Digital Forensics and the Law

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ABSTRACT

As computers and digital devices become more entrenched in our way of life, they become tools for both good and nefarious purposes. When the digital world collides with the legal world, a vast chasm is created. This paper will reflect how the legal community is failing to meet its obligation to provide adequate representation due to a lack of education about digital (computer) forensics. Whether in a civil litigation setting or a criminal setting, attorneys, prosecutors and judges have inadequate knowledge when it comes to the important questions they need to ask regarding digital evidence. Reliance on expert witnesses is not enough when the attorney cannot discern whether the opinion presented by the expert (even their own expert) is accurate, factual, or even plausible. The results of a survey distributed to attorneys, prosecutors and judges throughout the United States bear this out in a startling manner.

Keywords: attorneys, lawyers, computer forensics, digital forensics, CLE

1. INTRODUCTION

In 2002, Scott C. Williams, a supervisory special agent for the FBI's computer analysis and response team in Kansas City was quoted by writer David Hayes in the Kansas City Star newspaper, saying that over fifty percent of crimes investigated involved a computer. From January 1 through December 31, 2009, the FBI Internet Crime Complaint Center data reflected 336,655 complaint submissions, which represented a 22.3 percent increase in computer related crimes over 2008 (http://crimeinamerica.net/2010/03/16/computer-crime-reports-increase-22-percent-in-2009.html, March 16, 2010). These are just the crimes reported to the FBI. How many crimes involving computers are never actually reported or are investigated by local agencies?

Once law enforcement has investigated these crimes, prosecutors, defense attorneys and judges take over. The final outcome, be it an acquittal, plea bargain, or guilty verdict, is dependent on the quality of the evidence and the ability of the prosecutor or the defense attorney to convey the story in the most understandable manner to the judge and jury. The public depends on the prosecutor to represent the good of the people in an honest manner and to understand the evidence. A client depends on his or her attorney to be knowledgeable about the evidence in order to provide an adequate defense. This paper demonstrates the gap which exists between expectation and reality.

1.1 Background

“Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.” Frye v. United States, (1923).

Associate Judge Van Orsdel wrote this in his opinion denying the appeal of a man convicted of murder. James Alphonso Frye was convicted of second degree murder and appealed his conviction based on the trial court ruling that his expert witness, who conducted a polygraph test on Mr. Frye, could not testify on his behalf. Frye v. United States (1923) became the standard in jurisdictions across the United States with regard to scientific evidence. As such, the validity of methodologies and techniques used in gathering and processing evidence has gone through rigorous scrutiny to gain acceptance in the judicial system.

In 1975, the Federal Rules of Evidence went into effect. Up to this point Frye v. United States (1923) remained the yardstick and was widely accepted and followed by the courts. That the legislative history of the Federal Rules never addressed Frye v. United States (1923) or the issue of admittance of scientific evidence or use of expert witnesses, kept the 1923 opinion at the forefront in the making of judicial decisions. This finally changed in 1993 when the U.S. Supreme Court decided the first of the Daubert

Trilogy. In Daubert v. Merrell Dow Pharmaceuticals, Inc. (1993), 589, the Court ruled that scientific expert testimony should be admitted based on the following:

> **Judge is gatekeeper:** ". . . under the Rules the trial judge must ensure that any and all scientific testimony or evidence admitted is not only relevant, but reliable." (Daubert 589)
>
> **Relevance and reliability:** The trial judge must ensure that the expert's testimony is "relevant to the task at hand" and rests "on a reliable foundation". (Daubert 584-587)
>
> **Scientific knowledge:** "The Rule's requirement that the testimony "assist the trier of fact to understand the evidence or to determine a fact in issue" goes primarily to relevance by demanding a valid scientific connection to the pertinent inquiry as a precondition to admissibility (Daubert, 1993).
>
> **Factors relevant:** The Court defined "scientific methodology" as the process of formulating hypotheses and then conducting experiments to prove or falsify the hypothesis, and provided a nondispositive, nonexclusive, "flexible" test for establishing its "validity" (Daubert, 1993):
>
> 1. Ordinarily, a key question to be answered in determining whether a theory or technique is scientific knowledge that will assist the trier of fact will be whether it can be (and has been) tested.
> 2. Another pertinent consideration is whether the theory or technique has been subjected to peer review and publication.
> 3. Additionally, in the case of a particular scientific technique, the court ordinarily should consider the known or potential rate of error.
> 4. Finally, "general acceptance" can yet have a bearing on the inquiry.

1.2 No Algorithms Allowed

How does the legal community deal with the requirements set out by the Supreme Court? Not very well, as seen by the results of our survey, research and the results of case law. And how does all of this relate to a survey of attorneys regarding their knowledge of digital forensics? There exists a general lack of foundation with regard to digital forensics (computer forensics). Many in law do not recognize digital forensics as a "forensic science," and others just glaze over at the thought of having to learn anything about the topic. Countless attorneys and law students will admit they chose law school over other graduate programs to avoid math or science courses. In fact, statistics show that the arts and humanities and business administration comprise the vast majority of law school feeder degrees. Law schools have perpetuated this trend by not emphasizing the application of science and math to legal concepts; this, despite the growing necessity to provide education in all of the forensic sciences.

The widespread belief among attorneys is that the expert witness will take care of the issue. However, the attorneys, prosecutors and judges must know the correct questions to ask the expert in order to determine the validity, pertinence, and admissibility of the evidence.

1.3 What Would Perry Mason Say?

One of the problems confronted in the courtroom is the CSI effect. Television and movies dramatize the collection of forensic evidence, including digital evidence. The evidence is always clear and convincing, and the case is solved in sixty minutes with no worries about warrants or research time. This is one of the preconceptions which jurors bring with them. Unfortunately, what is shown on CSI or NCIS is not representative of sound evidence collection techniques, nor in some cases do the televised techniques even exist.

Jessica D. Gabel, in her Summer 2010 article, "Forensiphilia: Is Public Fascination with Forensic Science a Love Affair or Fatal Attraction?" posed the question which plagues many in the legal and scientific

community nowadays. Gabel posits that the CSI effect has caused a bias in juries which affects verdicts. In cases in which no forensic evidence is produced, jurors may have a tendency to decide in favor of the defense; however, when forensic evidence is presented by the prosecution, then jurors may make the connection to CSI, and assume that if it is good science on television, then it is good science in the courtroom. Gabel feels there is a larger issue: "bad science is slipping through the cracks, creating a glut of bad decisions and wrongful convictions." (Gabel, 2010, p.5)

2. THE SURVEY

The purpose of this study is to measure the understanding of practicing attorneys in the United States with respect to the field of digital forensics (aka computer forensics) and the application of digital evidence in the courtroom environment. In order to accomplish this, a four-step process was used to collect and evaluate data. This methodology consisted of:

1. Defining a problem for evaluation,
2. Collecting data to evaluate the problem,
3. Summarizing data collected in a suitable manner for analysis, and
4. Data analysis, interpretation of results, and communication of those results.
   (Longnecker and Ott, 2010, p. xi)

2.1 Defining a Problem for Evaluation

The Texas Disciplinary Rules of Conduct (http://www.texasbar.com/AM/Template.cfm?Section=Grievance_Info_and_Ethics_Helpline&Template=/CM/ContentDisplay.cfm&ContentFileID=96) for attorneys states that, "in all professional functions, a lawyer should zealously pursue clients' interests within the bounds of the law. In doing so, a lawyer should be competent, prompt and diligent." According to the American Legal Ethics Library at Cornell University Law School, "Competent" or "Competence" denotes possession or the ability to timely acquire the legal knowledge, skill, and training reasonably necessary for the representation of the client. Professional rules of conduct in all states require a similar application of professional skill, knowledge, and conduct. Based upon application of the Texas Disciplinary Rules of Conduct the problem for evaluation in this study is:

- Do attorneys have sufficient knowledge and training with respect to digital forensics to reasonably and competently represent their clients?

2.2 Case Law as an Index of Knowledge

Defining what is sufficient knowledge and training with respect to digital forensics so that an attorney has the tools necessary to adequately represent their client is, of course, subjective. Criminal defense work typically requires a strategic use of resources to achieve a verdict which in the minds of the jurors is "beyond a reasonable doubt," while civil litigation is directed to verdicts based on the "preponderance of evidence." The stakes are different, available resources are markedly dissimilar, and the weight of digital forensics evidence is often insurmountable for the criminal defense attorney. In many instances, such as sex crime cases, the perception of guilt is so great that the most valued attribute of the attorney is their ability to plea bargain a sentence that will eventually result in the release of their client from prison before the end of their natural life. This, of course, calls for a different skill set and does not result in appealable convictions.

Competence is a touchy area with practicing attorneys, and it requires conclusions that are judgmental rather than analytical. The kiss of death for trial counsel is to be judged to provide ineffective assistance of counsel. *Black's Law Dictionary* defines this as "a representation in which the defendant is deprived of a fair trial because the lawyer handles the case unreasonably, usually either by performing incompetently or by not devoting full effort to the defendant . . ." *Black's* relates ineffective counsel to a defendant being deprived of his Sixth Amendment right to a fair trial.

This argument implies that a defendant in a criminal case could have their Sixth Amendment rights contravened if their attorney does not have sufficient knowledge and training with respect to digital forensics to reasonably and competently represent their client. A baseline for measuring this was obtained by reviewing Westlaw citations for Federal and state cases appealed during the last ten years using the search term "computer forensics" in conjunction with "ineffective assistance of counsel." This combination appears in thirteen Federal cases, and twenty-one state cases since 2001. Review of these cases revealed that seventeen of the state cases involved issues related to the identification and retrieval of evidence from digital devices, and that such evidence was used at trial.

Westlaw Search Term	**Cites in Federal and State Courts**	**Additional Search Term "computer forensics"**
"inadequate defense"	139	No citations
"ineffective assistance of counsel"	> 10,000	34
"ineffective counsel"	3,721	No citations

In each state case one or more assignments of error were raised on appeal by appellants, which involved computer forensics evidence and alleged ineffective preparation of legal counsel with respect to such evidence. In order to determine the substance of these allegations and to identify common weaknesses in the presentation of computer forensics evidence and testimony in court, the seventeen state cases were examined in detail. While all of these cases were selected from the ten-year period (2001-2010), in actuality they were heavily-weighted to the period 2008 to 2010 which represented 76.5% of the cases reviewed. This was consistent with: (1) evolving digital technology; (2) increased spending on computer investigative services in conjunction with increased funding for Homeland Security programs; (3) the evolution of joint federal/state and federal/international child pornography and human trafficking task forces that effectively identified and provided evidence and assistance for the indictment of individual child pornographers; and (4) the evolution of a digital information-based culture in much of the world. More importantly, appeals court activity during this later time period was indicative of an evolving legal culture in the United States that was being forced to leave traditional measures of evidence in the realm of the observable and tangible, and cope with rapidly evolving digital evidence that was understandable only after technically-skilled experts massaged the storage devices and tapped a virtual jackpot of evidence. This, in many respects, changed the traditional role of defense attorneys as advocates for their clients, and created a deer-in-the-headlights effect for many practitioners as it became increasingly difficult to refute a new source of forensic evidence.

3. COLLECTING DATA TO EVALUATE THE PROBLEM

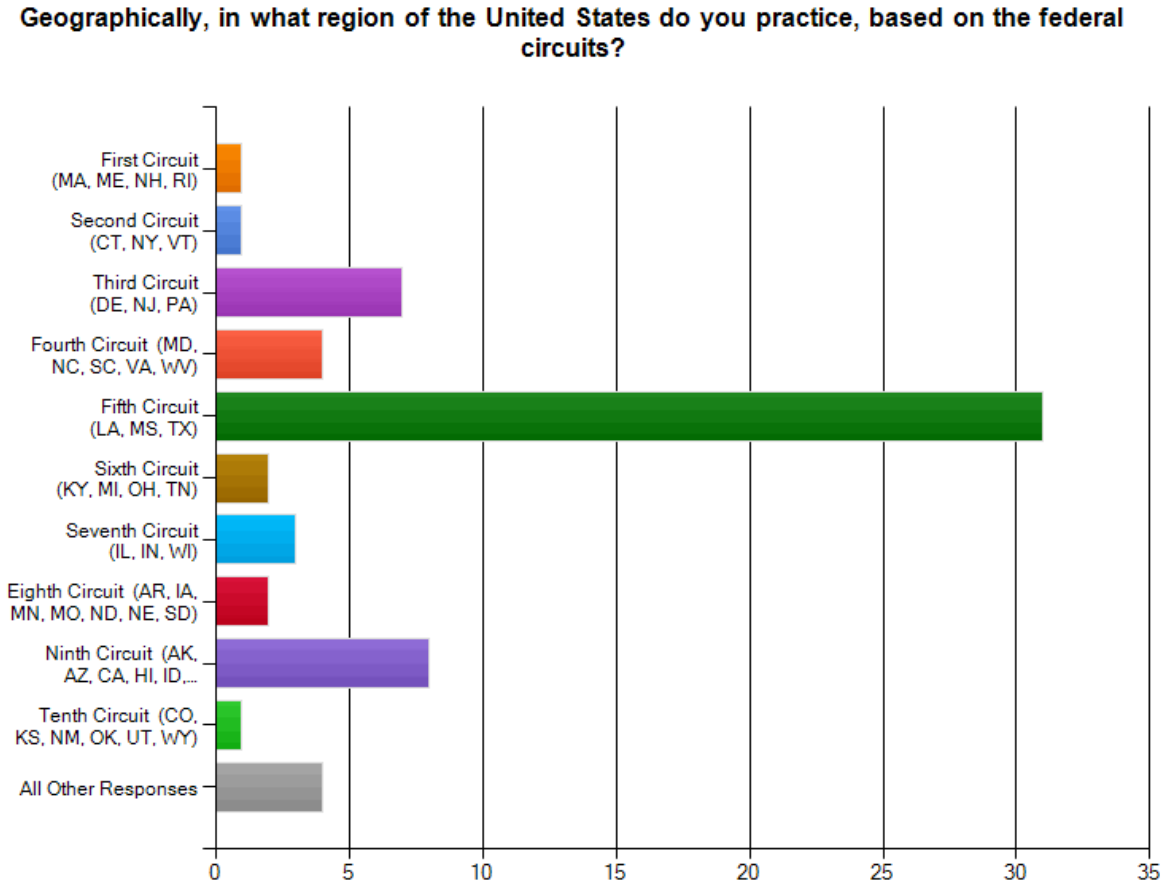
In order to properly evaluate our problem beyond subjective case law analysis, a survey was developed consisting of thirty-nine questions designed to provide answers about respondents' professional background, technical knowledge, and use of digital forensics evidence in the courtroom. This survey was only made available to attorneys licensed in the United States. Specific questions solicited information about participant attitudes, knowledge and experience with digital forensics, legal education, practice specializations, geographic practice regions by Federal Circuit, the ability of participants to identify knowledgeable digital forensic experts, and willingness of participants to take CLE courses in digital forensics. The survey was designed using the resources of a subscription service, SurveyMonkey.com and was available to participants by clicking a URL address provided to participants on the Internet.

3.1 Survey Participants

Survey participants were originally selected on a judgment basis based upon email listings obtained from professional journals, web site listings, telephone directory advertisements, court documents, and prior business dealings with the law firms. This circularization was done in August and September 2010, and consisted of approximately 1,100 direct email and fax survey solicitation requests directed to attorneys in all eleven Federal Circuits. Emails and faxes were personalized in order to avoid identification of survey participation requests as spam. The response rate from participants using these survey solicitation methods was poor. Due to the poor response rate, solicitation of responses was then encouraged by listings on business oriented, legal profession networking websites on the Internet (LinkedIn), consisting of law school alumni, legal practice areas (for example family law, corporate law, prosecutors, and criminal law), and special-interest areas directed toward attorneys. The identity of the respondents was anonymous to ensure candid answers.

The estimated number of attorneys per each of the fifteen LinkedIn groups selected was determined by reviewing membership listings by profession and determining the number of attorneys from sample pages selected on a judgment basis. The potential population was estimated to be in excess of 15,600. Using these circularization methods seventy-nine responses were received by November 11, 2010. Of these responses, sixty-six participants completed all thirty-nine questions.

Responses were received from each of the Federal Circuits; however, survey results were geographically biased based upon participant responses which were heavily weighted to the Fifth Circuit (Louisiana, Texas and Mississippi). This was attributable to many of the respondents being attorneys on legal list servers in the Greater Houston area, and a significant number of attorneys responding who were alumni of South Texas College of Law.



3.2 Summarizing Data Collected for Analysis

In order to determine the weight of responses provided by participants, and therefore to determine the significance of survey answers to our problem, survey questions were divided into eleven distinct categories (Table 2 – Response Rank Based on Category). Category weight was then determined by the ratio of questions by category to the number of total questions. Using the average number of responses per question, a response rank per category of (1 = most responses per question, to 11 = least responses per question) was assigned to each category for the purpose of determining the completeness of answers. The average number of responses for all questions was 53.67.

Question Category and Question Numbers	Number of Questions in Category	Category Weight	Total Responses for all Questions in Category	Response Rank Based on Responses	Average Number of Responses Per Question
Education (1 thru 3)	3	7.69%	89	11	29.7
Continuing Education (4 thru 7)	4	10.26%	197	7	49.3

Courtroom Experience (8 thru 12)	5	12.82%	268	6	53.6
Discovery (13 thru 17)	5	12.82%	294	5	58.8
Expert Testimony (18 thru 21)	4	10.26%	171	10	42.8
Admissibility of Evidence (22 thru 23)	2	5.13%	96	8	48.0
Expert Credentials (24 thru 25)	2	5.13%	89	9	44.5
Attorney Subject Knowledge (26 thru 30)	5	12.82%	325	2	65.0
Professional Specialization (31 thru 34)	4	10.26%	236	4	59.0
Geographic Location (35 thru 36)	2	5.13%	130	3	65.0
Experience (37 thru 39)	3	7.68%	198	1	66.0

Table 2: Response Rank Based on Category

In order to identify questions that reflected a response rate representative of a significant statistical variance from the expected mean, the standard deviation of the population of 39 questions was calculated. The standard deviation was determined to be 18.33, thereby providing the expectation that approximately 68% of all responses in a normal distribution would be between 35.34 and 72.00. From this ten questions were identified as having response rates which were more than one standard deviation from the population mean of 53.67. Answers to these questions were isolated and further analyzed in order to determine if responses were possibly invalid based upon survey design or population bias, or if answers were reflective of an evolving trend or different knowledge base. Review of answers to these ten questions indicated that responses were consistent with expectations, the purpose of the survey, and the definition of the problem being reviewed.

Question #	Question	Responses	Reason for Variance
1.	Did you have any courses in law school which dealt in whole or part with digital forensics (computer forensics, cell phone forensics, e-discovery, etc.)?	79	Initial question in survey. All respondents answered.
2.	If the answer to question 1 was yes, were these topics: (a) In courses dedicated to the topic (i.e. "Digital Forensics and the Law), (b) Topics within another course (i.e. Evidence), (c) Both	5	Five respondents answered this question. Only 6.33% of the attorneys answering this survey had any courses in law school that addressed digital forensics issues. This was explained by Question 39 – "How long ago did you graduate from law school?" Of sixty-six respondents only nine (13.6%)

			indicated that they had graduated within the last five years. This was consistent with the case law analysis earlier in this paper which indicated that 47.1% of the cases reviewed "reflected a clear misunderstanding of, or serious lack of knowledge with respect to the acquisition of computer forensics evidence and testimony provided to explain that evidence."
3.	If your answer to question 1 was yes, did you feel the attention to the topic of digital forensics was adequate?	5	Of the five responses, only one respondent felt that the topic was adequately addressed. This represents only 1.27% of the survey responses.
4.	Have you taken any CLE courses on the topic of digital forensics (including e-discovery)?	78	Responses on this question were almost evenly split with forty respondents (51.3%) saying that they had taken CLE courses on digital forensics, and thirty-eight (48.7%) saying they hadn't. This response was consistent with the interpretation of the case law analysis.
14.	If the answer to question 13 was yes, how knowledgeable do you feel the attorneys were with regard to their client's e-discovery issues?	20	Only twenty respondents of sixty-nine answering question 13 had participated in a Rule 26(f) conference regarding e-discovery. This represented 28.99% of the attorneys responding to this question. Of this number only 10.00% were considered to be very knowledgeable. This represented 2.90% of all attorneys responding to question 13.
19.	If you have engaged a digital forensics expert, what services did they perform? (may choose more than one answer)	34	Thirty-four of sixty-nine respondents answered this question (49.28%). This represented a significant level of reliance on expert witnesses in this area. This response did not correspond to the analysis of cases where only three defense computer forensics expert witnesses were used in seventeen cases (17.6%), however, it closely correlated with the responses to Question 31 where 21.6% of respondents indicated that they were a judge, prosecutor, or defense attorney.
20.	If you have participated in litigation in which a digital forensics expert was used, do you feel they were effective?	34	Twenty-five of the thirty-nine respondents (73.5%) felt that a digital forensics expert was effective in litigation.

21.	If you have participated in litigation in which a digital forensics expert was used, was the information they provided understandable to the attorneys, the judge and the jury, if applicable?	34	Twenty-five of the thirty-four respondents (73.5%) felt that the information provided was "not at all understandable," or was "somewhat understandable." Only nine of the sixty-nine respondents completing this part of the survey (13.04%) felt that digital forensics information provided at trial was "very understandable."
23.	If you have participated in litigation in which a digital forensics expert was used, did the information provided by the expert play a role in the outcome of the case?	33	Of thirty-three respondents, thirteen (39.4%) felt that a digital forensics expert played a large role in the outcome of a case. Evaluated in conjunction with responses to Question 21 above it appears that responding attorneys felt that it was not necessary to understand digital forensics information presented at trial in order for it be highly effective in the outcome of a case. When this response is evaluated in light of the conclusions drawn from the case law analysis earlier in this paper it becomes apparent that on occasion computer forensics evidence is obfuscated at trial in an attempt to achieve a desired verdict. This conclusion is particularly disturbing because traditional gatekeepers in the form of professional training and education appear to be lacking.
24.	If you have engaged a digital forensics expert, what was their background? (may choose more than one)	31	Eleven professional groups were represented as possible answers for this question. No profession got more than 20% of total responses (CCE – Certified Computer Examiner), and all professions represented got at least one response. Consistent with the Obstacles to the Engagement of Computer Forensics Experts section of this paper, private investigators received the fifth highest response rate.

3.3 Review of Questions by Category Weight

Questions 37 through 39 (EXPERIENCE) reflected the greatest category weight with 69.7% of respondents having been in the legal profession more than ten years. Over half of all respondents (51.6%) had been in the profession fifteen or more years which corresponded with more traditional law school educations (Question 37). Career mobility was also evident with almost half (48.5%) of those answering this question having been in their present position for less than five years (Question 38). Graduation from law school was also consistent with the number of years that respondents had been practicing law, with 54.5% of those answering the question indicating that they had graduated from law school fifteen or more years ago.

Taken as a whole, answers to the EXPERIENCE category were reflective of a mature, upwardly mobile sample of attorneys who were advancing in their careers, but had been, in all likelihood based upon their age, educated in a traditional law school environment.

37. How long have you been in the legal profession?

	Response Percent	Response Count
1 to 5 years	15.2%	10
5 to 10 years	15.2%	10
10 to 15 years	18.2%	12
15 to 25 years	**25.8%**	**17**
More than 25 years	**25.8%**	**17**
	answered question	**66**
	skipped question	**13**

38. How long have you been in your current position?

	Response Percent	Response Count
1 to 5 years	**48.5%**	**32**
5 to 10 years	24.2%	16
10 to 15 years	12.1%	8
15 to 25 years	9.1%	6
More than 25 years	6.1%	4
	answered question	**66**
	skipped question	**13**

39. How long ago did you graduate from law school?		
	Response Percent	Response Count
1 to 5 years ago	13.6%	9
5 to 10 years ago	12.1%	8
10 to 15 years ago	19.7%	13
15 to 25 years ago	27.3%	18
More than 25 years ago	27.3%	18
	answered question	66
	skipped question	13

Questions 26 through 30 (ATTORNEY SUBJECT KNOWLEDGE) reflected the second-highest category weight with almost half of all attorneys answering this question (49.3%) indicating that they stay current with court decisions concerning digital forensics, digital evidence, and digital communications (Question 26).

26. Do you keep abreast of court decisions concerning digital forensics, digital evidence, and digital communications?		
	Response Percent	Response Count
Yes	49.3%	33
No	50.7%	34
	answered question	67
	skipped question	12

Question 27 was more indicative, however, of the actual level of technical knowledge that attorneys responding had with respect to proper procedures in the collection and handling of digital evidence. 47.0% indicated that they were knowledgeable, but none of the additional responses left by six of the sixty-six were representative of a great degree of individual knowledge or confidence.

27. Are you aware of proper procedures in collecting and handling digital evidence?

	Response Percent	Response Count
Yes	47.0%	31
No	53.0%	35
Show replies Comment		6
answered question		66
skipped question		13

Responses to Question 27 –

1. "Somewhat, at least aware of how to research case law and seminar materials to find the procedures if the issue may be relevant in a case."
2. "Somewhat."
3. "I would have checked "somewhat" if that had been an option."
4. "I'm not at all oblivious to the problem posed, but I don't claim to know what the proper procedures are."
5. "Not sure what is meant by "proper procedures." We have internal procedures to retain and collect digital information."
6. "I am not aware of all of the specifics, but I have access to individuals and experts for consultation, if necessary."

Question 28, which was answered by fifty-seven people, provided a measure of where attorneys surveyed are getting information about digital forensics. Personal responses were varied and indicative of a small group of the attorneys having nontraditional career backgrounds and educations before they entered law school. This was as compared to traditional undergraduate educations in liberal arts, business, and political science, which have been the normal foundation. (It should be noted that on some questions that respondents could select more than one answer. Due to this the Response Percent totals to more than 100%.)

28. In the past, what has been the source of your knowledge about digital forensics (may choose more than one)?

	Response Percent	Response Count
Law school courses	5.3%	3
CLE	**66.7%**	**38**
Technical and professional literature	57.9%	33
CSI Miami (and other television programs)	12.3%	7
Show replies Other (please specify)		10
answered question		**57**
skipped question		**22**

Responses to Question 28 –

1. "My home was one of the very first adopters of personal computers. My mother was a computer analyst. My undergraduate major was in computer science."
2. "Aaron Hughes."
3. "I ask my tech guy when I have a question."
4. "Interest in computers."
5. "The problem is that what I've seen or read or heard has been limited, so far."
6. "Personal, professional experience as a digital forensic examiner. Daily contact with digital forensic examiners."
7. "I am an Electrical Engineer and Computer Engineer who spent 12 years as a R&D engineer for a major computer company before attending law school."
8. "On the job."
9. "CSI is not a source of knowledge."
10. "Discussions with IT professional."

Questions 29 and 30 address the receptiveness and interest of practicing attorneys in taking CLE courses focused on digital forensics and digital evidence. Participants were very receptive to this subject area with 82.3% of all respondents either being "Somewhat likely" or "Very likely" to attend a CLE course on these objects. The favored delivery method was seminars or classes.

29. How likely would you be to attend CLE courses focusing on digital forensics and/or digital evidence?

	Response Percent	Response Count
Very likely	36.8%	25
Somewhat likely	**45.6%**	**31**
Doesn't interest me	17.6%	12
	answered question	**68**
	skipped question	**11**

30. If you were to pursue CLE in digital forensics and/or digital evidence, which format would you prefer (may choose more than one)?

	Response Percent	Response Count
Seminars or classes you attend	**70.1%**	**47**
Online courses	38.8%	26
Webinars	31.3%	21
Self study	28.4%	19
	answered question	**67**
	skipped question	**12**

Questions 35 and 36 (GEOGRAPHIC LOCATION) represented the third highest category weight. As explained in the Survey Participants section of this paper, participant sample selection was biased based upon the large number of participants (48.4%) practicing law in the Fifth U.S. Circuit (Texas, Louisiana, and Mississippi). Sample participants, however, were largely homogeneous with 75.8% of all responses being from attorneys that practice in urban regions of 500,000 or more people. This implies that the majority of practices might be more similar than dissimilar.

35. Geographically, in what region of the United States do you practice, based on the federal circuits?

	Response Percent	Response Count
First Circuit (MA, ME, NH, RI)	1.6%	1
Second Circuit (CT, NY, VT)	1.6%	1
Third Circuit (DE, NJ, PA)	10.9%	7
Fourth Circuit (MD, NC, SC, VA, WV)	6.3%	4
Fifth Circuit (LA, MS, TX)	**48.4%**	**31**
Sixth Circuit (KY, MI, OH, TN)	3.1%	2
Seventh Circuit (IL, IN, WI)	4.7%	3
Eighth Circuit (AR, IA, MN, MO, ND, NE, SD)	3.1%	2
Ninth Circuit (AK, AZ, CA, HI, ID, MT, NV, OR, WA)	12.5%	8
Tenth Circuit (CO, KS, NM, OK, UT, WY)	1.6%	1
Eleventh Circuit (AL, GA, FL)	4.7%	3
D.C. Circuit	1.6%	1
	answered question	64
	skipped question	15

36. What is the population of the community you primarily practice law in?

	Response Percent	Response Count
Under 15,000	3.0%	2
15,000 to 30,000	3.0%	2
30,00 to 75,000	1.5%	1
75,000 to 150,000	6.1%	4
150,000 to 500,000	10.6%	7
Over 500,000	**75.8%**	**50**
	answered question	66
	skipped question	13

PROFESSIONAL SPECIALIZATION (Questions 31 through 34) was the fourth highest ranked category based on the number of responses. Judges, prosecutors and defense attorneys were in the minority constituting 21.7% of total responses.

31. What is your profession?

	Response Percent	Response Count
Judge	3.3%	2
Prosecutor	8.3%	5
Civil attorney	**78.3%**	**47**
Defense attorney	10.0%	6
Show replies Other (please specify)		15
answered question		60
skipped question		19

33. Is your practice mostly

	Response Percent	Response Count
State law cases	**59.1%**	**39**
Federal law cases	7.6%	5
A combination of state and federal	33.3%	22
answered question		66
skipped question		13

34. If you are in private practice, how many attorneys are in the practice?

	Response Percent	Response Count
Solo	**50.0%**	**27**
2 to 5	27.8%	15
5 to 15	5.6%	3
More than 15	16.7%	9
answered question		54
skipped question		25

All practice specializations (Question 32) except "Civil-Immigration" had two or more responses. The most significant practice areas were "Civil-General litigation" with 19.0% of total responses, "Civil-Family law" with 14.0%, and "Civil-Corporate" with 14.0%. All criminal categories represented 22.3% of all responses, with criminal categories that are most indicative of using digital forensics evidence (fraud and

financial crimes, family law and crimes against children, sex crimes, violent crimes, and identity theft), representing 14.0% of all responses to this question. Reponses to survey Questions 33 and 34 indicated that attorneys in practice, in most instances, were solo practitioners or were in practice units that consisted of less than five attorneys (77.8%). This was further reflective of respondents having to wear "multiple hats," being driven to "case-driven pragmatic" solutions, and eschewing "elegant solutions" that would be prevalent in an academic-driven or theoretical environment. This is a sign of a profession being driven from "billable hours" to "fixed-fee-contracts," and the difficulty of collecting professional fees, and in some instances the fees of expert witnesses, from clients that do not receive a favorable outcome at trial.

32. Do you have a specialization(may choose more than one)?

	Response Percent	Response Count
Criminal (Prosecutors and Defense Attorneys) – DUI, vehicular crimes, misdemeanors	8.9%	5
Criminal (Prosecutors and Defense Attorneys) – Fraud and financial crimes	8.9%	5
Criminal (Prosecutors and Defense Attorneys) – Family Law crimes and crimes against children	7.1%	4
Criminal (Prosecutors and Defense Attorneys) - Sex crimes	3.6%	2
Criminal (Prosecutors and Defense Attorneys) - Violent crimes	5.4%	3
Criminal (Prosecutors and Defense Attorneys) - Theft	8.9%	5
Criminal (Prosecutors and Defense Attorneys) – Identity theft	5.4%	3
Civil – Family law	30.4%	17
Civil – General litigation	41.1%	23
Civil – Intellectual property	7.1%	4
Civil – Bankruptcy	5.4%	3
Civil – Corporate	30.4%	17
Civil – Personal injury	17.9%	10
Civil – ERISA	3.6%	2
Civil – Labor law	5.4%	3
Civil – Oil and Gas	7.1%	4
Civil – Immigration	0.0%	0
Civil – Tax and estate law	8.9%	5
Civil – Real estate law	10.7%	6
Show replies Other (please specify)		9
answered question		56
skipped question		23

DISCOVERY (Questions 13 through 17) is central to all litigation, but questions in this category were weighted in fifth place. This relatively low ranking in relationship to the importance of this area reflects that responding attorneys did not have very much experience with e-discovery (Questions 13 and 14), did not routinely use preservation letters detailing digital evidence to be retained (Question 16), and received preservation letters infrequently (Question 17). The ability of responding attorneys to correctly identify sources of digital evidence (Question 15) was very good on an overall basis, but based on the earlier analysis of the answers to the ATTORNEY SUBJECT KNOWLEDGE questions establishment of a "link" between knowing where digital evidence can be found, and requesting that information in discovery is not very strong. In short, as reflected in the EXPERIENCE category questions attorneys responding to this survey were primarily trained in a classical law school environment that did not place emphasis on forensic sciences.

Responses in this question area reinforced observations from the Conclusions from Case Law section of this paper – "that trial tactics used by the defense, statements made by the state, or rulings of the trial court or the appeals court reflected a clear misunderstanding of, or serious lack of knowledge with respect to the acquisition of computer forensics evidence and testimony provided to explain that evidence."

13. Have you participated in a Rule 26(f) conference regarding e-discovery?

	Response Percent	Response Count
Yes	29.0%	20
No	**71.0%**	**49**
	answered question	**69**
	skipped question	**10**

14. If the answer to question 13 was yes, how knowledgeable do you feel the attorneys were with regard to their client's e-discovery issues?

	Response Percent	Response Count
Not very knowledgeable	20.0%	4
Somewhat knowledgeable	**70.0%**	**14**
Very knowledgeable	10.0%	2
	answered question	**20**
	skipped question	**59**

15. What do you consider to be digital evidence (may choose more than one answer)?

	Response Percent	Response Count
Computers	**97.1%**	**68**
Cell phones	88.6%	62
PDAs	88.6%	62
Smart phones	84.3%	59
Hard drives	94.3%	66
USB/flash drives	92.9%	65
Floppy disks	90.0%	63
Gaming machines (e.g. X-Box, Nintendo)	41.4%	29
Slot machines	28.6%	20
GPS devices (e.g. Garmin, TomTom)	68.6%	48
Bluetooth devices	58.6%	41
Automobile black boxes	74.3%	52
DVRs	58.6%	41
Tape drives and magnetic media	87.1%	61
Digital copy machines	72.9%	51
	answered question	**70**
	skipped question	**9**

16. During the course of litigation do you send the opposing counsel preservation letters detailing digital evidence to be retained?

	Response Percent	Response Count
Yes	47.8%	32
No	52.2%	35
answered question		67
skipped question		12

17. During the course of litigation have you received a preservation letter detailing digital evidence to be retained?

	Response Percent	Response Count
Yes	41.2%	28
No	58.8%	40
answered question		68
skipped question		11

Questions 8 through 12 addressed the COURTROOM EXPERIENCE of attorneys. Questions in this category were weighted in the sixth position according to response rate. Forty-seven of the seventy respondents (67.1%) who answered Question 8 – ("Have you participated in a case in which digital forensics played a part?") responded in the affirmative. Based upon responses to other sections of the survey this appears to be an unexpectedly high percentage, and taken in combination with responses in the EXPERIENCE, ATTORNEY SUBJECT KNOWLEDGE, and DISCOVERY question sections the matter has to be more carefully reviewed because the "courtroom skill level" of individual practitioners may be overstated based on self-assessment versus trial outcomes. Since this was a blind survey there is no way to reconcile individual responses with cases, verdicts, resources used, and jurisdictional prejudices. The conclusions from Case Law section of this paper also suggest that an overstatement of trial skills may be possible.

8. Have you participated in a case in which digital forensics played a part?

	Response Percent	Response Count
Yes	67.1%	47
No	32.9%	23
answered question		70
skipped question		9

9. If the answer to question 7 was yes, in how many cases have you participated in which digital forensics played a part?

	Response Percent	Response Count
Less than 5	62.5%	30
5 to 10	18.8%	9
10 to 15	4.2%	2
More than 15	14.6%	7
answered question		48
skipped question		31

Questions 10 through 12 were particularly revealing because they provided an assessment of how responding attorneys felt about the significance of digital evidence, the knowledge base of opposing counsel, and the knowledge of judges hearing the cases. The later assessment was easily the most disturbing answer in the entire survey, with only two of fifty-one respondents (3.9%) answering that they felt the judges were very knowledgeable with regards to digital forensics evidence in their cases.

This response, of course, raises the question of: "If only one in twenty-five judges are rated as being very knowledgeable with regards to digital forensics evidence presented in cases in their courts, how are defendants' rights being protected with respect to the Sixth Amendment?" More importantly, does this support the theory that ineffective assistance of counsel is highly likely in many criminal cases rich in digital evidence, but that no one who could challenge the digital evidence knows enough to do it? That answer is beyond the scope of this paper, but it is a fertile ground for further inquiry.

10. If you have participated in a case in which digital forensics played a part, how significant do you feel digital forensics evidence was?

	Response Percent	Response Count
Not at all significant	10.2%	5
Somewhat significant	38.8%	19
Very significant	**51.0%**	**25**
	answered question	49
	skipped question	30

11. How knowledgeable do you feel the other attorneys were with regard to the digital forensics evidence?

	Response Percent	Response Count
Not at all knowledgeable	44.0%	22
Somewhat knowledgeable	**52.0%**	**26**
Very knowledgeable	4.0%	2
	Show replies Other (please specify)	3
	answered question	50
	skipped question	29

12. How knowledgeable do you feel the judge was with regard to the digital forensics evidence?

	Response Percent	Response Count
Not at all knowledgeable	39.2%	20
Somewhat knowledgeable	**56.9%**	**29**
Very knowledgeable	3.9%	2
	Show replies Comment	3
	answered question	**51**
	skipped question	**28**

CONTINUING EDUCATION (Questions 4 through 7) was in the seventh position based on response rate. Question 4 reflected an almost even split between attorneys who have taken CLE courses that addressed digital forensics (51.3%) and attorneys who haven't (48.7%). To provide the proper context to these questions it is necessary to understand the position of CLE courses and the legal profession. Attorneys in Texas are required, as a condition for maintaining their license to practice law in the state, to take a minimum of fifteen mandatory hours of CLE per year. CLE is not mandatory in all states, and states that require it range from three hours per year (Alaska) to sixteen hours per year (New York) for new attorneys.

Question 4 responses indicate that forty participants who responded to this survey question have taken CLE courses which discussed digital forensics and/or e-discovery. Of this number, twenty-four (30.8%) of the original seventy-eight participants responding to Question 4 considered topics to be adequately covered.

4. Have you taken any CLE courses on the topic of digital forensics (including e-discovery)?

	Response Percent	Response Count
Yes	**51.3%**	**40**
No	48.7%	38
	answered question	**78**
	skipped question	**1**

5. If the answer to question 4 is yes, how was the CLE presented?

	Response Percent	Response Count
Online	30.0%	12
Seminar	**85.0%**	**34**
Webinar	12.5%	5
Self-study	10.0%	4
	answered question	**40**
	skipped question	**39**

Seven replies were left in the comments section for Question 7 by respondents. These responses provide a greater understanding of professional responsibilities and computer forensics knowledge, and provide context to information covered in CLE courses.

6. If you answered yes to question 4, did you feel the topic was covered adequately?

	Response Percent	Response Count
Yes	**58.5%**	**24**
No	41.5%	17
	answered question	**41**
	skipped question	**38**

7. If you answered yes to question 4, what were the topics covered (check all that apply)?

	Response Percent	Response Count
Legal issues only	60.5%	23
Operating systems	36.8%	14
Physical evidence	50.0%	19
Cell phones	31.6%	12
Computers	**71.1%**	**27**
Other (please list)	13.2%	5
	Other (please specify) Show replies	7
	answered question	**38**
	skipped question	**41**

Responses to Question 7 –

1. "e-mail."
2. "More precisely: 'beige boxing'."
3. "While I haven't taken any "courses," I am – of necessity – well schooled in e-discovery legal issues (having managed complex, multi-party, corporate cases involving e-discovery), the vulnerabilities of operating systems, computers generally, wireless security, security vulnerability/evidence value/potential for anonymity of cell phones, cryptography, IP/TCP, etc."
4. "Legal issues also, not legal issues only."
5. "Possible sanctions for non-compliance; importance of litigation holds for electronic documents and information."
6. "Social media and other forms of data that could (and likely is) relevant to a case."
7. "Covered specifics minimally – recommendation is usually to engage an expensive forensic computer expert, which is not cost-effective or available in lower-value cases."

Answers to Questions 22 and 23 (ADMISSIBILITY OF EVIDENCE) are indicative of a lack of overall experience on the part of survey respondents with respect to the application of Daubert (1993) as it applies to computer forensics evidence and expert witness testimony. Only six participants in this survey responded that they had "ever participated in a trial in which digital forensics evidence was challenged based on the Daubert Test." This represents only 7.6% of the participants who started this survey on Question 1, and when considered in conjunction with the COURTROOM EXPERIENCE questions, in particular Question 8, suggests courtroom "dust-ups" with respect to computer forensics evidence have been minimal. This may be because of: (1) the types of cases and subject matter, (2) resources available to trial counsel, (3) application of the principles of Daubert under some other theory of case law, (4) failure to see the Daubert Test as applying to digital evidence, (5) lack of experience, or in the worst case, (6) insufficiency of the judiciary. Dependent upon the, case these factors may collectively testify to ineffective assistance of counsel.

22. Have you ever participated in a trial in which digital forensics evidence was challenged based on the Daubert Test?

	Response Percent	Response Count
Yes	9.5%	6
No	90.5%	57
	Comment Show replies	2
	answered question	63
	skipped question	16

23. If you have participated in litigation in which a digital forensics expert was used, did the information provided by the expert play a role in the outcome of the case?

	Response Percent	Response Count
It played no role whatsoever	24.2%	8
It played a minor role	36.4%	12
It played a large role	39.4%	13
	Comment Show replies	1
	answered question	33
	skipped question	46

Responses to Question 22 –

1. "What is the daubert test?"
2. "Our state courts still apply Frye."

Digital forensics evidence as presented by expert witnesses was seen as very significant, however, and almost forty percent of responses to Question 23 indicated that it played a large role in case outcome.

EXPERT CREDENTIALS (Questions 24 and 25), which was the ninth ranked category, reflected a lack of consensus with respect to the professional qualifications of experts who have provided expert testimony for responding attorneys, and a responding affirmation of who should be providing digital forensics expert testimony in the future.

24. If you have engaged a digital forensics expert, what was their background? (may choose more than one)

	Response Percent	Response Count
CCE (Certified Computer Examiner)	54.8%	17
Law Enforment Officer	32.3%	10
Training provided by federal or state agency	19.4%	6
Private investigator	25.8%	8
CPA (Certified Public Accountant)	12.9%	4
CFE (Certified Fraud Examiner)	12.9%	4
CFF (Certified in Financial Forensics)	3.2%	1
Graduate degree in digital forensics or computer science	32.3%	10
J.D.	19.4%	6
Certification by forensic software manufacturer	48.4%	15
Show replies Other (please specify)		4
answered question		31
skipped question		48

Responses to Question 24 –

1. "For one of the experts I don't recall his specific credential, but it was related to digital forensics/data recovery."
2. "My computer guy, flashed the hard drive, and then examined the results."
3. "Don't know."
4. "IT consultant."

25. If you were to engage a digital forensics expert, what credentials would you find persuasive? (may choose more than one)

	Response Percent	Response Count
Law Enforcement Officer	20.7%	12
Training provided by federal or state agency	46.6%	27
Private investigator license	12.1%	7
CPA (Certified Public Accountant)	15.5%	9
CFE (Certified Fraud Examiner)	44.8%	26
CFF (Certified in Financial Forensics)	46.6%	27
Graduate degree in digital forensics or computer science	**87.9%**	**51**
J.D.	19.0%	11
Certification by forensic software manufacturer	58.6%	34
Other (please specify) Show replies		7
answered question		**58**
skipped question		**21**

Responses to Question 25 –

1. "Not sure certification is that important."
2. "By "training provided by federal or state agency," I limit my answer to the FBI (particularly counterintelligence) and the intelligence community."
3. "I'm a judge. How persuasive any of these credentials would be is unknown to me. Some are likely going to establish enough expertise for the witness to qualify as an expert, but other, e.g., CPA or training provided by a federal or state agency, or certification by forensic software manufacturer, I'd want to know what that's all about."
4. "CFCE."
5. "Not sure."
6. "E-discovery expert as certified by ACEDS or another organization."
7. "Recommendation based on prior performance."

Expert witnesses who have earned graduate degrees in digital forensics or computer science were favored over the other eight professions and were considered persuasive in 25.0% of the total responses. Private investigators were found to be the least persuasive of all professions with only 3.4% of responses indicating that they were persuasive. This was less than one seventh of the preference rate for expert witnesses with graduate degrees in digital forensics or computer science.

The next to last category, EXPERT TESTIMONY (Questions 18 through 21) indicated no reluctance on the part of attorneys to hire digital forensics experts, but did reflect fundamental issues with respect to communications, usefulness of information, understandability of testimony, and comprehension of digital evidence in the courtroom. Particularly strong reactions were registered by a few of the respondents who had apparently had bad experiences with "computer experts" who were felt to have created distressing results during discovery. With respect to using the services of digital forensics experts, attorneys responding were more inclined to use them for "traditional services," such as hard drive imaging and examination (35.3%), rather than expert testimony (11.1%).

18. Have you ever engaged the services of a digital forensics expert?

	Response Percent	Response Count
Yes	49.3%	34
No	50.7%	35
answered question		69
skipped question		10

19. If you have engaged a digital forensics expert, what services did they perform? (may choose more than one answer)

	Response Percent	Response Count
Hard drive imaging	73.5%	25
Hard drive examination	85.3%	29
PDA and cell phone forensics	32.4%	11
Network forensics	44.1%	15
Email forensics	64.7%	22
Expert testimony	50.0%	17
Preparation of written report	50.0%	17
Case review/consulting	44.1%	15
Other (please specify) Show replies	5.9%	2
answered question		34
skipped question		45

20. If you have participated in litigation in which a digital forensics expert was used, do you feel they were effective?

	Response Percent	Response Count
Yes	73.5%	25
No	26.5%	9
	Comment Show replies	3
	answered question	34
	skipped question	45

Responses to Question 20 –

1. "Opposing party hired a "computer expert" who probably fouled up the evidence; subsequently they decided "not" to use the expert."
2. "Poor communications skills."
3. "Helpful in getting our information searched and transmitted properly; not intended for testimony; only used to get information produced."

21. If you have participated in litigation in which a digital forensics expert was used, was the information they provided understandable to the attorneys, the judge and the jury, if applicable?

	Response Percent	Response Count
Not at all understandable	14.7%	5
Somewhat understandable	58.8%	20
Very understandable	26.5%	9
	Comment Show replies	2
	answered question	34
	skipped question	45

Responses to Question 21 –

1. "Never came to that; opposing party's expert rendered such evidence unusable."
2. "The answers above do not cover everything. Yes, some of what they had to say – much of it – was incomprehensible, but some was understandable."

When responses to these questions are analyzed as a whole, there appears to be little reluctance to use digital forensics expert witnesses to isolate, identify, and report on digital evidence; but significant communications issues exist between counsel and experts, which further exposes the gulf between the training and education of attorneys, and the background of commonly accepted expert witnesses in digital forensics.

As explained earlier in this paper the response rate of answers to (Questions 1 thru 3), EDUCATION, represented a significant statistical variance from the expected mean. This was attributable to all survey participants answering Question 1, and only five participants answering Questions 2 and 3.

1. Did you have any courses in law school which dealt in whole or part with digital forensics (computer forensics, cell phone forensics, e-discovery, etc.)?

	Response Percent	Response Count
Yes	5.1%	4
No	94.9%	75
answered question		79
skipped question		0

2. If the answer to question 1 was yes, were these topics:

	Response Percent	Response Count
In courses dedicated to the topic (i.e. "Digital Forensics and the Law)	20.0%	1
Topics within another course (i.e. Evidence)	80.0%	4
Both	0.0%	0
List topics studied Show replies		2
answered question		5
skipped question		74

Responses to Question 2 –

1. "Evidence, Criminal Procedure, Civil Procedure."
2. "How to use AccessData. Imaging using old school technology. Maintaining a chain of custody. Creating reports. Working with all OS."

The final question in this series addressed the adequacy of digital forensics education provided in law school to the five participants that responded. All but one of the attorneys who answered this question considered that education to be inadequate. The one attorney, out of seventy-nine, that initially responded to this survey represented 1.3% of the total. This is an ominous warning when consideration is given to an exploding digital age where Moore's Law predicts a continuation of exponential growth in computer and digital device capabilities.

3. If your answer to question 1 was yes, did you feel the attention to the topic of digital forensics was adequate?

	Response Percent	Response Count
Yes	20.0%	1
No	80.0%	4
	answered question	5
	skipped question	74

4. CONCLUSION

"New technologies create interesting challenges to long established legal concepts." (United States v. Maxwell, 45 M.J., 1996 p. 410).

Law schools have not caught up to the digital age. According to Gabel, the bar must be raised in educating young lawyers (Gabel, 2010). In his blog, "What do you call someone who gets the lowest passing grade on the Bar exam?" (EDD Update, 2010), Craig Ball, a noted Austin, Texas attorney and digital forensics expert, relates a conversation he had with a third-year law student at the University of Texas in Austin following a lecture he gave in an e-discovery class. The student balked at having to learn about digital forensics. Ball reminded the student that the penalty of not knowing, and being accused of gross negligence was severe. In response, the student asked, "What's the least I need to know?" (Ball, 2010)

Taking this as a whole, what is to be done? First and foremost, a system of continuing education, more extensive than is currently obtainable, should be made available to judges, prosecutors and practicing attorneys. Programs such as the Cybercrime Initiative at the National Center for Justice and the Rule of Law at the University of Mississippi School of Law, provide two to four day seminars to judges and prosecutors only, mostly in the area of child pornography. In fact, most programs offered are only for judges and/or prosecutors, the thought being that such knowledge should not be given to the "dark side." This sets a dangerous, and unethical, precedent as it steps on the Sixth Amendment rights of a defendant.

Law schools must step up to the plate and take responsibility. Course curriculums must be increased to include more than e-discovery. Digital forensics procedures and analysis should be taught as a part of evidence courses. As an example, currently the University of Memphis uses a multi-discipline method, combining the resources of the law school, the business school, and the colleges of engineering, criminal justice and computer science to form the Center for Information Assurance, which also spearheads the efforts of The U of M as a Center of Excellence in Information Assurance Education. Perhaps this should be used as a model for other universities which have law schools or affiliations with law schools.

REFERENCES

Ball, C., (2010), 'What do you call someone who gets the lowest passing grade on the Bar exam?" *EDD Update [online]* http://www.eddupdate.com/2010/02/what-do-you- call-someone- who-gets-the-lowest-passing-grade-on-the-bar-exam.html, October 20, 2010.

Daubert v. Merrill Dow Pharmaceuticals, Inc., 509 U.S. 579 (1993).

Frye v. United States, 293 F. 1013 (DC Cir. 1923).

General Electric Co. v. Joiner, 522 U.S. 136 (1997).

Gabel, J. D. (2010), "Forensiphilia: Is Public Fascination with Forensic Science a Love Affair or Fatal Attraction?" New England Journal on Criminal and Civil Confinement, Summer: 233.

Greenbaum, M. (2010), "No more room at the bench," Los Angeles Times, http://articles.latimes.com/2010/jan/08/opinion/la-oe-greenbaum8-2010jan08, January 8, 2010.

Hayes, D. (2002), " KC to join high-tech fight against high-tech crimes: FBI to open $2 million center here," Kansas City Star, page A1, April 26, 2002.

Johns, A. (2009), " Computer Science and the Reference Manual for Scientific Evidence: Defining the Judge's Role as a Firewall," Intellectual Property Law Bulletin, 14: 23.

Kumho Tire Co. v. Carmichael, 526 U.S. 137 (1999).

Longnecker, M., & Ott, R. L. (2010), An Introduction to Statistical Methods and Data Analysis (6^{th}ed.), Brooks/Cole, Belmont, CA