Using Multimedia Presentations to Enhance the Judiciary's Technical Understanding of Digital Forensic Concepts: An Indonesian Case Study

Niken Dwi Wahyu Cahyani
Inf. Assurance Research Group
University of South Australia
cahnd001@mymail.unisa.edu.au

Ben Martini
Inf. Assurance Research Group
University of South Australia
ben.martini@unisa.edu.au

Kim-Kwang Raymond Choo
Inf. Assurance Research Group
University of South Australia
raymond.choo@unisa.edu.au

Abstract

Members of the judiciary and law enforcement agencies need to understand digital forensics in order to determine the admissibility of, and to effectively present, digital evidence in a court. In this paper, we examine the use of multimedia presentations to improve participants' understanding of particular terms and concepts that commonly arise in digital forensic investigations. A questionnaire-based survey was conducted using a convenient sample of judges, investigators, prosecutors and staff from three provinces in Indonesia. We compared the participants' understanding of three technical terms: mobile forensics, time zones, and hashing; before and after watching three educational videos on the respective topics. The results showed that all participants had an increased level of understanding after viewing the educational videos. The participants also provided useful feedback that can be used as a guide for improved design decisions in future multimedia-based training.

1. Introduction

Digital forensics is a field of study that helps to bridge the implicit gap between the knowledge domains of computer science and law, as it encompasses both of these domains [1]. As a bridge, it can be seen as a "drawbridge" [2], in that when lowering it, legal practitioners and investigators are better able to understand the practical outcomes of digital forensics processes. This understanding will become more important as more court proceedings make use of digital data as a key evidence source in making legal decisions (i.e. reaching verdicts) [3, 4].

There are four main stages in a digital forensic investigation required to bring digital evidence to a court [5]. The first three stages, identification, preservation and analysis of the digital evidence, are mainly conducted at the scene and/or at a forensic laboratory. The last stage, presentation, involves the actual presentation of the collected evidence in a court of law.

For the presentation stage, an effective understanding of digital forensics by members of the judiciary and law enforcement is important. Without this understanding, they would have significant difficulties in grasping the digital forensics process, and may introduce doubt as to the reliability of the digital evidence presented [6-8]. Researchers have suggested that these parties require an improved understanding of digital forensics, particularly its technical aspects [6, 9]. The need for digital forensic understanding within Indonesia's judiciary and law enforcement officers, for example, is highlighted by the alarming level of cybercrime that is occurring in the country [10].

To improve digital forensic understanding for members of the judiciary and law enforcement, continuing education, including training for legal practitioners and investigators is necessary. Digital forensic science is a field that continuously progresses with the advancements in information and communications technologies (ICT) used to collect and analyze electronic evidence [11]. However, as a support to the existing presentation stage, this training is not intended to transform judges, prosecutors and investigators into digital forensic experts, but rather to equip them with the knowledge required to assess both the digital evidence presented and the digital forensic investigation that was conducted, specific to the case.

Common characteristics of the audience for this type of training include that they are adults, professionals and generally ICT laypersons. With these attributes in mind, it is necessary to devise a specific strategy in training preparation and implementation. This strategy should focus on overcoming inherent obstacles in training participation by this audience, such as insufficient time for ongoing training and a lack of awareness of the available training materials [12]. In addition, another study identified specific difficulties in the

technical implementation of judicial training, including the cost of training and the risk of bias being introduced by the training's sponsors [13].

Consideration of flexibility in training time, efficiency in training expenses and impartiality of training sources are, thus, particularly important factors to be considered when designing digital forensics training. Training materials should also be developed in a form that is easy to comprehend by a layperson in the field of digital forensic science.

Multimedia presentations seem to be an appropriate training material for digital forensics terminologies and also meet the aforementioned requirements. They can be played repeatedly for as many trainees as required and independently selected by the trainees according to their specific needs. These characteristics make multimedia presentations quite flexible in terms of participant time and efficient in terms of cost. The multimedia materials can be sourced from impartial organizations, such as universities. Another valuable feature of multimedia presentations is the use of visual training, which can facilitate understanding and is easier to memorize [14]. Schär and Krueger [15] suggest that using a particular mixture of pictures, text, voice and animation would make it easier for a trainee to understand educational material.

Multimedia presentations have been used as a training tool for members of the judiciary and law enforcement officials in various countries, and concepts, such as DNA [16] and restorative justice [17]. There appears to be significant benefits in utilizing multimedia presentations in training. However, thorough examination of the effectiveness of multimedia presentations in increasing judiciaries' knowledge of digital forensics outside the context of a trial remains understudied.

In this paper, we describe the results of our study which utilizes multimedia presentations to explain technical terms and concepts that are commonly used in digital forensics, for a selection of judges, law enforcement officers, prosecutors and support staff using Indonesia as a case study.

2. Background

The use of multimedia presentations in a legal setting is quite common. They have often been used as part of trials to assist in the explanation of a complex case to members of juries. These presentations are believed to be useful in describing a topic that is difficult to explain verbally and impractical to reconstruct [18].

Learning theories and pedagogies also support the selection of multimedia presentations as a training medium. A study by Adams, et al. [19] gives a brief description of how training can be effectively supported by multimedia. Highlighting the theory of operant conditioning, the study noted that "[i]n multimedia, tasks can be presented with [an] appropriate feedback mechanism to reinforce the learning" (p. 185). In terms of teaching strategy or pedagogy, the study argued that multimedia is conducive to simultaneous modalities. They note that the use of simultaneous modalities can only be implemented by utilizing multimedia technology, in which learners simultaneously interact with many components such as images, animations, videos, and audio and text narratives.

The way learners learn, known as cognitive style, also becomes an important factor that should be considered in examining engagement and performance in multimedia training systems [20]. Although cognitive style varies, and each learning activity has its own objectives, multimedia systems are capable of supporting multiple different learning levels [21].

The second level of Bloom's taxonomy, refers to Comprehension (or Understanding in Bloom's revised taxonomy [22]) in that people can be said to learn new information after they were able to link the information that they received with the knowledge that they had before. It is characterized by the presence of specific actions of learners such as: explaining, generalizing, and summarizing [23]. While the learning process requires a proper context that helps learners to understand the new information, Carter [21] argued that:

> [m]ultimedia supports using a variety of contexts. The recognition of alternate contexts should lead to a design that explicitly supports them for users and that makes recommendations to users of which context is most suitable in which circumstances. (p. 120)

3. Research Method

The positive characteristics of multimedia based training motivated us to examine the following research question: *Does the use of multimedia based training materials enhance the judiciary's technical understanding of the terms and concepts commonly used in digital forensics?*

To answer this research question, we presented a set of multimedia videos to our participants, and compared their understanding before and after they watched the videos. This lead to the following hypotheses:

Null hypothesis (H_0): The mean difference between a participant's comprehension before and after watching the video is zero.

Alternative hypothesis (H_a): The mean difference between a participant's comprehension before and after watching the video is not equal to zero.

With the enactment of the Act on Electronic Information and Transaction in 2008 (UU ITE/Law No 11/2008) [24], the legal system in Indonesia has regulated how digital evidence can be accepted in a court of law. In an effort to achieve a suitable level of understanding, the Indonesian government, through its Ministry of Communications and Informatics, routinely conducts digital forensic workshops as part of the implementation of the Act for members of the judiciary and law enforcement officials. Since 2013, the workshops have been conducted in a number of Indonesian cities. The study presented in this paper was conducted during three of these workshops, which took place between September and November 2014.

This study seeks to examine, utilizing survey results analysis, the potential for the use of multimedia presentations as a learning medium to present technical terms and concepts in the field of digital forensics. More specifically, this topic is studied with a view to determining to what extent multimedia presentations can effectively improve the understanding of individuals involved in the legal system, including judges, investigators, prosecutors and staff that support legal proceedings in a court. Based on previous research that outlined the usefulness of multimedia presentations in a trial [25, 26], we expect to find that multimedia presentations will effectively improve legal practitioners' comprehension of the technical terms and concepts in the digital forensic domain, when used to broaden their knowledge base.

3.1. Survey Method and Data Collection

We utilized convenience sampling when selecting our survey participants. The participants were audiences of digital forensic workshops in a consecutive period from September to November in 2014 that were conducted in three different provinces in Indonesia: South Sulawesi, Bangka Belitung and Yogyakarta Special Region. Audiences of these three provinces consisted of judges, investigators, prosecutors, and staff in government and in the legal system. The total audience size that participated in our survey was 121 participants. We consider that these audiences represent the parties who have the greatest need to understand digital forensic terminologies. This is due to the fact that judges act as a gate-keeper to admit and weigh digital evidence submitted by prosecutors [27]. In addition, various government officials have an important role in the formulation of policies and codes of practice relating to the conduct of digital forensic investigations [28].

To determine whether, after viewing multimedia presentations on topics in the field of digital forensics, there was an increased understanding of the technical terms presented, a face-to-face questionnaire-type survey was conducted. The questionnaire was distributed manually to the participants and we conducted the survey so that each participant had the same time to fill out the questionnaire and watch the multimedia presentations. The questionnaire was collected directly after the survey was completed.

The first section of the survey requested background information from the participants to obtain socio-demographic information. The second section, the main part of the survey, contained questions relating to the participant's comprehension of technical terms. Each question in this section was split into two stages. The participant's knowledge before viewing the multimedia presentation was captured once before the delivery, and again after delivery of the multimedia presentation to highlight any changes. Participants were provided with two opportunities to watch the multimedia presentations before they answered the questions in the second stage. If a participant was not at all familiar with a particular technical terminology, we suggested that they answer 'unfamiliar', which is an acceptable response even after watching the multimedia presentations.

The final section of the survey consisted of two open-ended questions. There were two parts in the first question. The first part asked participants to rate the usefulness of the multimedia presentations in improving their understanding of the technical terms and concepts presented, and for their general comments on the multimedia presentations. The second question allowed participants to provide feedback to improve our future multimedia presentations, and make recommendations if they felt that there were other, more appropriate, methods that could facilitate their understanding of the presented materials.

Our analysis of the survey responses is based on the quality of the participant's answers, before and after viewing our multimedia presentations (i.e. videos). These answers were categorized into four grades in ascending order (None, Weak, Moderate and Strong). To determine the grade for each

participant, we sought to identify the following information from within their answer: the use of relevant key terms, the use of examples; and the use of additional analogies.

For the purpose of analysis, we converted the grade of each participant's answer (None, Weak, Moderate, Strong) into 0, 1, 2, and 3, respectively. This represented the comprehension value and was calculated per video for each participant.

To determine a participant's improved understanding, we calculated a value known as 'ability to comprehend' for each participant for all videos. To obtain this value, we firstly compared the participants' comprehension value before and after they had watched each video. For example, if before watching video 1, the participant's comprehension value was None (0) and after it was Moderate (2), then the value for 'ability to comprehend' for video 1 for this participant is 2 (i.e. $2 - 0 = 2$). We then calculated the 'ability to comprehend' for each individual ($\bar{x}$) for all videos. It is calculated using

$$\bar{x} = \frac{x_{v1} + x_{v2} + x_{v3}}{3},$$

where x_{v1}, x_{v2} and x_{v3} denote the 'ability to comprehend' of the individual for videos 1, 2 and 3 respectively. Then, we classified the value for 'ability to comprehend' into two categories, namely: Not Improved (a score <=0) and Improved (a score >0).

3.2. Socio-demographic Information

Summary statistics and frequencies for the socio-demographic measures are presented in Table 1. More than forty percent of survey participants were 26-35 years old, and approximately 68% of participants held a Bachelor's degree or above.

Table 1. Socio-demographic information

Variable		% (n)
Age	18-25	12.40 (15)
	26-35	42.98 (52)
	36-45	27.27 (33)
	46-55	13.22 (16)
	>55	4.13 (5)
Highest Level of Education	Diploma or lower	32.23 (39)
	Bachelor's degree	52.89 (64)
	Master's degree	14.88 (18)
Technical Literacy	1 (least)	5.79 (7)
	2	14.05 (17)
	3	48.76 (59)
	4	20.66 (25)
	5 (most)	9.09 (11)
	Blank	1.65 (2)
Province	Bangka Belitung	23.97 (29)
	South Sulawesi	42.98 (52)
	Yogyakarta Special Region	33.06 (40)
Field of Employment	Government	10.74 (13)
	Judiciary	16.53 (20)
	Law Enforcement	47.11 (57)
	Prosecution	25.62 (31)
Job Title	Staff	14.05 (17)
	Judge	14.05 (17)
	Investigator	47.11 (57)
	Prosecutor	24.79 (30)

Participants were asked to self-assess their technical literacy, with the largest group of participants rating themselves as moderate (level 3) followed by above moderate (level 4), at approximately 48% and 21% respectively.

The total number of participants was 121; 43% of which lived in South Sulawesi, 33% in Yogyakarta Special Region and 24% in Bangka Belitung. Participants in the sample mainly work in the field of law enforcement (47.11%). Even though the largest group of participants is law enforcement investigators, the inclusion of participants who work as judges, prosecutors and government staff should provide sufficient representation of the legal community for the purpose of this study.

3.3. Multimedia Presentation Characteristics

Table 2. Video clip features

	Video 1	Video 2	Video 3
Term definition	No	Yes	Yes
Background music	Yes	Yes	Yes
Practical example	Yes	Yes	Yes
Analogy	No	No	Yes
Animation	Yes	Yes	Yes
Narration	Yes	Yes	Yes
Duration	2:24	3:03	2:38
Language	English	English	English

As an example of common technical terms and concepts relating to the field of digital forensics, we selected three terms for presentation as part of this research. Mobile forensics, as the first term, was selected to represent a key emerging field in digital forensics. The second concept selected was time zones. It was chosen because an understanding of this concept is integral in realizing the importance of digital evidence timestamps that are presented to the court. The final term, hashing, was selected as a term that must be understood to appreciate the guarantees made on the integrity of digital evidence. We utilized three video clips that had been developed at our

university to convey these technical terms and concepts.

Table 2 describes the characteristics of the three videos. Video 1 is the only video that does not provide a terminology definition and does not use an analogy in its description. Video 2 does not utilize an analogy, but it has a longer duration (around 3 minutes) to further explain its examples. Video 3 implements all features and has a moderate duration. All three videos were presented in English with Bahasa Indonesia subtitles.

All three videos were presented in the context of a single training session for the purpose of our survey. Additional materials (e.g. written guides) were not supplied as part of this study.

4. Results

For result presentation and analysis purposes, groups of age, field of employment and job title were compiled. Age categories were reduced to three groupings (18-35, 36-45 and >45). Both field of employment and job title were categorized into three groups to represent their role in the legal system. Members of the judiciary (judges) whose responsibility it is to reach a verdict, investigators and prosecutors as authorities to indict a suspect and submit evidence, and staff who act as direct or indirect support for the legal system.

4.1. Result One: The Improvement of Participants' Technical Comprehension

In order to determine whether participants' comprehension is significantly affected pre and post experiment, we conducted a paired t-test. We found that the mean of the participants' comprehension before watching the videos was 2.02 with a standard deviation of 0.62 and after watching them was 3.36 with a standard deviation of 0.60. The result of the t-test was $t = -25.71$, $\rho = 0.00$. Thus, the null hypothesis (H_0) was rejected and we conclude that a respondent's comprehension before and after watching the videos is significantly different. The mean difference value before and after watching videos is -1.34. This suggests that watching the videos significantly improved the participants' comprehension.

The calculation of results for all participants' ability to comprehend resulted in 100% of participants being categorized as Improved (the value of ability to comprehend variable >0).

The complete list of participants' mean ability to comprehend values, grouped by the independent socio-demographic variables is presented in Table 3. The mean values for age groups 18-35 and 36-45 are almost identical (1.40 and 1.42, respectively), but comprehension reduces in the age group above 45 years (0.98). The tendency for decreased mean values also occurs for participants with higher levels of education, where diploma or lower educated participants experienced greater improvement than participants holding a bachelor's or master's degree (1.44; 1.32; and 1.17).

Table 3. Participants' ability to comprehend

Variables	Groups	Ability to comprehend	
		Mean	Standard Deviation
Age	18-35	1.40	0.62
	36-45	1.42	0.48
	>45	0.98	0.43
Highest Level of Education	Diploma or lower	1.44	0.61
	Bachelor's degree	1.32	0.52
	Master's degree	1.17	0.64
Technical literacy	1-2 (least)	1.44	0.77
	3	1.30	0.50
	4-5 (most)	1.34	0.53
Field of employment	Government	1.46	0.72
	Judiciary	1.03	0.48
	Law Enforcement & Prosecution	1.39	0.55
Job title	Staff	1.35	0.69
	Judge	1.04	0.47
	Investigator & Prosecutor	1.39	0.55

Note: Mean is the average of participants' ability to comprehend $(\bar{x})$ in the variable's group.

Participants in the lowest technical literacy group have the highest mean improvement in their comprehension (1.44). As self-assessed technical literacy can be used as a general indication of a participant's existing comprehension of technical terms and concepts, we expected the group with higher technical literacy scores to achieve higher improvements in their comprehension. However, the results seem logical, as there would be less room for improvement in the answers of the participants who started with higher technical literacy.

When assessing ability to comprehend based upon field of work, the participants who are members of the judiciary have the lowest mean values compared with participants who worked in the government, law enforcement agencies and for the prosecution. This observation is also noted in the job title group.

In order to determine the correlation between the participants' ability to comprehend and their socio-demographic variables, we calculated Spearman's coefficient for ordinal variables (age, education level and technical literacy), and conducted a Chi-square test for nominal variables (field of employment, and job title). Spearman's rho coefficient for the relationship between a participants' age and their ability to comprehend indicated that there was a low, negative correlation between two variables, r = -0.18, n = 121, ρ =0.05. Higher ages were associated with lower levels of ability to comprehend. This result gave statistical significance support for the tendency of a reverse correlation between a participant's age and their mean ability to comprehend (see Table 3). Meanwhile, the test for correlation between participants' education and their ability to comprehend resulted in the conclusion that there was no correlation between the two variables at the 0.05 level, r = -0.14, n = 121, ρ = 0.12. There does not appear to be any correlation between participants' technical literacy and their ability to comprehend (r = 0.03, n = 119, ρ = 0.76).

A Chi-square test for independence suggested a significant association between the participants' fields of employment and understanding, at 0.1 level, χ^2 (2, n = 121) = 5.64, ρ = 0.06, Cramer's V = 0.22. Lastly, for correlation between the participants' job title and their ability to comprehend, there was also an indication of a significant association between the two variables at the 0.1 level, χ^2 (2, n = 121) = 5.26, ρ = 0.07, Cramer's V = 0.21.

4.2. Result Two: Variations in Respondents Comprehension dependent on Video Features

Table 4 outlines the participants' comprehension changes on a per video basis. This table presents the percentage of participants who experienced an improvement in comprehension from the None or Weak levels to the Moderate or Strong levels, which are the target levels that we sought to achieve.

The data shows that the greatest improvement, where participants experienced an improvement from the None to the Strong level, was after watching video 3 (68.42%) followed by video 2 and video 1 (45.45% and 15.38%, respectively). The same pattern was noted for improvement of participants' comprehension from the Weak to the Strong level (Video 3: 65.12%, Video 2: 62.50 and Video 1: 34.04). When correlating these results with the video clip data presented in Table 2, the results suggest that the presence of both analogy and a terminology definition in video 3 may have had a significant positive influence on the participants'

comprehension. Video 2 did not include an analogy while Video 1 did not include either feature.

Table 4. The influence of video features on respondents' comprehension

Level of comprehension		% (n)		
Before	After	Video 1	Video 2	Video 3
None	Moderate	84.62 (11)	54.55 (18)	31.58 (6)
	Strong	15.38 (2)	45.45 (15)	68.42 (13)
Weak	Moderate	65.96 (31)	37.50 (18)	34.88 (15)
	Strong	34.04 (16)	62.50 (30)	65.12 (28)

4.3. Result Three: Respondents' Comments on the Utility of Multimedia Presentations

Table 5 presents a rating of the multimedia presentations' usefulness in facilitating the participants' learning process. Around half of the participants in the staff and judge groups gave a rating of 3 from the 1-5 scale. The second highest rating is 4 (near 30%). For the investigators & prosecutors group, the percentage of participants who provided a rating of 3 or 4 is almost identical (around 34% and 33%, respectively).

Table 5. The rating of multimedia presentation usefulness

Rating	% (n)		
	Staff	Judge	Investigator & Prosecutor
1 (least)	0.00 (0)	0.00 (0)	2.30 (2)
2	11.76 (2)	5.88 (1)	5.75 (5)
3	52.94 (9)	47.06 (8)	33.33 (29)
4	29.41 (5)	29.41 (5)	34.48 (30)
5 (most)	0.00 (0))	17.65 (3)	22.99 (20)
Blank	5.88 (1)	0.00 (0)	1.15 (1)

Comments and feedback were requested from the participants in the two open-ended questions at the end of the questionnaire. In the remainder of this section, quotations were translated from Bahasa Indonesia to English using direct translation.

Summarizing the available comments, we found that more than 85% of the participants stated that multimedia presentations are valuable and useful for their learning process. For example, two participants, wrote, *"for me, multimedia presentation is very*

effective, because this kind of presentation facilitate me to understand the intent and purpose of the presentation than I just read" and *"[multimedia presentation] make me understand the technical concepts with ease and it is very useful to support law enforcement process"*.

Another participant stated that multimedia training materials, such as those presented, should be made available in the participants' workplaces.

Many similar statements were found in the participants' comments. In general, they agreed that animation and visualization made the training material clearer and thus easier to understand.

The participants also provided some critical feedback on the presentations. Some argued that the videos should be presented in the local language and that they were limited by only having the ability to watch the videos twice. Some participants commented on the video duration as being too short and that more information should be provided. For example two participants wrote, *"[the videos] are too short and fast, make content of the materials not focus"* and *"[the material] are poorly understood because the time is too short"*. Another participant indicated that *"[f]rom 1-10 scale, [this multimedia presentation is] worth 8 to 9. The information presented is easy to digest and has a good analogy, but the amount of information is very little"*.

Other comments caused us to consider the availability of supporting facilities and infrastructure, such as computers, audio devices and network bandwidth capacity, in the participants' workplaces. Another comment demonstrated a preference for interactivity in multimedia-based training and that the material needs to be customized to suit the participant groups' background.

In terms of interactivity, one participant commented that *"[i]t is better to implement a multimedia presentation that allows interaction and communication among users"*. In terms of participant groups' background, an opinion was expressed that investigators may be more focused on the technical aspect of digital forensics, while prosecutors may be more focused on the analysis of the case and its relationship with the digital forensic investigation, and judges would have a greater interest on case conclusion and the related digital evidence.

We categorized the participants' feedback into three sets. The first set relates to our training media (i.e. video) and its content. In this set, we identified two key items of feedback from participants, namely: adjustment of both the video duration and video content.

Participants suggested adding more case examples and a greater use of analogy. Participants also recommended other material that can be covered in future videos. For example, data acquisition techniques, digital forensics for other electronic devices, terms and concepts from the Act on Electronic Information and Transaction (UU ITE/Law No 11/2008) and a step-by-step explanation of various digital forensics procedures.

The second set of feedback was concerned with delivery method. Participants preferred having audio in the local language (Bahasa Indonesia) rather than having the audio in English and subtitles in Bahasa Indonesia. For example, two participants wrote, *"[i]t is better directly using Indonesia for the audio, no need subtitles"* and *"[u]se voice in Indonesian, it make the terminology is much easier to understand"*.

Some participants also requested that a broader range of key definitions be provided. For example one participant wrote, *"[i]t is better to have introduction about common terms in digital forensics before entering to the core material"*.

The last set of feedback related to whether the participants should be provided with any aids or other methods to assist in their comprehension of technical terms and concepts. Participants proposed special books, such as a handbook that contains digital forensic technical knowledge, a dictionary and a glossary. For example, one participant wrote, *"[i]t must be made a book which contains terms related to digital forensics"* while another wrote, *"[t]here should be a dictionary of technical terms and concepts in Indonesian"*. Additional training props, such as electronic devices and storage media, were also suggested.

5. Discussion

In this research, we have presented three major results from our study to determine the potential for use of multimedia videos in increasing the understanding of technical terms and concepts used in digital forensic investigations.

Our first result showed that all participants had a positive value for their mean ability to comprehend. This indicates that the videos were successful in increasing the participants' understanding of the terms and concepts presented. In comparison to our previous study [29] on this topic, the results of this study demonstrate an improvement in the effectiveness of multimedia presentations when used to enhance the technical understanding of participants (previously, it was around 80%). To achieve this improvement, we incorporated the feedback from our earlier study, such as the use of analogy and the addition of local language subtitles in our video.

However, referring to Bloom's taxonomy of learning levels, our assessment of participants' achievement remains at the Comprehension level. To achieve results at the Application level (or Apply in revised Bloom's Taxonomy [22]), we would need to assess how participants apply the new knowledge gained by giving them a problem and asking them to create a viable solution using the information they have gained or by asking them to take the role of a digital forensic investigator in a scene and presenting the digital evidence to a court.

As shown in Table 3, the judges' mean comprehension value was lower than other job titles, which is supported by a significant association between a respondent's job title and the respondent's ability to comprehend at the 0.1 level. The uniformity in our videos' content might not be suitable for a diverse range of jobs with their individual interests and needs. In order to increase judges' understanding, material could, for example, be designed to be more relevant to a judge's task of weighing the importance and soundness of digital evidence. This correlates with a similar suggestion by participants in terms of material customization. The Colloquium for Information System Security Education (CISSE 2008) has identified a number of groups that potentially have a need for digital forensics education and training [30]. They include law enforcement, expert witnesses, legal professionals, policy makers, business, community and higher education. Training material could be designed specifically for these groups.

The need for material customization correlates with Houle's findings [31], which showed that a link between job tasks and training helps to motivate professional involvement in the training. In addition, a study conducted by Armytage [12] argued that in continuing judicial learning, there are distinctive elements in the judicial profession which have implications on the designing of content and the learning program. These elements include the underlying motivating factors to learn and their preferred learning styles.

Result two indicates that videos that include analogy and explicit terminology definitions may have a greater effect on improving participants' comprehension in comparison to videos without these features. The efficacy of using analogies in learning materials correlates with the findings of Millet, et al. [32] and Podolefsky and Finkelstein [33] in the field of physics. Thagard [34] also notes that "[...] often analogy is indispensable for providing students with the beginnings of understanding in a strange domain" (p. 542).

Although our second result supports those studies, it can be argued that not all multimedia presentations should include analogy [35], as they are subject to misinterpretation. In our study, video 3 defined hashing, and an analogy combined with an example might be the best way to describe this concept. However, terms such as time zones and mobile forensics would seem to be easy to explain using examples. The use of case examples may help to improve understanding of these topics.

Result three demonstrated that most participants gave a rating of 3 or 4 (from a 1-5 scale) for the usefulness of multimedia as an aid to their learning. We consider this a moderate to good result, but we are still concerned with improving it. Limitations in terms of the number of videos presented and the inability for them to be viewed repeatedly may have influenced this rating. However, the increased understanding that was experienced by all participants, gives credence to the use of multimedia presentations, as one educational material source and technique, in digital forensics training.

Result three also summarized the participants' comments and feedback. The recommendation regarding additional materials that could be covered in future videos is valuable, as the suggested topics represent an actual need for practitioners. The request for videos on the topic of terms and concepts in the Act that regulates digital evidence confirms our finding that there is a need for material differentiation.

The suggestions to include discussion and interaction in our multimedia-based training are in line with a study by Palloff and Pratt [36]. The study identified responsiveness as one of the keys to success in distance learning, and stated:

> An online learning community simply cannot exist unless members respond to each other and the instructor responds quickly to the other participants. […] Through interactions with each other, the members of the group create understanding of the material they are struggling with together. (p.160)

We are aware of the positive effect that interaction has on participant learning and believe that it should be considered an important component of a future comprehensive training system. However, we did not survey broadband network access in participants' workplaces. Therefore, we cannot assume that these facilities are necessarily available. We designed our multimedia presentations to be used in an asynchronous offline manner and distributed them among participants using offline methods (e.g. DVDs). One possible way to address the suggestion for interactivity, without significant technical overheads, would be for question and answer

sessions to be conducted via specialized online forums or potentially even popular social media such as Facebook and Twitter.

Limitations: The question we sought to answer in this study was the extent to which multimedia presentations can improve the understanding of technical terms and concepts presented in digital forensics. To answer this question, we targeted survey participants who were closely related to court proceedings. As we had the opportunity to conduct workshops on digital forensics in three provinces in Indonesia, we utilized these opportunities to collect data for our study, a method widely known as the convenience sampling strategy.

Our use of a convenient sample may have inadvertently introduced some biases with our results. Whilst we can be confident that there is a reverse correlation between a participant age and their comprehension because this was seen in all groups, the fact that participants volunteered to attend the workshops may suggest that they were more motivated than the average member of their professions. Nevertheless, there is no reason to suspect that the motivation to attend would have influenced the findings within our categories. Our sample size is another potential concern, as it may not be representative of the participants' groups. To date, we have only examined three of 35 provinces in Indonesia.

6. Conclusion and Future Work

Overall, results from this study indicate that multimedia presentations can be used to effectively improve training participants' understanding of technical terms and concepts, particularly in the digital forensic domain. In spite of the limitations regarding our sampling method (i.e. convenience sampling), the chance to directly oversee the survey process was valuable. Moreover, this method was sufficient in helping us to gain an understanding of the expected result from this type of training.

Future work should consider a random sample with a larger scale of respondents. An online survey could be utilized to reach more participants from different areas, which would improve the statistical soundness of the data. Future studies should also include the refinements suggested by the participants of this study for the video content (e.g. more case based examples and the use of analogy), and the use of the participant's native language for audio narration, rather than adding subtitles. Elimination of subtitles is likely to reduce a learner's cognitive load,

according to the multiple source of information concept [37, 38]. Future studies could use our results as an initial guide to utilizing multimedia in digital forensics training.

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