings and may involve multiple learning modalities, such as lectures, laboratories, and demonstrations. Evaluation of student mastery of each topic may be done through a number of modalities, but the topic material must be specifically addressed in a syllabus and assessed.	material. These methods may include but are not limited to instruction, laboratory experience, and demonstrations. (Forensic Science Education Programs Accreditation Commission, 2014a, p. 6) **Pattern evidence**: **(Std 4.1.1c)** Evidence which lends itself to pattern analysis and interpretation. Examples of pattern evidence include fingerprints (latent and patent), footwear impressions, and tire impressions. (Forensic Science Education Programs Accreditation Commission, 2014a, p. 7)
2012	5.3.1a Core Forensic Science Topics	The following topics must be part of the curriculum: • Crime scene investigation • Physical evidence concepts • Law/science interface • Ethics and professional responsibilities • Quality assurance • Analytical chemistry and instrumental methods of analysis • Drug chemistry/toxicology • Microscopy and materials analysis • Forensic biology • Pattern evidence The emphasis on each topic should be appropriate in light of the degrees awarded. However, a minimum of 10 instructional hours must be spent on each topic. Normally, a topic will involve multiple class meetings and may involve multiple learning modalities, such as lectures, laboratories, and demonstrations. Evaluation of student mastery of each topic may be done through a number of modalities, but the topic material must be	**Physical Evidence Concepts (Std. 5.3.1a, 5.3.2a)** Concepts or fundamentals of physical evidence and its role in forensic investigations that include recognition, documentation, collection, handling, preservation, and approaches to analysis. (Forensic Science Education Programs Accreditation Commission, 2014a, p. 7)

		specifically addressed in a syllabus and assessed.	
2013	5.3.1a Core Forensic Science Topics	The following topics must be part of the curriculum: • Crime scene investigation • Physical evidence concepts • Law/science interface • Ethics and professional responsibilities • Quality assurance • Analytical chemistry and instrumental methods of analysis • Drug chemistry/toxicology • Microscopy and materials analysis • Forensic biology • Pattern evidence The emphasis on each topic should be appropriate in light of the degrees awarded. However, a minimum of 10 instructional hours must be spent on each topic. Normally, a topic will involve multiple class meetings and may involve multiple learning modalities, such as lectures, laboratories, and demonstrations. Evaluation of student mastery of each topic may be done through a number of modalities, but the topic material must be specifically addressed in a syllabus and assessed.	
2014	5.2.1a Core Forensic Science Topics	The following topics must be part of the curriculum: • Crime scene investigation • Physical evidence concepts • Law/science interface • Ethics and professional responsibilities • Quality assurance • Analytical chemistry and instrumental methods of analysis • Drug chemistry/toxicology • Microscopy and materials analysis • Forensic biology • Pattern evidence	

		The emphasis on each topic should be appropriate in light of the degrees awarded. However, a minimum of 10 instructional hours must be spent on each topic. Normally, a topic will involve multiple class meetings and may involve multiple learning modalities, such as lectures, laboratories, and demonstrations. Evaluation of student mastery of each topic may be done through a number of modalities, but the topic material must be specifically addressed in a syllabus and assessed.	
2015	5.2.1a Core Forensic Science Topics	The following topics must be part of the curriculum: • Crime scene investigation • Physical evidence concepts • Law/science interface • Ethics and professional responsibilities • Quality assurance • Analytical chemistry and instrumental methods of analysis • Drug chemistry/toxicology • Microscopy and materials analysis • Forensic biology • Pattern evidence The emphasis on each topic should be appropriate in light of the degrees awarded. However, a minimum of 10 instructional hours must be spent on each topic. Normally, a topic will involve multiple class meetings and may involve multiple learning modalities, such as lectures, laboratories, and demonstrations. Evaluation of student mastery of each topic may be done through a number of modalities, but the topic material must be specifically addressed in a syllabus and assessed.	
YEAR	**# TITLE**	**STANDARD**	**DISCUSSION**

2010	5.3.2.2 Courses in Specialized Areas	The curriculum must include graduate-level science courses appropriate to the specialization, track(s), and/or concentration(s) offered by that institution. For example, courses covering the topics of molecular biology and population genetics, advanced analytical chemistry, toxicology, and materials analysis may be appropriate.	**Specialized Knowledge (Std 5.3.1d, 5.3.2d)** Knowledge of a certain field or discipline that an individual may possess from personal experience, education, or skills beyond that of a lay person. (Forensic Science Education Programs Accreditation Commission, 2014a, p. 9)
2011	5.3.1b Courses in Specialized Areas	The curriculum must include graduate-level science courses appropriate to the specialization, track(s) and/or concentration(s) offered by that institution. For example, courses covering the topics of molecular biology and population genetics, advanced analytical chemistry, toxicology, and materials analysis may be appropriate.	
2012	5.3.1b Courses in Specialized Areas	The curriculum must include graduate-level science courses appropriate to the specialization, track(s) and/or concentration(s) offered by that institution. For example, courses covering the topics of molecular biology and population genetics, advanced analytical chemistry, toxicology, and materials analysis may be appropriate.	
2013	5.3.1b Courses in Specialized Areas	The curriculum must include graduate-level science courses appropriate to the specialization, track(s) and/or concentration(s) offered by that institution. For example, courses covering the topics of molecular biology and population genetics, advanced analytical chemistry, toxicology, and materials analysis may be appropriate.	
2014	5.2.1b Courses in Specialized Areas	The curriculum must include graduate-level science courses appropriate to the specialization, track(s) and/or concentration(s) offered by that institution. For example, courses covering the topics of molecular biology and population genetics, advanced analytical chemistry, toxicology, and materials analysis may be appropriate.	
2015	5.2.1b Courses in Specialized	The curriculum must include graduate-level science courses appropriate to the specialization, track(s) and/or	

	Areas	concentration(s) offered by that institution. For example, courses covering the topics of molecular biology and population genetics, advanced analytical chemistry, toxicology, and materials analysis may be appropriate.	

YEAR	# TITLE	STANDARD	DISCUSSION
2010	5.3.2.3 Graduate Seminar	A formal seminar presented by invited experts, faculty, and/or students covering topics such as published work, original research, and other relevant topics must be offered.	Seminar must be included in the curriculum as a required course.
2011	5.3.1c Graduate Seminar	A formal seminar, which is a requirement of a course, presented by invited experts, faculty, and/or students covering topics such as published work, original research, and other relevant topics must be offered.	
2013	5.3.1c Graduate Seminar	A formal seminar, which is a requirement of a course, presented by invited experts, faculty, and/or students covering topics such as published work, original research, and other relevant topics must be offered.	
2014	5.2.1c Graduate Seminar	A formal seminar, which is a requirement of a course, presented by invited experts, faculty, and/or students covering topics such as published work, original research, and other relevant topics must be offered.	
2015	5.2.1c Graduate Seminar	A formal seminar, which is a requirement of a course, presented by invited experts, faculty, and/or students covering topics such as published work, original research, and other relevant topics must be offered.	

YEAR	# TITLE	STANDARD	DISCUSSION
2010	5.3.2.4 Research	Each student is required to complete an independent research project. The research project shall culminate in a thesis, or written report of publishable quality. The academic program must have written guidelines for the format of the thesis or	**Documented Research Experience (Std. 5.4)** An individual has conducted research activities that resulted in an appropriate combination of publication in a relevant peer reviewed scientific journal, a formal

		report. In addition, the results of the work shall be presented orally in a public forum for evaluation by a committee. The research shall be conducted in an environment conducive to research and scholarly inquiry, and shall provide the opportunity for faculty and students to contribute to the knowledge base of forensic science, including research directed at improving the practice of forensic science. A committee of at least three individuals to include faculty, forensic practitioners and other with specialized knowledge will evaluate the project. At least one member of the committee must be external to the department housing the academic program.	scientific presentation at a relevant scientific meeting, or a successful peer reviewed grant of which there is a written record. (Forensic Science Education Programs Accreditation Commission, 2014a, p. 4) **Mentoring (Advising) (Std 3.5, 5.3.1d, 5.3.2d)** Serving as a counselor or teacher, in academic or occupational settings. (Forensic Science Education Programs Accreditation Commission, 2014a, p. 6) **Research** Original laboratory or field based scientific work of publishable quality in the natural or forensic sciences which must include original data analysis, interpretation, and falsifiable hypothesis testing, but is not a social science project or exclusively a literature review or validation study. (Forensic Science Education Programs Accreditation Commission, 2014a, p. 8)
2011	5.3.1d Research	Each student is required to complete an independent research project. The research project shall culminate in a thesis or written report of publishable quality. The academic program must have written guidelines for the format of the thesis/report and for the evaluation of the oral presentation. Each student is required to have a committee of at least three individuals who are responsible for mentoring the project. One member of the student's research committee must be a full-time faculty member of the program. The other two members can include full or part-time faculty, forensic practitioners and others with specialized knowledge. At least one member of the committee must be external to the department sponsoring the research. In addition, each student must present the results of the work orally, in a public forum, before the committee. Presentations at professional meetings do not meet this requirement. The research shall be conducted in	

		an environment conducive to research and scholarly inquiry, and shall provide the opportunity for faculty and students to contribute to the knowledge base of forensic science, including research directed at improving the practice of forensic science.	
2012	5.3.1d Research	Each student is required to complete an independent research project. The research project shall culminate in a thesis or written report of publishable quality. The academic program must have written guidelines for the format of the thesis/report and for the evaluation of the oral presentation. Each student is required to have a committee of at least three individuals who are responsible for mentoring the project. One member of the student's research committee must be a full-time faculty member of the program. The other two members can include full or part-time faculty, forensic practitioners and others with specialized knowledge. At least one member of the committee must be external to the department sponsoring the research. In addition, each student must present the results of the work orally, in a public forum, before the committee. Presentations at professional meetings do not meet this requirement. The research shall be conducted in an environment conducive to research and scholarly inquiry, and shall provide the opportunity for faculty and students to contribute to the knowledge base of forensic science, including research directed at improving the practice of forensic science.	
2013	5.3.1d Research	Each student is required to complete an independent research project. The research project shall culminate in a thesis or written report of publishable quality. The academic program must have written guidelines for the format of the thesis/report and for the evaluation of the	

		oral presentation. Each student is required to have a committee of at least three individuals who are responsible for mentoring the project. One member of the student's research committee must be a full-time faculty member of the program. The other two members can include full or part-time faculty, forensic practitioners and others with specialized knowledge. At least one member of the committee must be external to the department sponsoring the research. In addition, each student must present the results of the work orally, in a public forum, before the committee. Presentations at professional meetings do not meet this requirement. The research shall be conducted in an environment conducive to research and scholarly inquiry, and shall provide the opportunity for faculty and students to contribute to the knowledge base of forensic science, including research directed at improving the practice of forensic science.	
2014	5.2.1d Research	Each student is required to complete an independent research project. The research project shall culminate in a thesis or written report of publishable quality. The academic program must have written guidelines for the format of the thesis/report and for the evaluation of the oral presentation. Each student is required to have a committee of at least three individuals who are responsible for mentoring the project. One member of the student's research committee must be a full-time faculty member of the program. The other two members can include full or part-time faculty, forensic practitioners and others with specialized knowledge. At least one member of the committee must be external to the department sponsoring the research.	

		In addition, each student must present the results of the work orally, in a public forum, before the committee. Presentations at professional meetings do not meet this requirement. The research shall be conducted in an environment conducive to research and scholarly inquiry, and shall provide the opportunity for faculty and students to contribute to the knowledge base of forensic science, including research directed at improving the practice of forensic science.	
2015	5.2.1d Research	Each student is required to complete an independent research project. The research project shall culminate in a thesis or written report of publishable quality. The academic program must have written guidelines for the format of the thesis/report and for the evaluation of the oral presentation. Each student is required to have a committee of at least three individuals who are responsible for mentoring the project. One member of the student's research committee must be a full-time faculty member of the program. The other two members can include full or part-time faculty, forensic practitioners and others with specialized knowledge. At least one member of the committee must be external to the department sponsoring the research. In addition, each student must present the results of the work orally, in a public forum, before the committee. Presentations at professional meetings do not meet this requirement. The research shall be conducted in an environment conducive to research and scholarly inquiry, and shall provide the opportunity for faculty and students to contribute to the knowledge base of forensic science, including research directed at improving the practice of forensic science.	

APPENDIX D: FEPAC ACCREDITED GRADUATE FORENSIC SCIENCE PROGRAMS

UNIVERSITY	HOUSED	DEGREE NAME	WEBSITE
University of Alabama at Birmingham	College of Arts & Sciences; Dept of Justice Sciences	MSFS	http://www.uab.edu/cas/justice-sciences/graduate-programs/master-of-science-in-forensic-science-msfs
Arcadia University	College of Arts & Sciences; Dept of Chemistry & Physics	MSFS	http://www.arcadia.edu/forensic-science-colleges.htm
Boston University School of Medicine	School of Medicine; Dept of Anatomy and Neurobiology	MSBFS	http://www.bumc.bu.edu/biomedforensic
Cedar Crest College	Dept Chemistry and Physical Sciences	MSFS	http://www.cedarcrest.edu/ca/academics/forensic_science/index.shtm http://forensics.cedarcrest.edu/
Florida International University	School of integrated science & Humanity; Department of Chemistry and Biochemistry	MSFS	http://ifri.fiu.edu/academic-programs/ms-in-forensic-science/
The George Washington University	Columbian College of Arts & Sciences; Dept of Forensic Science	MFS	http://forensicsciences.columbian.gwu.edu
University of Illinois at Chicago	School of Pharmacy; Department of Biopharmaceutical Sciences	MSFS	http://www.uic.edu/pharmacy/depts/Forensic_Science/
John Jay College of Criminal Justice	College of Criminal Justice; Dept of Forensic Science	MSFS	http://www.jjay.cuny.edu/master-science-forensic-science
Marshall University	College of Science; School of Forensic and Criminal Justice Sciences	MSFS	http://www.marshall.edu/forensics
Michigan State University	College of Social Science; School of Criminal Justice	MS	http://www.forensic.msu.edu
University of New Haven	Henry C. Lee College of Criminal Justice and Forensic Sciences	MSFS	http://www.newhaven.edu
Oklahoma State University	Center for Health Sciences; School of Forensic Sciences	MSFS	http://www.healthsciences.okstate.edu/forensic
The Pennsylvania State University	Eberly College of Science; Dept. of Biochemistry & Molecular Biology	MPSFS	http://www.forensics.psu.edu

Sam Houston State University	College of Criminal Justice; Dept of Forensic Science	MSFS	http://forensics.shsu.edu
Towson University	Jess & Mildred Fisher College of Science & Mathematics; Dept of Chemistry	MSFS	http://www.towson.edu/chemistry/academic_programs/forensic_science/bs.asp
Virginia Commonwealth University	College of Humanities & Sciences; Dept of Forensic Science	MSFS	http://www.has.vcu.edu/forensics
West Virginia University	Eberly College of Arts and Sciences; Dept. of Forensic and Investigative Sciences	MSFIS	http://forensics.wvu.edu/

APPENDIX E: EMAIL REQUEST TEMPLATE

Dear [Name of Director]:

My name is Catherine G. Rushton. I am a faculty member at Marshall University Forensic Science Graduate Program, Huntington, WV. I am conducting a research study examining the curricula of FEPAC accredited forensic science graduate programs.

Accredited graduate forensic science programs have fulfilled the FEPAC Graduate Standard on Curriculum in order to receive accreditation; however, the manner in which they fulfill it may vary between programs. This study will seek to understand how each program fulfilled the FEPAC Graduate Standard on Curriculum by analysis of each program's Curriculum Section of their self-study document.

If you would like to assist me in this study, please send ONLY the Graduate Curriculum Section of your most recent FEPAC Self-Study. Please include this information by cutting and pasting the graduate curriculum information from your self-study into the attached template organized by FEPAC standard. Then send as an attached document with your reply to this email: rushton1@marshall.edu.

All data sent to me will be kept confidential. All data will be reported in the study in aggregate format and will not identify the name of the institution or program.

There are no risks related to this research. Participation is completely voluntary and there will be no penalty or loss of benefits if you choose to not participate in this research study or to withdraw. The benefit of this research is to increase the knowledge of how accredited forensic science graduate programs implemented the FEPAC graduate curriculum standards.

Sending the Graduate Curriculum Section only from your most recent FEPAC Self-Study indicates your consent for use of this information. If you have any questions about the study you may contact Dr. Edna Meisel at meisele@marshall.edu, Primary Investigator, or Catherine Rushton, Co-investigator at rushton1@marshall.edu.

This study has been approved by the Marshall University Office of Research Integrity, Institutional Research Board. If you have any questions concerning your rights as a research participant, you may contact the Marshall University Office of Research Integrity at (304) 696-4303.

Thank you!

Sincerely,

Catherine G. Rushton, MSFS, EdS
Forensic Science Instructor
Marshall University Forensic Science Graduate Program

APPENDIX F: SELF-STUDY DATA COLLECTION TEMPLATE

Curriculum:

The graduate program in forensic science shall offer a coherent curriculum that reflects the mission and goals of the program.

General Curricular Requirements:

The curriculum shall, at a minimum, ensure that each student:
1. Develop an understanding of the areas of knowledge that are essential to forensic science;
2. Acquire skills and experience in the application of basic forensic science concepts and of specialty knowledge to problem solving;
3. Be oriented in professional values, concepts and ethics; and
4. Demonstrate integration of knowledge and skills through a capstone experience, such as a formal, objective tool, (e.g., the American Board of Criminalistics Forensic Science Aptitude Test), or other comprehensive examination, thesis, and/or research projects.

The program shall define clear learning objectives for each discrete component of the curriculum. The program shall have clear procedures for assessing and documenting each student's progress toward the fulfillment of these learning objectives and toward readiness for forensic science practice.

The program shall provide students with the basic knowledge necessary for effective testimony as an expert witness, and each student shall participate in practical experiences where they will render expert testimony, e.g., moot court.

PROGRAM'S RESPONSE

Core Forensic Science Topics:

The following topics must be part of the curriculum:
- *Crime scene investigation*
- *Physical evidence concepts*
- *Law/science interface*
- *Ethics and professional responsibilities*
- *Quality assurance*
- *Analytical chemistry and instrumental methods of analysis*
- *Drug chemistry/toxicology*
- *Microscopy and materials analysis*
- *Forensic biology*
- *Pattern evidence*

The emphasis on each topic should be appropriate in light of the degrees awarded.

However, a minimum of 10 instructional hours must be spent on each topic. Normally, a topic will involve multiple class meetings and may involve multiple learning modalities, such as lectures, laboratories, and demonstrations.

Evaluation of student mastery of each topic may be done through a number of modalities, but the topic material must be specifically addressed in a syllabus and assessed.

PROGRAM'S RESPONSE

Courses in Specialized Areas:

The curriculum must include graduate-level science courses appropriate to the specialization, track(s) and/or concentration(s) offered by that institution. For example, courses covering the topics of molecular biology and population genetics, advanced analytical chemistry, toxicology, and materials analysis may be appropriate.

PROGRAM'S RESPONSE

Graduate Seminar: *A formal seminar, which is a requirement of a course, presented by invited experts, faculty, and/or students covering topics such as published work, original research, and other relevant topics must be offered.*
PROGRAM'S RESPONSE

Research:

Each student is required to complete an independent research project. The research project shall culminate in a thesis or written report of publishable quality. The academic program must have written guidelines for the format of the thesis/report and for the evaluation of the oral presentation.

Each student is required to have a committee of at least three individuals who are responsible for mentoring the project. One member of the student's research committee must be a full-time faculty member of the program. The other two members can include full or part-time faculty, forensic practitioners and others with specialized knowledge. At least one member of the committee must be external to the department sponsoring the research.

In addition, each student must present the results of the work orally, in a public forum, before the committee. Presentations at professional meetings do not meet this requirement.

The research shall be conducted in an environment conducive to research and scholarly inquiry, and shall provide the opportunity for faculty and students to contribute to the knowledge base of forensic science, including research directed at improving the practice of forensic science.

PROGRAM'S RESPONSE

APPENDIX G: WEBSITE DATA COLLECTION TEMPLATE

Curriculum:

What are the requirements for admission?

Website:

What courses are students required to take?

Website:

How many credit hours are required for the curriculum?

Website:

What type of capstone experience, such as a Forensic Science Aptitude Test, comprehensive examination, thesis, or research project, is required?

Website:

What are the primary learning objectives for program's curriculum?

Website:

What is program's graduation and/or employment rate?

Website:

Does the curriculum incorporate expert testimony and a moot court?

What type of curriculum does the program use? (Concentrations, generalist, etc)

How does the curriculum differ compared to the type of curriculum?

What are the similarities and differences among "comparable" courses?

Core Forensic Science Topics:

How are the following topics included in the curriculum:

- ***Crime scene investigation***
- ***Physical evidence concepts***
- ***Law/science interface***
- ***Ethics and professional responsibilities***
- ***Quality assurance***
- ***Analytical chemistry and instrumental methods of analysis***
- ***Drug chemistry/toxicology***
- ***Microscopy and materials analysis***
- ***Forensic biology***
- ***Pattern evidence***

How many instructional hours are spent on each of the core forensic science topics?

How does the program evaluation of student mastery of each topic?

Courses in Specialized Areas:

How does the curriculum include graduate-level science courses appropriate to the specialization, track(s) and/or concentration(s) offered by that institution?

Website:

Graduate Seminar:

How does the program incorporate a formal seminar, which is a requirement of a course, presented by invited experts, faculty, and/or students covering topics such as published work, original research, and other relevant topics into the curriculum?

Research:

How does each student complete an independent research project?

What are the requirements for completing the research project?

Other:

What interesting things stand out about this program?

Course Titles and Descriptions: