Developing Guidelines for Using Video to Teach Procedural Skills in an Online Learning Environment Based on Gagné's Nine Events of Instruction

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Abstract

The growth of online learning has provided opportunities for skills otherwise taught traditionally in a face-to-face learning environment to be taught in an online learning environment. Procedural skills, which have traditionally been taught in a face-to-face environment, can also be taught in an online learning environment using various delivery modes including virtual reality, augmented reality, simulations and videos. However, producing materials using some of these delivery modes could be expensive and might require advanced skills. However, video could be cost effective and might not require advanced skills based on the video produced.

This study seeks to produce guidelines for using video to teach procedural skills in an online learning environment based on Gagné's Nine Events of Instruction (Gagné, 1975)**.** To accomplish this goal, this study employed a design and development research methodology. The guidelines produced will assist instructors and course developers intending to use video to teach procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975)**.** A systematic literature review was used to create the initial guidelines which were distributed to expert reviewers. Expert reviewers provided feedback which was used to revise the guidelines for using video to teach procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975).

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General Audience Abstract

Procedural knowledge is defined as the knowledge of steps needed to attain a goal (Byrnes et al., 1991). Procedural skills can be taught in an online learning environment using various delivery modes including virtual reality, augmented reality, simulations and videos. However, some of the delivery modes can be expensive and might require advanced skills to use. Videos, on the other hand, can be cost effective and might not require advanced skills to produce depending on way it is produced. This study utilized a design and development research methodology to produce guidelines for using video to teach procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975). A systematic literature review was used to create the initial guidelines which were distributed to expert reviewers. Expert reviewers from diverse backgrounds related to the study provided feedback which was used to revise the guidelines for using video to teach procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975).

Dedication

To my grandparents, George and Cecilia C. Buumba, and His Royal Highness, Monokolya Siloka II Mukuni XVII and Princess Esnart Nsingu Kooma.

"This vision is for a future time. It describes the end, and it will be fulfilled. If it seems slow in coming, wait patiently, for it will surely take place. It will not be delayed" Hab 2:3.

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Chapter 1

Introduction

Procedural skills are taught across disciplines using various delivery modes. In engineering, health, mathematics, robotics and vocational schools, procedural skills are taught mainly in face-to-face environments. One of the common definitions of procedures appearing in the literature is as follows:

> Procedures, also called near - transfer tasks, are routine tasks in which workers follow the same step - by - step action sequences each time. Common work procedures include activities such as accessing email, completing a routine customer order, changing copy machine cartridges, and measuring the electrical resistance of equipment during troubleshooting. Some procedures can be quite complex and/or have safety consequences, such as landing an aircraft or administering CPR. (Clark & Lyons, 2010, p. 185)

At the time of writing this document, many institutions of learning moved most of their face-to-face courses online in an effort to keep students, faculty, and staff safe (Hodges, Moore, Lockee, Trust & Bond, 2020; Zhou, Wu, Zhou & Li, 2020). With the immediate rise of online learning, many opportunities for teaching and learning have also arisen. One of the advantages of online learning is that certain skills can be taught at a distance using various delivery modes. Procedural skills have been taught online using video, virtual reality (VR), and more recently, augmented reality (AR). Video, VR, and AR are examples of modes of delivering instruction to the learners which have been discussed in the literature (Inoue, 2007; Jang & Kim, 2014; Jou & Wang, 2013; Kneebone, 2005; Schott & Marshall, 2018).

However, teaching procedural skills online can be challenging for instructors and course developers. One of the challenges is producing the materials. Producing materials to teach procedural skills online can be expensive, time consuming, and may require advanced technical skills, particularly when using more complex technologies like virtual reality (VR) simulations (Inoue, 2007; Parham, Bing, Cuevas, Fisher, Skinner, Mwanahamuntu & Sullivan, 2019; Parham et al., 2019; Pickup, Ferren, Burkard, Jones, Rankin, Silver & Winsor, 2013; Rourke, 2020; Smith, 2018). This may present challenges for instructors and course developers with little or no training and no additional funding to produce real life simulations in virtual reality (VR).

Other tools used to deliver content online include videos. Videos can be less expensive to create and may not require as advanced technical skills to produce. When well produced, videos can increase learner motivation and interests (Cheng, Huang, Shadiev, Hsu & Chu, 2014), making them very useful in procedural learning (Biard, Cojean & Jamet, 2018). They can also be stopped and replayed, which can help with retention of targeted concepts (Borko, Jacobs, Eiteljorg & Pittman, 2008).

Another challenge related to the use of videos for learning is to ensure that proven principles of learning and cognition are used to design pedagogically-sound instruction. The literature contains information regarding procedural skills, including strategies which can be used to teach such skills (Gaies, Landrigan, Hafler & Sandora, 2007; Liddell, Davidson, Taub & Whitecross, 2002; Mackay, Morgan, Datta, Chang, & Darzi, 2002; Taylor, 1997; Wigton, Blank, Nicolas, & Tape, 1989).Theories such as information processing theory, skill acquisition theory, and situated learning/situated cognition can all be linked to teaching procedural skills. These theories have mostly been applied in face-to-face environments with a few focusing on the

application of the theory when a particular technology is used such as virtual reality (Schott & Marshall, 2018).

After conducting a review of the literature, an absence of theoretical guidance on how to use video to teach procedural skills online learning was identified. This study addresses this need by developing guidelines for using video as a delivery mode to teach procedural skills in an online learning environment, based on Gagné's Nine Events of Instruction (Gagné, 1975). The proposed guidelines provide an initial opportunity to obtain feedback from experts in order to guide further development before they are implemented in an authentic context.

Problem Statement

A review of the literature related to teaching procedural skills has shown that most studies, for example, Gaies et al., (2007); Liddell et al., (2002); Mackay et al., (2002); Taylor, (1997); Wigton et al., (1989), provided little or no evidence-based guidance on how to teach procedural skills in an asynchronous learning environment. The delivery modes that have been used in most of these studies include advanced video application, virtual reality, and augmented reality.

However, most of these delivery modes require highly developed technical skills and are also expensive. Video, on the other hand, could be less expensive to produce and may not require advanced technical skills depending on the intended use and production (Laaser & Toloza, 2017; Myllymäki Penttilä & Hakala, 2014; Rajadell & Garriga-Garzón, 2017). The absence of guidance on how to use video to teach procedural skills in an online learning environment based on a theory of learning warrants the need for such a study.

Rationale for the Study

This study will offer instructors and course developers guidelines for using video as a tool or delivery mode to teach procedural skills in an online learning environment based on Gagné's Nine Events of Instruction (Gagné, 1975). Producing materials to teach procedural skills in an online learning environment could be expensive, might also require advanced skills, and may need to be guided by a particular learning theory.

The intended audience for the guidelines is the academic environment in support of formalized, online learning. Video can be used to grab and focus learner attention and create visual images (Berk, 2009). Videos can also be used to showcase a procedure (Choe, 2017). Video can be used as a tool for self-assessment allowing learners to review their own behavior /performance and evaluate themselves (Yoo, Son, Kim & Park, 2009; Zick, Granieri & Makoul, 2007). These are useful features, especially in academic environments.

Organization of the Study

Chapter 1 is an introduction to the study containing background information, a description of the problem, and the rationale for the study. Key terms are defined such as online learning, distance education, asynchronous and synchronous learning environments, and procedural skills. Chapter 2 focuses on the literature related to teaching procedural skills, educational theories related to teaching procedural skills, and various delivery modes that have been used to teach procedural skills. In Chapter 3, the design of the study is further described. The study participants, the procedures of the study, and the methods used to analyze the data are discussed in this chapter. Chapter 4 describes the synthesis of the literature and describes how the guidelines were formulated based on the literature. Chapter 5 discusses the results from the

expert reviews. This chapter also describes the changes made to the guidelines based on the review. The revised guidelines are presented in this chapter. In Chapter 6, conclusions and contributions of the study are presented.

Definitions of Key Terms

Online learning: Courses in which all or most of the content is delivered online, usually with no face-to-face meetings (Simonson, Zvacek & Smaldino, 2019).

Distance education: "Institution-based, formal education where the learning group is separated, and where interactive telecommunications systems are used to connect learners, resources, and instructors" (Schlosser & Simonson, 2006, p. 1).

Asynchronous learning environments: Teaching and learning that takes place at different times, with the instructor and learners not engaging collectively. Participants in the course are not engaged at the same time and are separated geographically (Somenarain, Akkaraju & Gharbaran, 2010).

Synchronous learning environments: Teaching and learning that takes place at the same time, with the instructor and learners engaging collectively. Online and face-to-face learning can be blended in a synchronous learning environment (Somenarain et al., 2010).

Procedural skills: Step-by-step actions needed to complete a task or process (Clark & Lyons, 2010).

Design and development research: Systematized design, development and evaluation process aimed at providing empirical grounds for creating instructional or non-instructional tools or products or new or enhanced models governing their creation (Richey & Klein, 2008).

Learning Theory: A theory of learning is a set of laws or philosophies about learning. A learning theory is made up of a set of concepts linking observed changes in performance with what is thought to bring about the changes (Driscoll, 2005).

Digital video: Moving images captured and or digitized from source, including live feed. Animated video can be produced using software packages (Williams, Lock & Burnett, 1996).

Virtual reality: A simulated near reality environment created with the use of computer technology in which the user can interact in a three-dimensional virtual world by using a screen which assists to provide simulated vision, touch and hearing in the virtual world (Javaid & Haleem, 2020).

Chapter 2

Review of Literature

The purpose of this study is to produce guidelines for using video as a delivery mode to teach procedural knowledge in distance education. The literature review focuses on the research that has been conducted which is related to delivery modes used when teaching procedural skills. The review also focuses on some of the theoretical foundations that surround teaching procedural skills and how they could be used in an online learning environment.

Procedural Knowledge

Procedural knowledge is defined as the knowledge of steps needed to reach several goals (Byrnes & Wasik, 1991). Procedural knowledge differs from declarative knowledge. Declarative knowledge is either factual or experiential while procedural knowledge, on the other hand, is "goal-oriented and mediates problem solving behavior" (Corbett & Anderson, 1994, p. 256). Procedural knowledge has been discussed in different ways in the literature (Corbett & Anderson, 1994; Hiebert & Lefevre, 1986; Lewicki, 1986; Willingham, Nissen, & Bullemer, 1989). One of the studies reviewed and summarized "evidence for the process of acquisition of information outside of conscious awareness" (Lewicki, Czyzewska & Hoffman, 1987, p. 253). The authors found that:

> …the subject acquires some form of intuitive knowledge about patterns of stimuli and how to process them, although the subject is unable to articulate these processing rules. For example, most people are unable to articulate semantic and syntactic rules of the language they use, although at the same time, they doubtless have intuitive knowledge of those rules. The same is true about elementary perceptual phenomena. (p.253)

Lewicki, Hill & Czyzewska (1992) point out that:

> A considerable amount of evidence indicates that as compared with consciously controlled cognition, the nonconscious information-acquisition processes are incomparably faster and structurally more sophisticated. They allow for the development of procedural knowledge that is "unknown" to conscious awareness not merely because it has been encoded (and entered the memory system) through channels that are independent from consciousness. This knowledge is fundamentally inaccessible to the consciousness because it involves a more advanced and structurally more complex organization than could be handled by consciously controlled thinking. (p. 796)

Procedural knowledge is applied when determining which methods or tests should be run (Blumberg, 2009). According to the same authors, procedural knowledge incorporates a criterion for deciding when to use suitable procedures and how to construe them. According to Sitzmann, Kraiger, Stewart & Wisher (2006), “Procedural learning outcomes include compilation (i.e., proceduralizing steps and mentally grouping the steps into a more complex production) and automaticity (i.e., accomplishing tasks without conscious cognitive effort, which enables simultaneous performance of additional tasks)” (p.627-628).

A distinction should be made, however, between procedural knowledge and procedures in general. The difference between procedural knowledge and procedures is that procedural learning or procedural knowledge is learning and constructing steps which are held to particular rules and facts in accomplishing a task, while procedures are routine tasks which are followed step by step each time (Clark & Lyons, 2010). Procedures which are common to workplaces according to the same authors include checking emails and changing printer paper. Other procedures on the other hand, are more complex. These include taking off and landing a fighter jet or performing a surgery.

According to DeKeyser (2007), there are three stages of development: declarative, procedural, and automatic. The first stage involves obtaining factual or experiential knowledge. DeKeyser contends that such knowledge can be acquired through observation and by analyzing others involved in a skilled behavior. The second stage involves acting on the knowledge that is obtained by converting it from knowledge that into knowledge of how to. This process can be referred to as turning declarative knowledge into procedural knowledge.

DeKeyser (2007) points out that "proceduralization of knowledge is not particularly arduous or time consuming. Provided that the relevant declarative knowledge is available and drawn on in the execution of the target behavior, proceduralization can be complete after just a few trials/ Instances" (p.95). The last stage is automatization of knowledge, which is actualized through practice. Practice reduces the time required to execute the task and the rates of errors encountered. There are guidelines for teaching procedural skills which have been offered that are worth discussing.

Teaching Procedures

As mentioned earlier, procedural skills are taught in various fields including mathematics, science, engineering and in vocational training. There are guidelines which have been offered on how to teach procedural skills. According to one author, "Teaching communities worldwide would benefit from standardised validated curriculums that use proved technology for teaching technical competence effectively, minimise wasted time, and focus on the breadth of skills needed for a specific practice" (Grantcharov & Reznick, 2008, p.1129). The same authors also claim that technical procedural training currently is unstructured and unsystematic.

Strategies for teaching procedures. Procedures are often well defined and are sequential, meaning they are often taught in steps (Smith & Ragan, 2005). The same authors also

differentiate between the ability to describe steps or list the steps and the ability to apply the procedures in a new environment. Merely describing or listing the steps is declarative knowledge while the ability to apply the procedures in a new situation or environment is procedural knowledge. The authors provide the following guidelines when describing verbally the procedures:

1. The steps should be defined in clear sentences
2. The steps should be a result of a cognitive task analysis that was carefully conducted
3. Each operation should show a single elementary action
4. Whenever it is possible, each step should be dichotomous allowing for the selection of one possible path out of two and that the branches should not be more than five in a case where the decision must result in more than two options
5. They also recommend that the decision should be represented in a question form and that the steps should begin with a verb
6. The authors also state that procedures should be taught as simple as possible. (P.190-191).

There are guidelines for teaching technical procedural skills in a clinical situation. According to Grantcharov & Reznick (2008), the following are the steps that should be taken when teaching technical procedural skills. These include;

Practicing basic psychomotor skills until proficiency criteria are achieved. Grantcharov & Reznick (2008) recommend that the learners should practice basic skills in simulations and once they have mastered the skills, they can progress to more advanced skills. This is particularly useful for more risky procedures, like medical procedures.

Acquiring knowledge that is specific to the procedure. Grantcharov & Reznick (2008) emphasize the necessity of specifying the knowledge needed to the procedure such as knowledge of the instrumentation, indications, anatomy, complications related to the procedure, successful completion of an assessment procedure among others. The authors recommend that a learner should be considered competent to begin on basic skills procedures upon successful completion of an assessment procedure.

Demonstrating the procedure. Grantcharov & Reznick (2008) recommend that learners must review a demonstration or a video of an expert performing a real procedure on patients which will allow the learner to perceive and understand the skills required to perform the procedure. Demonstrating the procedure allows the learners to observe and understand the procedure and what is necessary to complete the procedure. Complex procedures could require multiple demonstrations.

Breaking the procedure into key steps. According to Grantcharov & Reznick (2008), the trainer should describe the steps as they are performing the procedure. This will assist the learner to find and follow the key steps involved in a procedure in the right order. More complex procedures could require more key steps. The trainer can demonstrate how to perform the key steps while explaining why each key step is important.

Comprehension. According to Grantcharov & Reznick (2008), the goal in this stage is to ensure that the learner understands the steps by having the trainer demonstrate the steps of the procedure as the learner describes the steps. The trainer could demonstrate the steps as many times as necessary until the learners understand the steps. This could be essential for more complex procedures.

Performing single components of a procedure. According to Grantcharov & Reznick (2008), it is important to allow the learners to perform one step at a time by dividing technical procedures into two or three cardinal steps. This allows the learners to master each step. The steps will enable the learners to perform the whole procedure if they are well mastered. If the procedure involves removing a flat tire from a vehicle, learners can first master how to use wheel/lug wrench to loosen lug nuts. The learners can perform this step until they are able to master it.

Performing an entire procedure. Grantcharov & Reznick (2008) point out that under supervision, the learners should be allowed to perform the whole procedure once they have mastered each component of the procedure. Mastering each component will make it easier for the learner to perform the whole procedure. Allowing the learners to perform the whole procedure at this stage could help them master how to perform the procedure, especially if the next phase is implemented.

Assessing and providing feedback throughout the learning process. Grantcharov & Reznick (2008) emphasize the need for each operative procedure to be followed by a debriefing session in order to reinforce learning. An alternative assessment method that the authors propose is the use of video recording of the learner performing the procedure, followed by a review by the learner and the trainer of the recording.

Challenges

There are various challenges that can be encountered when teaching procedural skills. One of the challenges is the demand placed on the trainers or course developers developing training for procedural skills (Norris, Cullison & Fihn, 1997; Roberts, Bell & Duffy, 2006). One of the demands is that the trainer should be competent in the procedure and should be readily available to teach the procedure (Norris, Cullison & Fihn, 1997). For instructors and course developers involved in the health sector for example, it is expected that the surgeons who are involved in teaching and training advanced procedures should assist in the development of training and evaluation that establishes procedural based competency (Roberts, Bell & Duffy, 2006). This is particularly challenging for instructors and course developers with busy schedules who are under pressure for maximum efficiency and speed, but have too many students (Grantcharov & Reznick, 2008). One other challenge of teaching procedural skills involves the need for a robust theoretically based method of teaching procedural skills. According to Gaies et al. (2007), "A more robust and standardized method is needed for teaching procedural skills and for documenting competence" (p.715).

Another challenge associated with teaching procedural skills using certain delivery modes is the expense involved. According to some scholars (Inoue, 2007; Parham et al., 2019; Smith, 2018), virtual reality remains expensive to produce and use, especially when producing realistic simulations. At the time of writing this document, the costs of surgical simulations, immersive medical simulations and virtual worlds ranged from $100,000 to $1,240,000 (Kyaw, 2019; Parham, Bing, Cuevas, Fisher, Skinner, Mwanahamuntu & Sullivan, 2019; Pottle, 2019).

This study seeks to address two of the aforementioned challenges. The first of these challenges is the cost associated with using certain delivery modes. Videos can be a cost-

effective delivery mode for teaching procedural skills. The cost of producing video varies greatly depending on the production and intended use (Haskin, 2015; Laaser & Toloza, 2017; Myllymäki, Penttilä & Hakala 2014; Rajadell & Garriga-Garzón, 2017). For example, it can cost up to $30 per finished minute for a one-person custom educational video produced in a studio (Minnes, 2019).

According to Hill & Harris (2019), to produce a high quality three minute video, it can cost between $5,000 and $8,000 or more if production is outsourced to a freelancer or a small studio, and between $12,000 and $15,000 if a larger production house with a producer, writer and director is used. However, the cost can be further reduced with the use of readily available technology. As noted by Rickley & Kemp, "using commonly available technology, such as computers, smartphones, video or web cameras, video recording software, video-editing applications, and a high-speed internet connection, instructors can create and disseminate self-produced video lectures quite easily and cost efficiently" (2020, p. 4).

The goal of this study is to offer a cost-effective method of teaching procedural skills in an online learning environment. As a result, self-produced videos are emphasized. Self-produced videos are both accessible and affordable and can be a useful tool for teaching (Björgvinsson, 2007; Case & Hino, 2010; June, Yaacob & Kheng, 2014; McAlister, 2014). With the availability of affordable video cameras and simple user-friendly video editing software, video production can be accessible to many users (Case & Hino, 2010). However, the guidelines can also be used to produce higher-cost videos for teaching procedural skills, should such resources be available and desired.

The other challenge to be addressed in this study is related to the use of learning theories to guide the strategies to teach procedural skills online using video. This study addresses this

challenge by developing guidelines based on a proven theoretical approach. The aim of this study is to use what is currently known about learning and about teaching procedural skills to produce guidelines for using video to teach procedural skills in an asynchronous learning environment.

Delivery Modes for Teaching Procedural Skills

The literature contains many studies which have been conducted related to teaching procedural skills using various delivery modes (Dickey, 2007; Gaies, Landrigan, Hafler & Sandora, 2007; Liddell, Davidson, Taub & Whitecross, 2002; Mackay, Morgan, Datta, Chang & Darzi, 2002; Schott & Marshall 2018; Taylor,1997; Wigton, Blank, Nicolas & Tape, 1989). This section will review the common delivery modes which have been used to teach procedural skills. These include, video, virtual reality, game design, and simulations. However, it is necessary to discuss the significance of the debate regarding media studies before describing the various delivery modes which have been used in teaching procedural skills.

Clark (1983) has argued that research on the impact of media on learning has shown that using different media has no benefit to learning. Clark's position is that media has no impact on learning, but that it is just a tool through which the instruction is delivered to the learner. He compared the use of media for instruction to a grocery truck delivering food. The person is not nourished by the truck which delivers the food, but by the food delivered by the truck. Clark has called for a ban on media comparison studies as they are a waste of resources (Clark, 1983). Kozma (1994), however, argued that media does play a significant role in the learning process. He described how certain studies had proved that the technology had improved the performance of the learners. This study is not a media comparison study seeking to claim that students learn more when video is used than when virtual reality or augmented reality is used. Instead, this

study focuses on how video can be used as a delivery mode for teaching procedural skills in an online learning environment based on Gagné's Nine Events of Instruction (Gagné, 1975).

Videos

Some studies have been conducted on teaching procedural skills using videos (Aragon & Zibrowski 2008; Biard, Cojean & Jamet, 2018; Low, Healy & Rasburn, 2008; Vincent & Stacey, 2008). Videos can be used to teach procedural skills. According to Biard et al. (2018), "videos also seem to be particularly useful for procedural learning (i.e., learning to perform a series of actions to achieve a particular goal…" (p. 411). According to Koumi (2006), the following learning outcomes can be provided through self-assessed, segmented video–print combinations. These include;

1. Hook to capture the attention of the learners and sustain their interests. The authors suggest creating suspense, using shock and or entertaining or fascinating the audience.
2. Signpost. The author suggests the use of signpost to inform the learners what will be next and what will come later. They also suggest that the signpost should tell learners what to look out for.
3. Facilitate cognitive engagement. According to the author, using pose questions, encouraging prediction and establishing relevance to personal life are good ways of facilitating cognitive engagement.
4. Enable the construction of knowledge by not using words to duplicate images. The authors also recommend the use of pause commentary to enable contemplation. The authors also recommend using visual metaphors.
5. Sensitize by using consistent style and also by personalizing the teacher.

6. Elucidate by using varying tempo so that syntax can be indicated. Koumi (2006) also suggest that image-word density should be restrained while enhancing legibility and audibility.
7. Reinforce by using varying angles when repeating a scene. The author recommends the use of comparison and contrast to reinforce a point.
8. Conclude and reinforce through the use of chapter ending and summarization of key features. Koumi (2006) also recommends that complementary materials should be incorporated.

Videos have also been used in clinical skills training. In one study, Jang & Kim (2014) examined learner perceptions and use of clinical videos online in learning clinical skills as well as preparing for objective structured clinical examination. According to the authors, their study:

> …confirms the overall positive impact of OSCE videos on student learning of clinical skills. Having faculty integrate these learning resources into their teaching, integrating interactive tools into this e-learning environment to foster interactions, and using mobile devices for convenient access are recommended to help students make more effective use of these resources. (p.1)

Videos provide certain advantages for both the learners and the instructors (Berk, 2009; Biard, Cojean & Jamet, 2018; Yang & Tao, 2015). Videos could be used both in face-to-face environments and online learning environments and they could be used to teach various skills.

Using videos in education. Video can be used in various ways in a classroom environment. According to Choe (2017), video can be used to "showcase demonstrations, experiments, and hands-on procedures. Use videos to help teachers learn processes like classroom management, use them as tools for self-reflection, and use them to show off

demonstrations that are difficult to analyze in real-time" p.4. Viewing a video for educational purposes can increase learner motivation (Cheng, Huang, Shadiev, Hsu & Chu, 2014).

Videos have long been used to teach certain skills both in synchronous and asynchronous learning environments. In the medical field, for example, videos can be used together with other simulations. A trainer box is a good example of such a training method. The following is a description of the trainer box:

> This type of surgical simulator uses real surgical instruments and equipment including video monitors, cameras, and laparoscopes. It is an opaque box that approximates the size of the adult human abdominal cavity. Slits are prefabricated on the anterior surface of the box, through which trocars (access ports) may be placed. An attached flexible arm acts as a camera holder. Laparoscopic instruments are then inserted through the ports and into the box. Various targets are manipulated inside the box, with visual information relayed through a video source and display comparable to that used in most operating theatres. Tactile feedback is limited, as it is in laparoscopic surgery, by the instruments used. The use of real instruments and equipment is clearly the strength of these systems (Roberts, Bell & Duffy, 2006, p.3220).

In the health sciences, videos have also been used for assessing the learners. There are various assessment methods which are used in the health sciences. One such examination is the Objective Structured Clinical Examination (OSCE). Video demonstrations of clinical skills have proved to be effective in teaching clinical skills. Videos, according to another author, are highly effective when communicating complex biomedical information in such a way that other modes cannot, such as print (Drazen, Morrissey, Prince, Graham, Campion & Scott, 2016).

Video clips can also be used for teaching. When using video clips in a classroom environment, the following guidelines have been suggested:

1. Pick a particular clip to provide the content or illustrate a concept or principle (Note: If you want students to view the entire movie, assign that viewing outside of class.);
2. Prepare specific guidelines for students or discussion questions so they have directions on what to see, hear, and look for. What's the point of the clip? Make it clear to the students;
3. Introduce the video briefly to reinforce purpose;
4. Play the clip;
5. Stop the clip at any scene to highlight a point or replay clip for a specific in-class exercise;
6. Set a time for reflection on what was scene;
7. Assign an active learning activity to interact on specific questions, issues, or concepts in clip; and
8. Structure a discussion around those questions in small and/or large group format (Berk, 2009, p.10).

When using videos for learning, some researchers have provided guidance on the length of the video. The authors recommend that lengthy videos could be segmented to ensure that the learners are not overwhelmed with too much information. Biard et al. (2018) also recommended that the video used for instructional purposes should be segmented, especially for video used for procedural training. According to Berk (2009), videos selected for use in education should be

appropriate for the lesson. Berk also recommends that before selecting a video for use in a classroom setting, the characteristics of the learners should be considered.

Virtual Reality/Simulation

Virtual reality simulations are also a common way to deliver instruction related to procedural skills. These are used in various fields such as science, the medical field, and in aviation. The most common fields in which virtual reality simulations are used is in the medical field, particularly, in the surgical arena. The following is a description of the use of virtual reality to teach procedural skills in surgery:

> Sophisticated computer software has been developed in an attempt to replicate critical skills required for laparoscopic surgery and, in some cases, entire procedures. Many of these simulators provide a more believable practice environment than traditional box trainers, hence providing higher face validity. These trainers can be set up to record and save accurate and objective data for individual performance on specific tasks. The metrics of most devices can be customized, setting pass/fail criteria. These features present the opportunity for a trainee to practice independently on their own time as part of a structured curriculum (Roberts, Bell & Duffy, 2006, p. 3221).

Even though virtual reality and simulations have been widely used for teaching procedural skills especially in clinical environments, the challenge that still remains for using such methods includes the cost. VR is expensive to both produce and use (Inoue, 2007; Parham et al., 2019; Pickup et al., 2013; Rourke, 2020; Smith, 2018). VR surgical simulations are also costly though beneficial for training. At the time of writing this document, the estimated cost of surgical simulation, building virtual worlds was between $100,000 and $1,240,000 (Kyaw, 2019; Parham et al, 2019; Pottle, 2019).

Learning Theories Related to Procedural Knowledge

Driscoll states that, "a theory of learning is a set of laws or principles about learning" (2005, p.2). A learning theory is made up of a set of concepts linking observed changes in performance with what is thought to bring about the changes (Driscoll). There are various learning theories which have been applied in educational environments. These theories include cognitive information processing theory, skill acquisition theory and situated learning or situated cognition, among others.

Cognitive Information Processing Theory

Cognitive information processing (CIP) theory suggests that the human learner processes information similarly to a computer. The information input is from the environment and is then processed and stored in the memory and the output is in the form of learned ability (Driscoll, 2005). Information is processed in stages in this theory. In the first stage, known as sensory memory, information from the senses, mainly visual and auditory, is held in the memory briefly, long enough to be processed further. The information is further processed in the next stage in the working memory. The working memory holds a very limited amount of information for a limited amount of time. The information then goes into the next stage, the long-term memory which acts as a permanent storehouse of the information (Driscoll, 2005).

Within this theory, two concepts are well discussed. These are selective attention and automaticity. Selective attention is a learner's ability to select and process certain information while at the same time ignoring other information (Driscoll, 2005). Selective attention results in 'internal concentration on a certain stimulus of a single goal among multiple outside stimulants' (Moradi, Omidi, Vosoughi, Ebrahimi, Alizadeh & Alimohammadi, 2019, p.214). Automaticity on the other hand refers to the ability of the learner to perform a task with minimal attention or

when the sources of information become a habit (Driscoll, 2005). The two, selective attention and automaticity play a role in learning skills and could play a role in learning procedural skills.

An information processing analysis for a procedure can be conducted. The following, according to Smith & Ragan (2005) shows how an information processing analysis can be conducted:

- Recognizing a situation in which a procedure can be applied
- Recalling the procedure
- Applying the steps involved in the procedure
- When required, making decisions at the points of decision
- Selecting the correct branch or branches if required
- Completing the steps in the required branches
- Determining if the procedure has been applied aptly (p.190).

According to the Smith & Ragan (2005), there are certain procedures which may have many decision points. Decision points are stages within a procedure at which possible steps can be taken based on the judgement of the individual performing the procedure. At decision points, it is possible that there could be other possible steps which may be taken depending on the situation and information presented. An example of a procedure requiring decision points includes jump starting a vehicle. The steps could be as follows:

1. Determine if the battery is connected properly
2. Connect the jumper cables
3. Determine if the current is flowing from the running car to the battery needing to be charged
4. Determine if the battery has a sufficient charge by trying to start it

5. If the battery has a charge, disconnect cables and let the car idle for about 5 minutes
6. If no charge detected, repeat steps 2-5 or call a professional

Skill Acquisition Theory

Another theory which could be linked to procedural learning is the skill acquisition theory. According to Dekeyser (2007), this theory explains how people advance in learning different skills from the primary learning to advanced proficiency. Dekeyser further discusses the theory as follows:

> The basic claim of Skill Acquisition Theory is that the learning of a wide variety of skills shows a remarkable similarity in development from initial representation of knowledge through initial changes in behavior to eventual fluent, spontaneous, largely effortless, and highly skilled behavior, and that this set of phenomena can be accounted for by a set of basic principles common to the acquisition of all skills (Dekeyser, 2007, p.94).

The theory of skill acquisition is often applied in language acquisition in the literature (Laliberté, 2019; Lyster, 2013; Taie, 2014). Learning a new language requires certain skills. As a result, this theory is intricately linked to language acquisition. There are important concepts to consider in the skill acquisition theory. These include skill, repetition priming, automaticity and practice. Skill is a key concept in the theory. Some of the attributes of a skill are that it is learned, a skill has an aspect of motivation, purpose and goal, a skill incorporates both content and context performance, a specific stimuli presence is needed to perform and transfer the skill, and that a good amount of time is required to reach higher levels of skill (Taie, 2014). Repetition priming, on the other hand, is a modification in the handling of a stimulus as a result of a previous contact to the exact or a related stimulus (VandenBos, 2007).

As described earlier in the cognitive information processing theory, the idea of automaticity is that skills move from attentive to automatic (Dekeyser, 2007). The core features of automaticity include an increase in the speed of performing the task, decrease in the level of attention and reduced competition from other processes (Taie, 2014). Practice is also another component of this theory. Practice reduces the number of errors and also the amount of time required to perform the task. Practice is required in skill acquisition (Taie, 2014).

Situated Learning or Situated Cognition

This theory suggests that most of what is learned is particular to the situation in which it is learned (Anderson, Reder & Simon, 1996). Situated cognition focuses on sociocultural setting and activities of the individuals within a particular setting, because in this theory, knowledge is gained through lived practices of individuals within a society (Driscoll, 2005). According to the same author, learning is seen as an increased participation in communities of practice. Learners' participation in communities of practice is through cognitive apprenticeships (Brown, Collins & Duguid, 1989). A good example of cognitive apprenticeship is an apprentice who learns of the skills and knowledge by acquiring the skills and knowledge from working with the experts. Internships are also based on the idea of cognitive apprenticeship as they give the students an opportunity to practice the skills and knowledge they gained in school (Driscoll, 2005).

Cognitive apprenticeship endeavors to promote learning inside the bond of culture, activity and tools and the learning done inside and outside the school progresses through collaborative social interaction and the social formation of knowledge (Brown, Collins & Duguid, 1989). Cognitive apprenticeship is also linked with collaborative learning, hence the need for collaborative groups. According to Brown et al. (1989) the features of group learning include:

* Collective problem solving. Groups are not just a convenient way to accumulate the individual knowledge of their members. They give rise synergistically to insights and solutions that would not come about without them (Schoenfeld, in preparation).

* Displaying multiple roles. Successful execution of most individual tasks requires students to understand the many different roles needed for carrying out any cognitive task. Getting one person to be able to play all the roles entailed by authentic activity and to reflect productively upon his or her performance is one of the monumental tasks of education. The group, however, permits different roles to be displayed and engenders reflective narratives and discussions about the aptness of those roles.

* Confronting ineffective strategies and misconceptions. We know from an extensive literature (diSessa, 1982, 1983, McCloskey, Caramazza, & Green, 1980; White, 1983) that students have many misconceptions about qualitative phenomena in physics. Teachers rarely have the opportunity to hear enough of what students think to recognize when the information that is offered back by students is only a surface retelling for school purposes (the handing back of an uncomprehended tool, as we described it at the beginning) that may mask deep misconceptions about the physical world and problem solving strategies. Groups, however, can be efficient in drawing out, confronting and discussing both misconceptions and in- effective strategies.

* Providing collaborative work skills. Students who are taught individually rather than collaboratively can fail to develop skills needed for collaborative work. In the collaborative conditions of the workplace, knowing how to learn and work collaboratively is increasingly important. If people are going to learn and work in

conjunction with others, they must be given the situated opportunity to develop those skills. (p.40)

Situated cognition also "positions the learning process in the 'real world' to provide meaningful learning and promote the transfer of knowledge" (Schott & Marshall, 2018, p.844). Groups and real-world experiences are common themes within situated cognition theory.

Gagné's Nine Events of Instruction

According to Robert Gagné, special conditions are required for a particular learning outcome to be attained (Gagné, 1975). Gagné prescribed the events of a lesson, which may occur in a particular order, though not solidly set in the particular order in which they are discussed below:

Activating motivation. According to Gagné (1975), preliminary events of a lesson are more often designed to re-stimulate motivational states in the learner. Learners could need to be motivated in the course at the beginning of the lesson. More often, learners need to be stimulated again to get back in the motivational state.

Informing the learner of the objective. According to Gagné (1975), establishing a specific expectancy with regards to the outcome of learning is the second part of motivating events. This can be done by letting the leaners know what they will be able to do upon completion of the lesson. This could be done by using verbs describing what the learners will be able to do upon completion of the lesson. For example, learners will be able to describe the Nine Events of Instruction (Gagné, 1975) upon completion of this lesson.

Directing attention. The event which follows informing the learners of the objective is directing their attention to the stimuli which are integral part of the learning task. According to

Gagné (1975), this might be accomplished through communication by using terms such as "look," "notice," etc.

Stimulating recall. Gagné (1975) emphasized the need for previously learned capabilities to be readily made available in memory of the learner. Various strategies can be used to accomplish this. This includes using specific terms such as 'remember' among others. This will assist them to recall the previous information necessary for the current lesson.

Providing learning guidance. According to Gagné (1975), the events which form a part of instruction during this phase of learning can be referred to as learning guidance. The amount of guidance offered during a lesson varies depending on the situation and the lesson. Gagné recommends that the guidance should be oriented to the objective. The guidance could be offered during the lesson activities. The activities should align with objective.

Enhancing retention. Spaced reviews, according to Gagné (1975), are a form of enhancing retention and retrieval of the things learnt. Spacing includes requiring recall of things learnt at reasonable intervals of time. Additional examples spaced in time over weeks or days after the initial learning greatly enhances recall of learned capability.

Promoting transfer of learning. When using learning transfer in promoting new learning in a course or subject, Gagné (1975) stresses the importance of providing for the prior learning of prerequisite information and intellectual skills. He recommends including questions or problems which determine the presence of the prerequisite capabilities and also ensure that they are available in the working memory of the students. He also recommends the use of examples and situations when the aim is to transfer learning to other fields of study or activities.

Eliciting the performance; providing feedback. Providing an opportunity for the learners to display their performance is one of the important stages in learning. According to

Gagné (1975), informative feedback should be provided after the performance so that reinforcement may occur. Even though Gagné (1975) suggested that the sequence in which they are listed should be used to deliver instruction, the way in which the events are implemented varies depending on the instructional delivery system selected (Driscoll, 2005). The events of instruction are used in various fields. The events of instruction can also be used to teach procedural skills.

The aim of this study is to combine what is known about learning theories and effective methods for teaching procedural skills, and use this information to create guidelines for teaching procedural skills in an online asynchronous learning environment using video. The development of guidelines for teaching procedural skills using video are grounded in Gagné's Nine Events of Instruction (Gagné, 1975). The development of these guidelines is based on prior research regarding procedural skills instruction and the use of video for teaching such skills.

Summary of Literature Review

The literature discusses procedural skills in various ways. One of the aspects discussed with regards to procedural knowledge is how they differ from other skills such as declarative knowledge. According to the literature reviewed in this study, procedural knowledge involves a series of steps which may or may not be in a particular order. There are also guidelines which have been proposed for teaching procedural skills which include making sure that the steps taught are clearly described, the steps are a result of cognitive task, the steps should be written beginning with a verb and that the procedure should be taught as simple as possible among others.

Some of the studies also revealed that procedural skills are also commonly taught in clinical situations. As a result, there are also guidelines that have been provided for teaching

technical procedural skills. These include practicing basic psychomotor skills until the learners become proficient, enabling the learners to acquire knowledge specific to the procedure, breaking the procedure into key steps, assessing and providing feedback, among others.

This study also examined some delivery methods which can be used when teaching certain skills. These include virtual reality, videos and augmented reality. Videos have long been used in education. Some studies have also claimed that videos are effective when communicating complex information. Videos have also been used to teach clinical procedural skills.

There are also learning theories which have been discussed in this study. These include, cognitive information processing theory, skill acquisition theory, and situated learning. A review of the literature showed that Gagné's Nine Events of Instruction (Gagné, 1975) has been effectively used to teach procedural skills. These events include activating motivation, informing learners of the objectives, directing attention, stimulating recall, providing learning guidance, enhancing retention, promoting transfer of learning and eliciting performance/ providing feedback (Gagné).

This review revealed that current studies regarding teaching procedural skills using videos provided little guidance on how to use Gagné's Nine Events of Instruction (Gagné, 1975) to teach procedural skills in an asynchronous learning environment. This study provides instructors and course developers with guidance on how to use video to teach procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975).

Chapter 3

Research Methodology

The purpose of this study is to develop guidelines for teaching procedural skills in an asynchronous online learning environment using video, based on Gagné's Nine Events of Instruction (Gagné, 1975). This study used a design and development research methodology. The development of the guidelines was conducted in four phases. These phases include analysis, design, development, and evaluation.

Study Design

In this design and development study, guidelines were developed which will support faculty in teaching procedural knowledge using video in an asynchronous online learning environment. Design and development research is "the systematic study of design, development and evaluation processes with the aim of establishing an empirical basis for the creation of instructional and non-instructional products and tools and new or enhanced models that govern their development" (Richey & Klein, 2008, p. 748).

This research is "a type of inquiry unique to the instructional design and technology field dedicated to the creation of new knowledge and the validation of existing practice" (Richey & Klein, 2014, p.141). The guidelines developed from this study will be used to support teaching and learning processes. According to the same authors, design and development studies often tend to be empirical in nature. The whole process of design and development from analysis, design, development, implementation and evaluation is often documented (Richey & Klein, 2014).

Study Procedures

This study was conducted in four (4) phases. These include analysis, design,

development and evaluation based on the Analysis, Design, Development, Implementation and Evaluation (ADDIE) model (Peterson, 2003). However, this study did not include the implementation phase, as this activity was beyond the scope of the study.

Analysis

In the first phase, information from the literature related to procedural skills training, strategies for teaching procedural skills and strategies for using videos to deliver instruction will was gathered. Information on how to use Gagné's Nine Events of Instruction (Gagné, 1975) to teach procedural skills was obtained. A systematic review of the literature was conducted in which a criterion was used to select the literature. The criteria that was used to select the relevant literature ensured that the literature was current, related to instructional strategies for teaching procedural skills in online learning environments and strategies for using videos in an online learning environment.

The sources of the literature included online academic journals, doctoral dissertations, books, academic databases, learning management systems websites and academic journals. The first step during this phase was to identify the relevant literature from which to collect the data needed to design the guidelines. The second step was to collect the necessary data from the literature. This data was used in the second phase in which the guidelines were designed.

Design

The second phase involved the design of the guidelines and examples of the application of the guidelines based on the data collected from the literature review. General considerations for the use of video for learning were also designed during this phase. A real-world example of how video can be used to teach procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975) was designed during this phase. An ideal method of presenting and housing the

guidelines and resources was identified during this phase. The main goal of this phase was to identify how videos can be used when teaching procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975).

Development

During this phase, the development of the guidelines commenced. The process included describing the guidelines, linking a particular event of instruction with a guideline on how to use video to teach procedural skills in an online learning environment based on Gagné's Nine Events of Instruction (Gagné, 1975). During this phase, the guidelines were edited, and new information was added as need arose. A website was developed in which necessary resources related to the guidelines was housed. A rubric to evaluate the guidelines was developed during this phase. The rubric was developed within a Qualtrics survey. The survey was used to collect the data from the expert reviewers. The questions in the survey included both Likert scale and open-ended questions for qualitative feedback.

Evaluation

The goal of this phase was to validate the design of the guidelines and obtain input for improving them. The steps included conducting expert review of the developed guidelines, and finally making revisions based on feedback from expert reviewers. During the evaluation phase, the data gathered during expert review was analyzed and used to revise the initial guidelines. A survey was used to collect the data from the expert reviewers. The survey enabled the collection of both qualitative and quantitative data. The quantitative and qualitative data was individually analyzed to look for common themes from the expert reviewers. Once common themes were identified, the next step was to revise the guidelines based on the common themes in the suggestions made by the reviewers.

Participants

The participants in this study included instructional design and technology scholars and experts in online pedagogies. They were selected based on their knowledge and experience with teaching procedures, using videos in an online learning environment and or their experience in online teaching. The expert reviewers with a Doctor of Philosophy (PhD) in their respective fields were asked to participate in the study after approval from Institutional Review Board (IRB). The reviewers were contacted through email and asked to participate in the study. Upon acceptance to participate in the study, they were provided with a link to the website containing the materials for review, including further details on how to complete the review. The reviewers were provided with the opportunity to participate in the study anonymously or to be recognized by name.

Data

The data gathered in this study included information from the literature and feedback from the experts. From the literature, the data that was collected includes definition of terms and examples of strategies that can be used to teach procedural skills in an online learning environment using video. The data also included qualitative data from open ended questions and quantitative data from Likert-scale based questions. There are three sections in the survey. The first section focuses on general considerations for using videos for learning, while the second section focuses on guidelines for using videos to teach procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975). The third section focuses on the effectiveness, practicality and possible real-world constraints in the use of the guidelines as a whole. The three sections included both open-ended and Likert-scale based questions.

Data Analysis

The data analysis phase included an analysis of the literature and analysis of the feedback provided from survey responses. The data analyzed from the literature contained information on the strategies for teaching procedural knowledge using videos, and information on available strategies for using Gagné's Nine Events of Instruction (Gagné, 1975) to teach procedural skills. This data was used to develop the guidelines. Once the guidelines were created and distributed to the experts, the responses from the experts were analyzed to obtain information such as the effectiveness of the guidelines and how they can be improved. The analysis of this data revealed the effectiveness of the guidelines and areas of the guidelines that could be improved.

Final Product

Once the feedback from expert reviewers was analyzed, revisions were made to the guidelines. A revised version of the guidelines was developed and included in Chapter 5 of the dissertation document.

Chapter 4

Developing Guidelines for Teaching Procedural Skills Online Using Video

This study seeks to develop guidelines for teaching procedural skills in an asynchronous online learning environment using video based on Gagné's Nine Events of Instruction (Gagné, 1975). A design and development research methodology was used and included the following stages: analysis, design, development and revision, and evaluation. In the analysis stage, a comprehensive literature review on procedural skill instruction, Gagné's Nine Events of Instruction (Gagné, 1975), video in education, and other related theories was conducted. In the design phase, a proposal on how Gagné's Nine Events of Instruction (Gagné, 1975) can be applied to teach procedural skills as well as how video can be used in support of these strategies is presented. The development stage involved designing the guidelines based on relevant literature. The evaluation stage requires that the guidelines be formatively evaluated by experts for recommendations and improvement. This chapter presents the findings from a systematic literature review which was conducted at the analysis stage and during the development process.

Guideline Development

The steps involved during the development process included an analysis of the literature, formulation of the guidelines, developing the survey to be distributed to the experts and also developing a website to house the resources. The resources housed on the website include information about the study, informed consent information, and the expert review survey link (See Appendix G for the informed consent form and Appendix H for the rubric).

Analysis of the Literature

To develop the guidelines, a comprehensive review of the literature related to the topic was conducted. The literature analysis centered on Gagné's Nine Events of Instruction (Gagné,

1975), video use in education and theories related to video use. Because an analysis of the literature is an important part of a design and development study, various databases were consulted. These include Virginia Tech Summons, ProQuest, Inter library loan services, Gale In Context, Networked Digital Library of Theses & Dissertations, Directory of Open Access Journals, JSTOR Journals, Health Source, Humanities International Complete, J-STAGE, Academic Search Complete, Scopus®, Religion and Philosophy Collection among others.

Chapter 2 described the need for guidelines for using video to teach procedural skills in an online learning environment based on a theory. This study seeks to develop guidelines for using video to teach procedural skills in an online learning environment based on Gagné's Nine Events of Instruction (Gagné, 1975).

Formulating the Guidelines

After analyzing the literature, the next step was to formulate the guidelines. The initial guidelines were created to assist instructors and course developers with teaching procedural skills using video in an online learning environment based on Gagné's Nine Events of Instruction (Gagné, 1975). Formulating the guidelines involved analyzing the literature, organizing the literature in groups, creating categories and finally, organizing the information collected in the literature analysis and placing it into the categories created.

Analyzing the literature. To create the guidelines, relevant literature was carefully searched, consulted and used. Related materials were selected and used. From the related materials, similar themes were identified and noted to facilitate the next stage in the process.

Organizing the literature in groups. The next stage after analyzing the literature was to organize the similar themes into different groups. The groups created in this study included general guidance on the use of video in education and then Gagné's Nine Events of Instruction

(Gagné, 1975). The purpose of organizing the literature into groups was to make it easier to create the different categories and then to place the information collected into the categories created.

Creating Categories

The next step was to create categories under which to place the information collected from the literature. Two categories were created and presented as two tables. These include: *General Considerations for Using Video for Learning* and *Guidelines for Using Videos to Teach Procedural Skills Based on Gagné's Nine Events of Instruction* (Gagné, 1975). The subcategories under *General Considerations for Using Video for Learning* include length, context, visual cues/actions, characters/information, and accessibility.

General considerations for using video for learning. This category provides guidelines on the length of the video, the format, context visual cues/actions, characters/information and accessibility. On the length of the video, most of the sources consulted agree that the video should not be too long, but variance existed across the suggested length (Anderson, 2005; Berk, 2009; Biard, Cojean & Jamet, 2018; Brame, 2016; Cheng, Huang, Shadiev, Hsu & Chu, 2014). The common recommendation was that the video should not be longer than 20 minutes. However, according to Choe (2017), a video should be concise and to the point. The author recommends that a long video should be segmented. Biard et al. (2018) and Cheng et al. (2014) also recommend that a long video should be segmented to avoid overwhelming the learners with too much information. As a result, this category was created in the general guidelines for using video.

The second subcategory created was the format and quality of the video. This category provided guidance on the formats and quality of video which can be used (Brook, 2014; Brown,

2002; Chan, 2010; Forbes, Oprescu, Downer, Phillips, McTier, Lord, Barr, Alla, Dayton, Simbag & Visser, 2016). The recommendation was that more common video formats should be used so that learners can easily access the video (Brook, 2014). The author also recommended that when the instructor intends to use video to assess the learners, instructions on which format to use and how to upload the video in that format should be provided to the learners. The recommendation was that the videos should be of good quality.

The third subcategory created focused on the context. According to Berk (2009) and Brame (2016), the video should be context based. For example, a video teaching a procedure on how to operate a truck could be enhanced by recording the steps from the viewpoint of the learner as a driver, within the physical context of the truck cab. The authors recommend that the language used in the videos should be related to the video. According to Berk (2009), the language in the video should be day-to-day authentic language with the exception that the purpose is related to the language. Brame (2016) suggests that the language used in the video should be conversational language.

According to Brame (2016), using conventional language will ensure that the learners understand the content and do not struggle to understand the content. In many of the recommendations for improving videos for use in the educational context, Choe (2017) suggests that videos should be well scripted and should be authentic. The author suggests that the presenter in the video should be able to both write and speak as naturally as possible so that an authentic message can be conveyed.

Another subcategory created focused on actions, visual cues, and number of characters. In order to achieve the desired learning outcome, the actions, visual cues and number of characters should be intentional. According to Berk (2009), the actions within the video should

be related to the purpose of the lesson. For example, a video describing how to remove a flat tire from a car should only include specific shots that focus on each step in the process, to avoid confusing the learner or adding extraneous cognitive load. Berk (2009), recommends that any other unnecessary actions, visual cues should be removed from the video. The author also recommends that the number of characters should be limited only to those needed to emphasize the point. According to Berk (2009), having too many characters may be disrupting to the viewers. If the video to be produced describes the process of removing a spare tire, there would be no purpose in having more than one person in the frame, except to convey that such action may require assistance. According to Choe (2017), visuals should be intentional and should not distract the learner. The visuals should assist in clarifying a point within the lesson. Showing images of that are close-ups of each action related to the changing of a tire would help the learner maintain focus on the action, as well as eliminate extraneous detail.

The last subcategory created was accessibility and user interface. The Web Content Accessibility Guidelines (WCAG) 2.2 offers suggestions on how to make web content accessible to individuals with disabilities (Caldwell, Cooper, Reid & Vanderheiden, 2008). This study included guidelines for how video can be accessible to individuals with disabilities related to the use of video and audio. The Web Content Accessibility Guidelines (WCAG) 2.2 suggest the use of closed captioning and alternative text. According to McAlvage & Rice (2018), a deaf or hearing-impaired learner uses the closed captioning to read the content of the video.

This subcategory also suggests ways in which a video can be created to ensure that the user has more control over the video. Some authors have suggested that more play options and interactive features should be included in the video, including having a play, rewind, and pause option (Anderson & Ellis, 2005; Brame, 2016; Brook, 2014; Forbes et al., 2016; Schreiber

Fukuta & Gordon, 2010). Brook (2014) recommends that the video should have playback features available to the learner, such as fast forward, slow motion, rewind, and pause. Schreiber et al. (2010) suggested that students appreciated the ability to control the video through the use of playback features as this enabled the learners to use the video based on their needs. Having control will provide the learners with opportunities to control their learning. A student can replay the video for example when they want to further understand the lesson or point in the lesson. Learners can also pause the video so that they can practice performing the procedure.

Considerations for teaching procedural skills. The other category created during this phase provided considerations for teaching procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975). The events under which the considerations were sub-categorized include: (1) Gaining attention, (2) Informing learners of objectives, (3) Stimulating recall of prior learning, (4) Presenting the content, (5) Providing learning guidance which was combined with Eliciting performance (practice), (6) Assessing performance which was also combined with Providing feedback, and finally, (7) Enhancing retention and transfer.

(1) Gaining attention. To gain the attention of the learners, the recommendations included engaging the learners, arousing interest and emphasizing the practicality of the procedure. To engage the learner, inform them of the efficiency of the procedure over trial and error (Smith & Ragan, 2005). Learning procedures could be intrinsically motivating because they provide the learners with the opportunity to complete tasks more efficiently than when they applied the trial-and-error approaches prior to the lesson (Smith & Ragan, 2005). Therefore, it is necessary to emphasize the importance of learning the procedure (how it could be efficient and reliable) because it could be meaningless and rote to the learners. The authors also suggest that the instructors could also demonstrate the efficiency and reliability of the procedure. Arouse

interest and curiosity through the use of questions related to the procedure (Buscombe, 2013). Asking questions related to the procedure could make the learners curious and interested in the lesson. These questions could include asking the learners why the procedure is necessary and if it can be applied in certain situations. Emphasizing why the procedure is a practical skill to acquire was recommended by Cheung (2016). This could also assist in gaining the attention of the learners as they could be willing to learn the procedure if they are informed of the practicality of acquiring the skill.

(2) Informing learners of objectives. To inform learners of objectives, use introductory that inform learners what they will be able to accomplish upon completion of the lesson (Smith & Ragan, 2005). An example of an introductory term may include: "Students will be able to..." The objectives should be student centered and measurable (Buscombe, 2013; Cheung, 2016). The objectives could be written in a way that they center on the learner by informing the learner what they will be able to accomplish after the lesson (Cheung, 2016). If the lesson centers on removing a spare tire, an example of an objective would be: Upon completion of this lesson, learners will be able to correctly remove a spare tire from a car, based on the rubric provided to them.

(3) Stimulating recall of prior learning. To stimulate recall of prior learning, use questions and images related to previously learned information (Miner, Mallow, Theeke, & Barnes, 2015). Concepts that are known and that should be used in recognizing a situation can support the acquisition of a procedure. Learners may have previously learned procedures that were less complex that will be combined with other procedures to form a new and complex procedure (Smith & Ragan, 2005).

(4) Presenting the content. When presenting the content, ensure that it is well organized and that it addresses the learning objectives (Buscombe, 2013). Provide learners with opportunities to view the procedure through demonstrations (Cheung, 2016; Grantcharov & Reznick, 2008; Wearne, 2011; Woo, 2016). The instructor could describe the steps as they are performing the procedure (Buscombe, 2013; Grantcharov & Reznick, 2008; Wearne, 2011; Woo, 2016). Provide opportunities for learners to learn how to recognize situations that may need a particular procedure, complete its steps, recall the steps in the procedure and ascertain if the procedure was applied properly (Smith & Ragan, 2005). The procedure to be demonstrated should be relatively simple, about seven steps or fewer and even fewer for novice learners who may find it difficult to learn complex procedures.

Decision points should be fewer as well (Smith & Ragan, 2005). Providing learners with mnemonic devices to assist them remembering critical steps within a procedure can be useful (Smith & Ragan, 2005). Learners should also be encouraged to develop their own mnemonic devices. Mnemonic devices could assist the learners recall necessary information which might be useful when making a decision (Bellezza, 1981). This could be particularly helpful for complex procedures or procedures with many decision points. A mnemonic device could help them remember which points decision should be made.

Instructors should emphasize the learning points which are important Cheung (2016). These points are usually critical to the procedure to be performed. Instructors should also emphasize the actions to avoid so that risks may be minimized, apart from emphasizing actions needed to correctly perform the procedure (Cheung, 2016). This is particularly important for procedures involving some risks, for example, medical procedures in which a human life is at risk. In such a procedure, it is necessary to inform the learner of the actions to avoid so that the

risk is minimized. For example, when practicing how to perform an open-heart surgery, avoid the reuse of instruments to prevent contamination.

(5) Providing learning guidance/Eliciting performance (practice). To provide "learning guidance" and elicit performance (practice), learners can be presented with situations in which the procedure might be useful. Learners could then be asked to determine whether or not the procedure should be applied (Smith & Ragan, 2005). Each individual step within a procedure could then be practiced (Grantcharov & Reznick, 2008; Smith & Ragan, 2005). After practicing the step, the learners could then practice the entire procedure multiple times (Kneebone, 2005; Smith & Ragan, 2005). Learners could practice recalling the pattern and nature of the steps in the procedure, after practicing how to execute the procedure and determining whether a procedure was correctly completed should be part of the practice (Smith & Ragan, 2005). The following guidance for practicing may be applied:

1. Learning to determine if the procedure is required. To practice this skill, learners can be presented with situations in which the procedure might be useful, and having the learners determine whether or not the procedure should be applied.
2. Learning to complete the steps in the procedure. Each individual step within a procedure should be practiced soon after it is presented. After practicing the step, the learners should then practice the entire procedure multiple times. A job aid should only be provided to the learners during practice of procedures requiring a job aid.
3. Learning to list the steps in the procedure. According to the authors, the learners should practice recalling the pattern and nature of the steps in the procedure, after practicing how to execute the procedure.

4. Learning to check the appropriateness of a completed procedure. Determining whether a procedure was correctly completed should be part of the practice. Learners should practice reviewing their performance and that of others as well (Smith & Ragan, 2005).

(6) Assessing performance\ Providing feedback. The next stage is to assess performance and provide feedback. For the purpose of this study, feedback is defined as the information regarding the progress, accuracy and appropriateness of their actions or submitted work (Van De Ridder, 2008). A debriefing session to provide feedback on the performance of the learner can be used (Grantcharov & Reznick, 2008). The feedback provided to the learners should be objective (Cheung, 2016; Buscombe, 2013) and could include determining if the situation allowing the use of the procedure was correctly identified. Provide the reason why or why not this criterion was met. Certain situations might not require the procedure to be applied. For example, if a car tire only needs more pressure, it could be unnecessary to remove the whole tire. Instead, adding air pressure would be the best solution. The learners could be provided with feedback on the accuracy of how they completed each step of the procedure. For procedures involving decision steps, the feedback should include feedback on whether the learner made the right decision, thereby correctly selecting the correct path in the procedure (Smith & Ragan, 2005).

It is important to make a distinction between decisions/steps that are fitting, but not important, and those that should be present (Farmer & Page, 2005). Some steps/ decisions are important to complete the procedure while others are fitting to have but not important for completing the procedure. For example, when changing a flat tire, it is fitting to wash one's hands after the procedure, but it is not an important step in performing the procedure. The feedback provided to the learners should address this distinction. The feedback provided to the

learners should indicate whether the procedure that was given was completed correctly. A detailed explanation of why a decision was made might be included in the general feedback (Smith & Ragan, 2005). Feedback could be provided at the end of the task (Bould, Crabtree & Naik, 2009). Feedback can also accompany the practice (Kneebone, 2005). After the practicing the procedure, feedback could be provided. The feedback could include information describing if the steps were correctly practiced and if decisions were applied correctly.

(7) Enhancing retention and transfer. To enhance retention and transfer, summarize the nature, form, and variation of the procedure and incorporate complementary materials (Smith & Ragan, 2005). Repeating the nature of the procedure, how it can be beneficial and also the different ways in which the procedure can be performed could assist the learners to remember the procedure and also assist them to transfer the knowledge and skill. A lesson on procedures might be summarized beginning with a review of the types of problems, situations or goals to which the procedure applies (Smith & Ragan, 2005). Such a review could also aid the transfer of this learning. The nature, form and variation of the procedure should also be summarized and reviewed. Directing learners to opportunities available for them to use the skills acquired (Buscombe, 2013) could also assist in the transfer and retention. Describing other contexts in which the procedure can be applied (Cheung, 2016) is also beneficial at this stage, as this could assist the learners to remember the procedure.

Examples of video use. Under the same category, a subcategory suggesting how video can be used to was created. This section was created to offer guidance on how video could be used to teach procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975). The guidance was arranged according to a particular Event(s) namely: gaining attention, informing learners of objectives, stimulating recall of prior learning, presenting the content, providing

‘learning guidance’/eliciting performance (practice), assessing performance/providing feedback, enhancing retention and transfer. Two sets of the events were combined (learning guidance and eliciting performance; assessing performance and providing feedback) because the guidance suggested on how to use the video to teach could be applied in the same way for these specific events.

To gain the attention of the learners, Koumi (2006) suggested that suspense, shock, surprise or entertainment. Using a funny or fascinating short scene was recommended to accomplish this goal (Berk, 2009; Choe, 2017). A short video showing the procedure can be used to gain the attention of the learners (Qutieshat, 2018; Woo, 2016). However, the short video should be related to the topic for it to be used (Miner, Mallow, Theeke & Barnes, 2015).

To inform the learners of the objectives of the lesson, Brame (2016) suggested the use of out-of-video text. However, text can be used within a video to display the objectives. On the other hand, Choe (2017) recommended the use of music and visual cues to highlight key points to be covered in the lesson. The use of visual cues or music could be incorporated as a means of stimulating recall. Visual cues could help learners focus their attention on an important element (Choe, 2017) in the video or image. This could stimulate their recall of the prerequisite. These can be incorporated into the video. See *Considerations for Teaching Procedural Skills* category for details on how to write the objectives.

When presenting the content, various suggestions have been provided (Anderson & Ellis, 2005; Borko, Jacobs, Eiteljorg & Pittman, 2008; Brunvand, 2010; Choe, 2017; Koumi, 2006; Pryor & Bitter, 2008). Pryor & Bitter (2008) suggested the use of examples in videos. Examples within a lesson could assist learners watching the video to see the application of the procedure in the real world. Related to examples are visual metaphors which have been suggested by Choe

(2017) and Koumi (2006). These are particularly helpful for conceptualization or to make statements within a lesson. Similarly, video can be used to highlight important points (Borko et al., 2008; Brunvand, 2010). If the video created is long, it could be segmented so as not to overwhelm the learners (Biard et al., 2018; Choe, 2017). The instructor could ensure that the learner has the opportunity to watch the video multiple times so that they are able to see what they would have missed the first time (Beck, King & Marshall, 2002). When recording a procedure to be demonstrated to the learners, capturing a scene using various angles is beneficial to the learners (Brook, 2014). This will ensure that the learners observe all the necessary aspects of the procedure.

To provide learning guidance, Brame (2016) recommended that guiding questions should be incorporated. The guiding questions could provide opportunities for learners to be engaged in the course and also opportunities for learners to conduct a self-assessment. Allowing the learners to view the video multiple times is beneficial to the learners as they can see what they could have missed the first time they viewed the video (Beck et al., 2002). This could particularly be beneficial when the learners are practicing the procedure. During practice, the learner could record themselves performing the procedure and can then send the video to the instructor for review (Brook, 2014; Grantcharov & Reznick, 2008; Santagata, Zannoni & Stigler, 2007).

Video can also be used to assess performance and provide feedback to learners. Brunvand (2010) recommends that tools which allow video commentary could be used. Feedback can be provided to the learners using video commentary features. Brook (2014) recommends that the learners should be provided with clear instructions on how to record their videos and also which formats to use and submit to the instructor. Video could be used as a tool for self-assessment, allowing learners to review their own behavior or performance and evaluate themselves (Yoo,

Son, Kim & Park, 2009; Zick Granieri & Makoul, 2007). Learners could view their own performance and re-record themselves performing the procedure if they are not satisfied with their initial performance (Winters, Hauck, Riggs, Clawson & Collins, 2003).

To enhance retention and transfer, the instructor could use video to reinforce repetition by using different angles (Koumi, 2006). This could assist the learners to remember the key steps in the procedure as key steps would be repeated in the video from different angles. Video can also be used to summarize the lesson by highlighting key points from the lesson (Borko et al., 2008; Brunvand, 2010).

Organizing the Information Collected

The last step was to organize the information collected from the literature into categories from themes that emerged. These categories were then used to create the guidelines, based on Gagné's Nine Events of Instruction (Gagné, 1975).

Survey Development

An expert review process was utilized to obtain the feedback about the design of the proposed guidelines. According to Richey & Klein (2014), experienced design practitioners are used to validate the tool or product designed. As such, the survey was developed to collect input from the expert reviewers in order to improve the guidelines for future use.

This survey developed had three sections— a section on general guidelines for using video in education, a section on the effectiveness, practicality and possible real world constraints in the use of the guidelines for teaching procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975), and a section on particular guidelines for using videos for teaching procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975).

The survey questions included Likert scale questions and open-ended questions. The Likert scale questions had five choices which were strongly agree, agree, neutral, disagree and strongly disagree. Other choices included rating the guidelines poor, fair, satisfactory, very good or excellent. Open ended questions provided the reviewers with the opportunity to provide further feedback with regards to the guidelines. The survey was designed using Qualtrics and was created with an option of having the reviewers include their name, affiliation and title should they select to do so. The reviewers were provided the option of including their identity if they desired to be acknowledged by name when the study is published. The expert reviewers had the opportunity to receive a separate electronic copy of the survey questions emailed to them should they desire one.

In order to organize the materials to be distributed to the expert reviewers, a website was created. The website was created within Google Sites and was used to host the materials and content related to the study. The website has a home page which provides more information about the study and also provides guidance on where the necessary content is located on the website. The content includes the study background, the projected timeline, informed consent, project documents and contact information for the researchers. The section for *Guideline Elements* consists of five subpages: The study background provided information on the need of the study, the proposed guidelines for the use of video to procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975), the detailed guidelines with supporting literature and additional background information which linked to Chapter Four of the dissertation describing how the guidelines were created. A Microsoft Word document version of the survey included all of the questions included in the online survey.

Conclusion

The purpose of this study was to develop guidelines for using video to teach procedural skills in an asynchronous online learning environment based on Gagné's Nine Events of Instruction (Gagné, 1975). To accomplish this, this study examined literature related to the use of video in education, procedural skills instruction, and also the use of Gagné's Nine Events of Instruction (Gagné, 1975) in teaching procedural skills. The information obtained from the literature was organized into categories that were then used to create the guidelines. The categories created in the study included general guidelines for using video in education and Gagné's Nine Events of Instruction (Gagné, 1975). The guidelines created will be useful for course developers and instructors who intend to use video to teach procedural skills in an online learning environment.

Chapter 5

Results

This chapter presents the feedback from expert reviewers and how it was used revise the guidelines for using video to teach procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975). The chapter provides a summary of the comments from the expert reviewers and highlights common themes from their responses.

Review of the Guidelines

In order to complete the design and development process, reviewers with expertise related to procedural skill training, video use in education, and instructional design were contacted and requested to provide their feedback on the proposed guidelines. Upon approval from Institutional Review Board (IRB), seven experts where contacted initially. Of the seven experts contacted, three agreed to participate in the study. Participants who agreed to participate in the study were provided with information on how to complete the review. The information included the following steps necessary to complete the review: The first step was to ensure that they read the study details. The second step was to read the informed consent details and the last step was to review the guidelines and provide feedback using the rubric provided. All reviewers used the same rubric to complete the evaluation of the guidelines. The reviewers where provided with the option of participating in the study anonymously. The profiles of the expert reviewers who participated in the study are presented as follows.

External Reviewers

Dr. Wendy Gentry currently serves as Assistant Professor of Education in the Instructional Design and Performance Technology program at Baker University. She has served as a director of project planning and performance for an environmental services organization.

She has also worked in the corporate sector as a project manager and instructional designer, before moving to higher education. She has over 25 years of industry experience in business performance improvement, planning, and instructional design. In the last few years, she has taught graduate courses in: Assessment, Evaluation, and Reporting, Design Principles for Instructional Design and Performance, Project Management for Instructional Design and Introduction to Instructional Design.

Dr. Christopher T. Miller is the Interim Dean of the College of Education at Morehead State University. His experiences include instructional design, curriculum development, P-12 teacher professional development, post-secondary program and course development, and multimedia development. His specialties include research and grants, games and simulations, distance learning, post-secondary teaching, and program development. He is an expert in Educational Technology.

Dr. M. Aaron Bond is a Senior Director, Professional Development Network, Instructional Design, and Innovation at Virginia Tech. He has worked to improve education across various settings. He has an extensive educational background in the public and private sectors, serving as a corporate trainer, k-12 instructor and administrator, and as a university faculty. He is an expert in higher education and instructional design assisting faculty incorporate innovative teaching and learning strategies in their courses. His research has included designing guidelines for maintaining a virtual community of practice for online teaching faculty.

Evaluation rubric design. The rubric for the evaluation of the guidelines by the expert reviewers was developed as a survey in Qualtrics and contained a total of thirty-one questions arranged in three sections. The first section focused on the content in *General Considerations for Using Videos for Learning*, while the second section focused on the content in *Guidelines for*

Using Videos to Teach Procedural Skills Based on Gagné's Nine Events of Instruction (Gagné, 1975). The third section focused on the effectiveness, practicality and possible real-world constraints in the use of the guidelines as a whole. Open-ended questions where included in the survey to ensure that the reviewers had the opportunity to provide additional feedback regarding the guidelines. The feedback from the reviewers is presented in the following section. To ensure that the names of the reviewers are not associated with their feedback, the reviewers were randomly assigned numbers, hence they appear as Expert Reviewer One, Two, or Three.

Overall Expert Reviewer Perspectives

Generally, the reviewers believed that the guidelines are somewhat effective in achieving their targeted goal of teaching procedural skills using video, based on Gagné's Nine Events of Instruction (Gagné, 1975). Reviewer One suggested, "I think a lot of the effectiveness will be based on the individual video produced, which can be affected in a variety of ways that could enhance or detract from the effectiveness of the video." On the other hand, Reviewer Two mentioned, "Also, I just think that some of the statements are too vague to be very effective at this point. I think you have a great start and can really make this better by digging deeper in the literature." Reviewer Three suggested that, "More examples can aid the learner." The feedback provided by the expert reviewers, though supporting the guidelines, provided recommendations for improving the guidelines. The recommendations were used to revise the guidelines. The results are discussed based on two tables under which the guidelines where presented to the expert reviewers*: General Considerations for Using Videos for Learning*, and *Guidelines for Using Video to Teach Procedural Skills Based on Gagné's Nine Events of Instruction (Gagné, 1975)*. Most questions in the rubric had a follow up question requesting reviewers to provide additional feedback (See Appendix H).

Reviewer Feedback for General Considerations for Using Videos for Learning

On Question 1, the expert reviewers were asked if the guidelines for (a) the video format/quality were clear and easy to understand. Two out of three of the reviewers selected agree while one reviewer selected strongly agree. When asked on the Question 2 to provide additional feedback regarding how to improve the (a) video format/quality section of the guidelines, expert Reviewer Two stated:

> This seems a bit outdated. With the ubiquity of streaming services like YouTube, Google Drive, the LMS, and other platforms. Do we really need a variety of formats? If folks have to download a video file, they probably have enough internet bandwidth to watch it online.

Expert Reviewer Three asked, “Is there a resolution that could be shared?” Because these guidelines were designed to offer strategical guidance, technical aspects such as formats, video resolutions and current streaming platforms will not be included in the revised guidelines. In an effort to ensure that the intended users of the guideline are not constrained by particular technical recommendation such as video format or streaming platforms, general recommendations were provided instead (See revised guidelines section in this chapter).

On Question 3, the expert reviewers were asked if the guidelines for (b) length of the video were clear and easy to understand. One of the three reviewers strongly agreed. Another reviewer selected agree while one reviewer selected disagree. When asked On Question 4 to provide additional feedback, Reviewer Two stated:

> The phrasing is too vague. What does it mean that "the video should not be too long." Is five minutes too long? Can you provide some parameters? I am certain that there is way more literature out there around this topic than what you have identified.

Similarly, Expert Reviewer Three asked, “What length is recommended in minutes for the segments?” Based on these two concerns, a statement recommending the length of the video was added to the revised guidelines.

On Question 5, the expert reviewers were asked if the guidelines for (c) context of the video were clear and easy to understand. One of the three reviewers strongly agreed. Another reviewer selected agree while another reviewer selected disagree.

Under Question 6, on which reviewers were asked to provide additional feedback regarding question five, Expert Reviewer Two suggested, “Can you elaborate on "unless the language is purpose related?" I am not certain that phrase is clear enough for the average user.” The revised guidelines will include the following: ’Use 'everyday' language when necessary depending on the lesson.’ Expert Reviewer Three suggested that, “Guidelines for use of jargon or concepts could be helpful.” This suggestion was added to the future recommendations as it is beyond the scope of this study.

Under Question 7, expert reviewers were asked if the guidelines related to (d) the use of characters, information, visual cues and action in a video were clear and easy to understand. Two of the three expert reviewers agreed while one reviewer disagreed. On Question 8, Expert Reviewer One, providing additional feedback for question seven, stated:

> My only concern is the use of the term characters. This makes it sound like it is animated or fictional, but are all the videos to be fictional? Is there a different term to use instead of characters? Maybe it could be phrased Presenter/Characters.

To address this concern, a clarifying statement was added to the guidelines explaining what is meant by number of characters. Expert Reviewer Two, on the same question, commented, “Again, this information is so vague. What does it mean to limit characters and

information?" A clarifying statement was added stating that actions and visual cues should be directly related to the goals/purpose of the lesson.

On Question 9, expert reviewers were asked if the general considerations for using video for learning were clear and easy to understand. One of the three reviewers strongly agreed. Another reviewer selected agree while another reviewer selected disagree. When asked on Question 10 to provide additional feedback, Expert Reviewer Two commented:

> The table is distracting with some text bolded and other text not. It causes cognitive load with so many words highlighted in the text. If you are emphasizing those words, you should find a different way to showcase the information. When you bold everything, nothing is emphasized. Another consideration...much of the information you provide is just too vague. One way you might improve this part of the guidelines is to use the same strategy that you use in the second part...Add an example column and describe what these vague statements might look like if operationalized.

Based on this and similar suggestions, another table was created which provided a real-world example of how to apply the guidelines (See Appendix I). Again, bold formatting was removed from the guidelines.

Reviewer Feedback For Guidelines For Using Video To Teach Procedural Skills Based On Gagné's Nine Events of Instruction (Gagné, 1975)

In the second section of the survey, on Question 11, the reviewers were asked if guidelines for (1) gaining attention using video were clear and easy to understand. One out of three reviewers strongly agreed, and two others agreed. Question 12 asked reviewers to provide additional feedback. Expert Reviewer Two asked:

Are there other ways to gain attention through video? Satire? Hollywood movie clips? News Clips for current events? I think you can build out the example column with many more examples. A robust set of examples will provide more clarity and stimulate recall from a diverse audience.

Based on this suggestion, the example provided in the revised guidelines shows how learner attention can be gained in the procedure suggested (See Appendix I).

In the same section, on Question 13, the reviewers were asked if the guidelines for (2) informing learners of objectives using video were clear and easy to understand. One of the three reviewers strongly agreed, and one reviewer agreed. Another reviewer selected neutral. On Question 14, on which the reviewers were asked to provide additional feedback, Expert Reviewer Two stated, "The literature guideline chart does not match your practical suggestions. I like the literature chart better." Only the reference chart (*Detailed Guidelines With Supporting Literature*) was used and modified in the revised guidelines (See revised guidelines section in this chapter).

On Question 15, the reviewers were asked if the guidelines for (3) stimulating recall of prior learning using video were clear and easy to understand. One of the three reviewers strongly agreed, and one reviewer agreed. Another reviewer selected neutral. On Question 16, Expert Reviewer Two provided the following additional feedback: "I think some of the same strategies used in gaining attention can be used here. Again, the language here is so vague that it is not clear what a good example of this would look like." Based on this recommendation, some of the strategies for gaining attention were added to this section of the revised guidelines.

The reviewers were asked on Question 17 if the guidelines for (4) presenting the content using video were clear and easy to understand. One of the three reviewers strongly agreed, and

one reviewer agreed. Another reviewer selected neutral. On Question 18 on which the reviewers were asked to provide additional feedback, Reviewer Two commented, “In some ways your example column has become a things to consider column. Make sure you are providing real examples, not giving strategic advice.” This suggestion was incorporated in the guidelines by adding a real-world example showing how the guidelines can be applied (See Appendix I).

Under Question 19, the reviewers were asked if the guidelines for combined events (5) providing learning guidance and (6) eliciting performance (practice) using video were clear and easy to understand. One of the three reviewers strongly agreed, and two reviewers agreed. On Question 20, on which reviewers were asked to provide additional feedback, Reviewer Two suggested that:

> The last example in the example column for 5 is much better and seem to provide an actual example of video use. The top two are suggestions to consider, not an example. As I am getting deeper into this, I am wondering if you don't need a third column for considerations. I believe that both examples and considerations are important, but they should not be in a column called examples.

Expert Reviewer Three suggested “Examples and nonexamples can support the learner. Additional examples would be helpful.” An example was provided based on these recommendations (See Appendix I).

The third column of the guidelines was renamed from Examples of Video Use to Considerations for Video Use.

On Question 21, the reviewers were asked if the guidelines for the combined events (7) assessing performance and (8) providing feedback using video were clear and easy to understand. One of the three reviewers strongly agreed, and two reviewers agreed. On Question

22, a follow up question to 21 on which reviewers were asked to provide additional feedback to question twenty-one, Reviewer Two stated, “Event 7 and 8 is pretty good as is. Do make sure you revisit whether the examples are really examples or design considerations.” Expert Reviewer Three suggested that, “Include examples of using images and interactive video in which learners can indicate something that could be improved or something that is being performed correctly.” Similarly, based on these suggestions, an example was provided, and the third column of the guidelines was renamed to Considerations for Video Use.

Finally, on Question 23, the reviewers were asked if the guidelines for (9) enhancing retention and transfer using video were clear and easy to understand. Two out of three of the reviewers agreed while one reviewer disagreed. On Question 24, a follow up question to question twenty-three, Reviewer Two stated, “Just considerations...no operationalized examples here.” Expert Reviewer Three suggested that, “Encourage learners to reflect on what they will apply in their job. Or a downloadable handout.” This suggestion was added to the guidelines (See revised guidelines section in this chapter).

Reviewer Feedback For The Effectiveness, Practicality And Possible Real-World Constraints Section Of The Guidelines

The final section of the survey asked the reviewers to rate the factors related to the effectiveness, practicality and possible real-world constraints in the use of the guidelines for using video to teach procedural skills based on Gagné’s Nine Events of Instruction (Gagné, 1975). Question 25 in this section asked the reviewers to rate on a scale of 1-5, if they agreed or disagreed that indicators listed were applicable to the guidelines with 1 representing strongly disagree and 5 strongly agree. Table 1 shows the results.

Table 1:

Summary of Indicators Applicable to The Use of the Guidelines

	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	strongly agree 5
Usefulness			1	1	1
Functionality				2	1
Feasibility			1	2	
Relevant				2	1
Easy to understand			1	2	
Reliable				1	2
Adequate			2		1

Based on these results, it can be observed that one reviewer strongly agreed that the guidelines are (a) useful for practical application while one review agreed while one reviewer selected neutral. For (b) functionality, two reviewers agreed that the guidelines support their intended purpose. One reviewer selected strongly agree. For (c) Feasibility, two reviewers agreed that the guidelines are feasible for real world use while one reviewer selected neutral. When asked about (d) relevance, one reviewer strongly agreed that the guidelines are appropriate for the field of Instructional Design and Technology (IDT) while two reviewers selected agree. Two reviewers agreed that the guidelines are (e) easy to understand while one reviewer selected neutral. From the table, it can also be observed that two reviewers strongly agreed on (f) reliability, that the information in the guidelines can be trusted. One reviewer selected agree. On (g) adequacy, two reviewers selected neutral when asked if the guidelines were comprehensive

and sufficient. One reviewer strongly agreed that the guidelines are comprehensive and sufficient.

On Question 26, the reviewers were asked to indicate to what extent they believed the factors provided could affect the use of the guidelines. Table 2 shows the results.

Table 2:

Summary of Factors Affecting the Guidelines Results

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Budget		1	1		1
Time				2	1
Complexity of the procedure to be taught				1	2
Technical nature of the content to be developed				1	2
Level of expertise					3

As seen in the data displayed in Table 2, one reviewer disagreed that (a) budget could affect the use of the guidelines, while one reviewer strongly agreed that budget could affect the use of the guidelines. One reviewer selected neutral. With regards to (b) time, two reviewers agreed that time could affect the use of the guidelines while one reviewer strongly agreed. Two out of three reviewers strongly agreed that (c) complexity of the procedure to be taught could affect the use of the guidelines while one reviewer selected agree. With regards to (d) the technical nature of the content to be developed, one reviewer agreed that this could affect the use of the guidelines while two reviewers strongly agreed. It can also be observed that all reviewers strongly agreed that (e) the level of expertise could affect the use of the guidelines.

Question 27 in this section asked the reviewers how effective they perceived the guidelines to be in achieving their targeted goal of teaching procedural skills using video, based on Gagné's Nine Events of Instruction (Gagné, 1975). All three reviewers indicated that the guidelines are somewhat effective. On Question 28 when asked to provide additional feedback with regards to question twenty-eight, Reviewer One pointed out, "I think a lot of the effectiveness will be based on the individual video produced, which can be affected in a variety of ways that could enhance or detract from the effectiveness of the video." On the other hand, Reviewer Two added:

> I really got confused when I was reviewing considerations for Gagne's 9 events and found that there were only 7 things listed. I completely understand why you combined the events that you did, but it really caused me confusion and I had to revisit the guidelines several times, before I figured out what you had done. If you explained that somewhere at the beginning of the guidelines, it might be helpful. I really think they should be broken back out into 9 events. Also, I just think that some of the statements are too vague to be very effective at this point. I think you have a great start and can really make this better by digging deeper in the literature.

To address this, a statement was added to the guidelines stating that some of the Events of Instructions (Gagné, 1975) were combined. Expert Reviewer Three suggested, "More examples can aid the learner." The example provided will help reduce the vagueness described by Reviewer Two.

Question 29 in this section asked the reviewers if the guidelines were designed in an organized format which can support their purpose and use. Two of the three reviewers selected

yes while one reviewer selected no. On question 30 on which reviewers were asked to provide additional feedback with regards to question twenty-nine, Reviewer Two asked:

> Quick question...Why do you not have any Gagne literature in the operationalization of the events? It seems he suggested strategies as well. Do the strategies he suggested align with the strategies you identified in the other literature? It might be worth a shot to show how the strategies that he suggested aligned with the other literature. Also see my comments in Q31. You also have to get rid of all the bold words. It caused me to get a headache.

As a result of this comment from the reviewer, all bold text was removed from the guidelines. With regards to incorporating some of the strategies proposed by Gagné, strategies proposed by Gagné (1975) which could be used to teach procedural skills were added to the revised guidelines. Reviewer Three stated "This may not be the intent, but additional examples can support the learner in applying the guidelines in real life. The guidelines offer a solid framework, but a little more detail can bring it to life." To address this and similar recommendations, a new table was created which shows a practical example of how the guidelines can be used to teach procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975) (See Appendix I).

The last question in the survey, Question 31, asked the reviewers to provide any additional recommendations or suggestions on how to improve the Guidelines for Using Video to Teach Procedural Skills based on Gagné's Nine Events of Instruction (Gagné, 1975). Reviewer One reiterated:

> I want to clarify my response on question 25c where I listed a 3. I do think there may be some feasibility issues when it comes to the assessment. While the guideline for

assessment makes sense I think the reality of implementation may be more difficulty, particularly for the learner.

Two sets of guidelines were presented to the reviewers. The first set of guidelines, *Proposed Guidelines for the Use of Video to Teach Procedural Skills, Based on Gagné's Nine Events of Instruction* (Gagné, 1975) showed the guidelines which were developed after a synthesis of the literature. The second set, *Detailed Guidelines With Supporting Literature*, showed the how the proposed guidelines were developed, highlighting the literature used. As a result, Reviewer Two wrote:

> I wonder why you have two sets of guidelines (1 with literature references and 1 without. I actually like the 1 with literature references better. It seems cleaner and justified. I would strongly encourage you to drop the other set altogether and stick to guidelines that are easily tied to the literature."

Based on this recommendation, the two sets of guidelines were combined. Three columns were created to organize the combined information: Considerations, Source, and Explanation. Revised guidelines are provided in this chapter. The considerations column provided citations related to the length, context, actions/visual cues and number of characters, and accessibility/user interface. All the sources were arranged in the Source from the literature column. The explanations of the considerations were arranged in the Explanation column. The revised guidelines that reflect these changes are included in this chapter.

Summary of Revisions Made to Guidelines

The common theme from the feedback from the reviewers related to the need to have examples showing the operation of the guidelines. Based on these recommendations, a real-world example was added to the revised guidelines showing how each concept of the guidelines

can be applied. The example lists a procedure and provides suggestions of how video can be used to teach that procedure. Another common theme which appeared in the reviews was the need to reduce the vagueness in some of the guidelines. As a result, explanations and clarifying statements were added to various sections of the guidelines. The example provided will also assist to reduce the vagueness in sections of the guidelines.

The formatting issues that reviewers found problematic were also addressed. Bold text was removed to make the guidelines easier to read. Only one set of guidelines will be presented because the *Detailed Guidelines With Supporting Literature* was incorporated into the guidelines originally presented to the reviewers. Based on the comments from one of the reviewers, a statement was added to the guidelines explaining that some of the Events of Instruction were combined.

Three columns were created: Considerations, Source, and Explanation. The Considerations column provided citations related to the length of the video, context, actions/visual cues and number of characters, and accessibility/user interface. All the sources of supporting literature were arranged in the Source column. The explanations of the considerations were arranged in the Explanation column. Technical aspects such as recommended video formats were removed from the guidelines. Other suggestions incorporated in the guidelines include adding, “Encourage learners to reflect on what they will apply in their job. Or a downloadable handout” as suggested by Expert Reviewer Three. This was addressed by adding similar statements to the guidelines. One reviewer also suggested using some of the strategies for gaining learner attention in the strategies for stimulating recall. This has been added to the revised guidelines. Similarly, some of the strategies suggested by Gagné (1975) were incorporated in the guidelines as suggested by Reviewer Two (See revised guidelines section in

this chapter). Table 3 provides a summary of the changes made to the guidelines based on reviewer feedback.

Table 3:

Summary of Guideline Revisions

Recommendation	Change Made
Provide examples	A new table, *Guideline Application Example* was created to show how each concept can be applied. Example column in the revised guidelines renamed to considerations for video use.
Use only one set of guidelines	The detailed guidelines with supporting literature was incorporated into the guidelines originally presented to the reviewers. Three columns were created: Considerations, Source, and Explanation. The Considerations column provided citations related to the length of the video, context, actions/visual cues and number of characters, and accessibility/user interface. All the sources of supporting literature were arranged in the Source column. The explanations of the considerations were arranged in the Explanation column.

Recommendation	Change Made
Reduce the vagueness in some of the guidelines	Explanations and clarifying statements were added to various sections of the guidelines. The example table provided will also assist to reduce the vagueness in sections of the guidelines.
Fix formatting	Bold text was removed to make the guidelines easier to read.
Clearly state that some Events of Instruction were combined	A statement was added to the guidelines explaining that some of the Events of Instruction (Gagné, 1975) were combined.
Add "Encourage learners to reflect on what they will apply in their job. Or a downloadable handout."	The following were added to the strategies for enhancing retention and transfer in the revised guidelines: • Provide opportunities for learners to reflect how they could apply the skills in real life. • Provide materials such as job aids or downloadable handouts.

Recommendation	Change Made
Use strategies proposed for gaining attention on stimulating recall	The following was added to the strategies for stimulating recall: • Short video related to the topic can be shown (Miner et al., 2015).
Incorporate strategies suggested by Gagné in the guidelines	Some of the strategies suggested by Gagné (1975). Under strategies for stimulating recall: • Use words such as 'remember', 'recall', etc. (Gagné, 1975) was added. Under strategies for enhancing retention and transfer: • Provide examples and situations the procedures might be applied (Gagné, 1975).
Provide technical guidelines such as video format and streaming platform	In acknowledgement of the ever-changing technical aspects of videos, recommended video formats or streaming platforms were not included in the guidelines.
Elaborate on "unless the language is purpose related	’Use 'everyday' language when necessary depending on the lesson’ was added.

Recommendation	Change Made
Use a different term instead of ‘characters’	‘Number of Individuals in a scene’ was added to the guidelines.
Provide some parameters for the length of the video	‘The video should be as brief as possible (between 3-20 minutes) based on the learning outcome’ was added to the guidelines.
Consider adding guidelines for use of jargon or concepts	This was added to the future recommendation.

Revised Guidelines

Table 4:

Revised General Considerations for Using Video for Learning

Consideration	Source	Explanation
a) Video Format/Quality		
Provide common format of the video.	(Brown, 2002; Brook, 2014)	If you will require students to download the video, include more than 1 format of the video so that students can access it.
Ensure that the videos are of good quality.	(Chan, 2010; Forbes et al., 2016)	Videos produced should be clear enough/ acceptable quality.
b) Length		
The video should not be too long.	(Anderson & Ellis, 2005)	The video should be as brief as possible (between 3-20 minutes) based on the learning outcome. Long videos should be segmented.
"…..as short as possible to make the point, edit unmercifully to a maximum of three minutes unless the learning outcome requires a lengthier extract."	(Berk, 2009, p.7)	
"Make sure each video is brief."	(Brame, 2016, p.3)	
Segment long video to reduce cognitive load.	(Cheng et al., 2014; Biard et al., 2018)	

Consideration	Source	Explanation
c) Context (language used in the video)		
Use authentic language used every day unless the language is purpose related.	(Berk, 2009, p.7)	Use 'everyday' language when necessary depending on the lesson. Jargon could be used if the learners are familiar with it.
Use conversational language in the video.	(Brame, 2016, p.3)	
d) Characters (Number of Individuals in a scene)/Information Visual Cues/Actions		
''—action should relate directly to purpose, eliminate anything extraneous."	(Berk, 2009, p.7)	Information and characters (Number of Individuals in a scene) should be limited to what is needed to help students understand a particular point/concept. Actions and visual cues should be directly related to the goals/purpose of the lesson. This may help prevent confusing or distracting the viewers.
"number of characters—limit number to only those few needed to make the point, too many can be confusing or distracting."	(Berk, 2009, p.7)	

Consideration	Source	Explanation
e) Accessibility/User interface		Provide closed captioning or transcripts for deaf or hearing-impaired learners. Enable control tools such as pause, play rewind and fast forward.
Make sure that the content is perceptible.	(Caldwell et al., 2008)	
Provide captions, transcripts	(McAlvage & Rice, 2018)	
"Include interactive features which enables student control."	(Brame, 2016, p.3)	
Allow learners to rewind, pause, or replay video based on their needs	(Anderson & Ellis, 2005; Brook, 2014; Forbes et al., 2016; Schreiber et al., 2010)	

Table 5:

Revised Guidelines for Using Videos to Teach Procedural Skills Based on Gagné's Nine Events of Instruction

(Note: Some Events of Instruction have been combined)

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use
1. Gain attention	• Engage learner informing them of the efficiency of the procedure over trial and error (Smith & Ragan, 2005). • Arouse interest and curiosity through the use of questions related to the procedure (Buscombe, 2013; Khadjooi et al., 2011; Wong, 2018). • Emphasize why the procedure is a practical skill to acquire (Cheung, 2016).	Use a funny or fascinating video clip to engage the learner (Berk, 2009; Choe, 2017). A short video showing the procedure can be used (Ng, 2014; Qutieshat, 2018; Wong, 2018; Woo, 2016). Short video related to the topic can be shown (Miner et al., 2015).
2. Inform learners of objectives	• Let the learners know what they will be able to do upon completion of the lesson (Gagné, 1975; Smith & Ragan, 2005). • Use introductory terms to inform learners what they will be able to accomplish upon completion of the lesson. The objective should be student centered and measurable (Buscombe, 2013; Cheung, 2016; Ng, 2014).	• Use out-of-video text to inform the learners (Brame, 2016). • Use visual cues or music to highlight the objectives (Choe, 2017).

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use
3. Present the content	• The content should be well organized and should address the learning objectives (Buscombe, 2013; Khadjooi et al., 2011). • Provide learners with the opportunity to view the procedure through a demonstration of the procedure (Angros Jr et al., 2002; Belfield, 2010; Cheung, 2016; Khadjooi et al., 2011; McCormick, 1997; Grantcharov & Reznick, 2008; Rickel & Johnson, 1999; Wearne, 2011; Wong, 2018; Woo, 2016). • The trainer can describe the steps as they are performing the procedure (Buscombe, 2013; Grantcharov & Reznick, 2008; Khadjooi et al., 2011; Qutieshat, 2018; Wearne, 2011; Wong, 2018; Woo, 2016). • The steps should be listed such that they are not ambiguous (Larson & Lockee, 2020; Miller & Hudson, 2007). • Provide opportunities for learners to learn how to recognize situations that may need a particular procedure, complete its steps, recall the steps in the procedure and ascertain if the procedure was applied properly (Smith & Ragan, 1993). • The procedure to be demonstrated should be relatively simple, about seven steps or fewer and even fewer for younger learners. Decision points should be fewer as well (Smith & Ragan, 2005).	• Showcase the procedure using the video (Choe, 2017). • Allow learners to view video multiple times to see what they could have missed the first time (Beck et al., 2002). • Incorporate various angles of a scene (Brook, 2014). • Provide examples within the video (Pryor & Bitter, 2008). • Use video to highlight important points (Borko et al., 2008, Brunvand, 2010). • Use visual metaphors where necessary (Choe, 2017; Koumi, 2006). • If the lesson is long, segment the video (Biard et al., 2018; Choe, 2017).

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use
4. Provide learning guidance/Elicit performance (practice)	• Learners can be presented with situations in which the procedure might be useful. Learners could then be asked to determine whether or not the procedure should be applied (Smith & Ragan, 2005). • Provide opportunities for practice (Angros Jr et al., 2002; Foshay & Kirkley, 2003; Miner et al., 2015; Ng, 2014; Qutieshat, 2018). • Learning procedures may require a significantly higher rounds of practice (National Academies of Sciences, Engineering, and Medicine, 2018). • Each individual step within a procedure could be practiced (Grantcharov & Reznick, 2008; Smith & Ragan, 2005). • After practicing the step, the learners should then practice the entire procedure for multiple times (Kneebone, 2005; Smith & Ragan, 2005). • Learners could practice recalling the pattern and nature of the steps in the procedure, after practicing how to execute the procedure (Smith & Ragan, 2005). • Determining whether a procedure was correctly completed should be part of the practice (Smith & Ragan, 1993). • Feedback on the performance could accompany the practice (Khadjooi et al., 2011; Kneebone, 2005; Ng, 2014).	• Allow learners to view video multiple times to see what they could have missed the first time (Beck et al., 2002). • Incorporate guiding questions within the vide0 so that learners can have an opportunity for self-assessment (Brame, 2016). • The learner could record themselves and send the video for review to the experts (Brook, 2014; Grantcharov & Reznick, 2008; Santagata et al., 2007). • Video can also be used as a tool for self-assessment allowing learners to review their own behavior /performance and evaluate themselves (Yoo et al., 2009; Zick et al., 2007). • Learners can view their own performance and rerecord if they are not satisfied with their performance (Winters et al., 2003).

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use
5. Assess performance/ Provide feedback	• Provide opportunities for the learners to demonstrate the whole procedure without guidance or prompt (Khadjooi et al., 2011; Wong, 2018). • Use a debriefing session to provide feedback regarding the learner's performance procedure (Grantcharov & Reznick, 2008). • Feedback provided to the learners should be objective (Belfield, 2010; Buscombe, 2013; Cheung, 2016). • Was the situation allowing the use of the procedure correctly identified? Provide the reason why or why not. The learners could be provided with feedback on the accuracy of how they completed each step of the procedure (Smith & Ragan, 1993). • For procedures involving decision steps, the feedback should include feedback on whether the learner made the right decision, thereby correctly selecting the correct path in the procedure (Smith & Ragan, 2005). • It is important to make a distinction between decisions/steps that are fitting, but not important, and those that should be present (Farmer & Page, 2005). • The feedback provided to the learners should indicate whether the procedure that was given was completed correctly. A detailed explanation of why a decision was made might be included in the general feedback (Smith & Ragan, 2005). • Feedback could be provided at the end of the task (Bould et al., 2009; Miner et al., 2015).	• The learner could record themselves and send the video for review to the experts (Brook, 2014; Grantcharov & Reznick, 2008; Santagata et al., 2007). • Use tools which allow video commentary so feedback can be provided (Brunvand, 2010). • Video can also be used as a tool for self-assessment allowing learners to review their own behavior /performance and evaluate themselves (Yoo et al., 2009; Zick et al., 2007). • Learners can view their own performance and rerecord if they are not satisfied with their performance (Winters et al., 2003).

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use
6. Enhance retention and transfer	• Summarize the nature, form, and variation of the procedure and incorporate complementary materials (Smith & Ragan, 2005). • Direct learners to opportunities available for them to use the skills acquired (Buscombe, 2013; Ng, 2014). • Provide learners with opportunities to practice the procedure (Khadjooi et al., 2011; Qutieshat, 2018). • Describe other contexts in which the procedure can be applied (Cheung, 2016). • Provide examples and situations the procedures might be applied (Gagné, 1975). • Provide opportunities for learners to reflect how they could apply the skills in real life. • Provide materials such as job aids or downloadable handouts.	• Reinforce repetition by using different angles (Koumi, 2006). • Use video to highlight important points (Borko et al., 2008; Brunvand, 2010).

Chapter 6

Conclusions and Recommendations

This study was designed to develop guidelines for using videos to teach procedural skills in an online learning environment based on Gagné's Nine Events of Instruction (Gagné, 1975). The guidelines developed could be used to assist instructors and course developers by providing recommendations for using video to teach procedural skills based on Gagné's Nine Events of Instruction (Gagné, 1975). This chapter presents a summary of the study and provides recommendations for future research.

Study Review Synopsis

The literature review revealed that a number of studies related to teaching procedural skills, for example (Gaies et al., 2007; Liddell et al., 2002; Mackay et al., 2002; Taylor, 1997; Wigton et al., 1989), provided little or no evidence-based guidance on how to teach procedural skills in an asynchronous learning environment. Gaies et al., (2007) concluded that "A more robust and standardized method is needed for teaching procedural skills and for documenting competence" (p.715). The first need, therefore, identified in the literature review was a need for evidence-based studies providing guidance on how to teach procedural in an online learning environment. Another issue identified in the literature review was the expenses involved when using certain technology to teach procedural skills. Procedural skills could be taught using learning materials produced for advanced technology such as augmented reality (AR), virtual reality and simulations. However, some of these methods are not only expensive, but they could require advanced knowledge and skills (Inoue, 2007; Parham et al., 2019; Pickup et al., 2013; Rourke, 2020; Smith, 2018). At the time of writing this document, the costs of surgical

simulations, immersive medical simulations and virtual worlds ranged from $100,000 to $1,240,000 (Kyaw, 2019; Parham et al., 2019; Pottle, 2019).

However, video could be less expensive to produce and may not require advanced technical skills depending on the intended use and the production (Laaser & Toloza, 2017; Myllymäki et al., 2014; Rajadell & Garriga-Garzón, 2017). Therefore, the absence of evidence-based guidance on how to use video to teach procedural skills in an online learning environment warrants the need for such a study. The purpose of this study was to help address this need by creating a set of guidelines based on prior research. The development of the guidelines began with the identification of the problems described above, before commencing with the second literature review. The literature review concentrated on strategies for teaching procedural skills in an online learning environment, strategies for teaching procedural skills using Gagné's Nine Events of Instruction (Gagné, 1975) and finally, strategies for using videos for learning. After this, the next step was creating the guidelines for teaching procedural skills using video based on Gagné's Nine Events of Instruction (Gagné, 1975). The guidelines included examples of how an event from Gagné's Nine Events of Instruction (Gagné, 1975) can be taught using video. Expert reviewers provided feedback on the initial guidelines distributed to them. Thereafter, the guidelines where revised based on the feedback provided by the expert reviewers.

Contributions of the Study

Practical Contributions

With the outbreak of COVID-19 at the time of writing this document, many institutions of learning moved their face-to-face courses online in an effort to keep students, faculty and staff safe (Hodges et al., 2020; Zhou et al., 2020). However, before the pandemic, the number of distance education students continued to rise. According to a report:

> The number of distance education students grew by 5.6% from Fall 2015 to Fall 2016 to reach 6,359,121 who are taking at least one distance course, representing 31.6% of all students. Total distance enrollments are composed of 14.9% of students (3,003,080) taking exclusively distance courses, and 16.7% (3,356,041) who are taking a combination of distance and non-distance courses. (Seaman, Allen & Seaman, 2018, p.3).

Given the situations described, opportunities for teaching and learning various skills traditionally taught in face-to-face environments have also arisen. One of the advantages of online learning is the flexibility of learning and teaching anywhere and at any time (Hodges et al., 2020). Procedural skills, which are the focus of this study, are an example of skills that can be taught online using video, virtual reality (VR) and augmented reality (AR) as delivery modes. The literature review shows that various studies have been conducted related to teaching procedural skills using different delivery modes including video, virtual reality, game design and simulations (Dickey, 2007; Gaies et al., 2007; Liddell et al., 2002; Mackay et al., 2002; Schott & Marshall, 2018; Taylor, 1997; Wigton et al., 1989).

However, producing materials to teach procedural skills online can be time consuming, expensive and may require advanced technical skills, particularly when using more complex technologies like virtual reality (VR) simulations (Inoue, 2007; Parham et al., 2019; Pickup et al., 2013; Rourke, 2020; Smith, 2018). VR Surgical simulations are also costly though beneficial for training (Parham et al., 2019).

On the other hand, video could be less expensive to produce and may not require advanced technical skills depending on the intended use and the production (Laaser & Toloza, 2017; Myllymäki et al., 2014; Rajadell & Garriga-Garzón, 2017). The absence of evidence-based

guidance on how to use video to teach procedural skills in an online learning environment warrants the need for such a study. This study explores how procedural skills can be taught in on online learning environment using video based on Gagné's Nine Events of Instruction (Gagné, 1975).

This study also proposes a method of assessing procedural skills and providing feedback in an online learning environment. This method can be applied synchronously or asynchronously. This study proposes that video can be used for assessment and for providing feedback to learners (Brook, 2014; Grantcharov & Reznick, 2008; Santagata et al., 2007; Winters et al., 2003; Yoo et al., 2009; Zick et al., 2007). For assessments, learners can record themselves performing the procedure and can then send the video recording to the instructor or expert (Brook, 2014; Grantcharov & Reznick, 2008; Santagata et al., 2007). Self-assessment is also proposed in this study. Learners can record themselves performing the procedure and can then watch the recording to assess their own performance (Yoo et al., 2009; Zick et al., 2007). Feedback could be provided synchronously through the use of video conferencing tools. In an asynchronous learning environment, feedback could be provided through the use of tools which allow video commentary (Brunvand, 2010). These strategies for video use can be applied in teaching contexts, even when there is no pandemic.

Theoretical Contributions

The proposed guidelines are based on Gagné's Nine Events of Instruction (Gagné, 1975). According to Robert Gagné, special conditions are required for a particular learning outcome to be attained (Gagné, 1965). The Events of Instruction have been used to teach various skills and in different fields. For example, the Events of Instruction were used to teach medical procedures (Belfield, 2010; Buscombe, 2013; Woo, 2016) in science education (Nurtamara, 2020: Solanki,

2014), business education (McCaster, 2020), computer-aided drawing and graphics (Al-Qassabi, & Al-Samarraie, 2013; Theng & Mai, 2009), language (Mei, 2015), technical communication (Zhu et al., 2010) and various middle and high school classes (House, 2002; McKinney, 2012).

A design and development approach adopted in this study involved synthesizing literature related to procedural skill acquisition, video use for teaching and strategies for using Gagné's Events of Instruction (1975). Design and development studies are "a type of inquiry unique to the instructional design and technology field dedicated to the creation of new knowledge and the validation of existing practice" (Richey & Klein, 2014, p.141). The guidelines that have been developed from this study will be used to support the teaching and learning processes (Richey & Klein, 2014). All the processes involved in developing the guidelines where carefully carried out and documented as suggested by Richey & Klein (2014). The guidelines produced contribute to the research by offering empirical-based guidelines for using video to teach procedural skills in an online learning environment. This area has not been fully researched.

Limitations of the Study

This study, though involving expert reviewers who provided valuable feedback, would have benefited from feedback from more expert reviewers. Another limitation of the study is the lack of the implementation phase of the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model utilized in developing the guidelines. The reason this phase was excluded from the process is that including the phase was beyond the scope of the study. The guidelines could possibly be used in K-12 learning environments, in vocational training schools, community colleges, and four-year learning institutions. Since design development studies are

iterative, in the future, the guidelines could be pilot tested in the learning environments described and the feedback could be used to improve them.

Next Steps and Recommendation for Future Application

The next steps will be to validate the guidelines. The guidelines could benefit from the implementation phase which was not conducted in this study. The recommendation is that a field test should be conducted at various levels of learning. These may include K-12 education, vocational training centers, community colleges and also 4-year universities. After using the guidelines in the intended learning environment, a product evaluation will be considered in order to determine how to improve the guidelines. It could also be beneficial if the guidelines were adapted for student use in support of alternative assessment strategies. These strategies could include students demonstrating their attainment of procedural skills using video.

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Appendices

Appendix A

Initial Guidelines with the Supporting Literature

The following two tables show the guidelines with the supporting literature used in their development.

Table 6:

General Considerations for the use of Video in Learning

Tip	Source
a) Length	
The video should not be too long.	(Anderson & Ellis, 2005)
"....as short as possible to make the point, edit unmercifully to a maximum of three minutes unless the learning outcome requires a lengthier extract."	(Berk, 2009, p.7)
"Make sure each video is brief."	(Brame, 2016, p.3)
Segment long video to reduce cognitive load.	(Cheng et al., 2014; Biard et al., 2018)

Recommendation	Source
b) Context	
Use authentic language used every day unless the language is purpose related.	(Berk, 2009, p.7)
Use conversational language in the video.	(Brame, 2016, p.3)
c)Actions/visual cues and number of characters	
"—action should relate directly to purpose, eliminate anything extraneous.	(Berk, 2009, p.7)
"number of characters—limit number to only those few needed to make the point, too many can be confusing or distracting."	(Berk, 2009, p.7)

Recommendation	Source
d) Accessibility/user interface:	
Make sure that the content is perceptible.	(Caldwell, et al., 2008)
Provide captions, transcripts	(McAlvage & Rice, 2018)
"Include interactive features which enables student control."	(Brame, 2016, p.3)
Allow learners to rewind, pause, or replay video based on their needs	(Anderson & Ellis, 2005; Brook, 2014; Forbes et al., 2016; Schreiber et al., 2010)
f) Format/Quality:	
Provide common format of the video, e.g. MP4, MOV, etc.	(Brown, 2002; Brook, 2014)
Ensure that the videos are of good quality	(Chan, 2010; Forbes et al., 2016)

Table 7:

Initial Detailed Guidelines for Using Videos to Teach Procedural Skills Based on Gagné's Nine Events of Instruction (Gagné, 1975) With Supporting Literature

Event	Considerations for Teaching Procedural Skills	Examples of Video Use
1. Gain attention	Engage learner informing them of the efficiency of the procedure over trial and error (Smith & Ragan, 2005). Arouse interest and curiosity through the use of questions related to the procedure (Buscombe, 2013; Khadjooi et al., 2011; Wong, 2018). Emphasize why the procedure is a practical skill to acquire (Cheung, 2016).	Use a funny or fascinating video clip to engage the learner (Berk, 2009; Choe, 2017). A short video showing the procedure can be used (Ng, 2014; Qutieshat, 2018; Wong, 2018; Woo, 2016). Short video related to the topic can be shown (Miner et al., 2015).
2. Inform learners of objectives	Let the learners know what they will be able to do upon completion of the lesson (Smith & Ragan, 2005). Use introductory terms to inform learners what they will be able to accomplish upon completion of the lesson. The objective should be student centered and measurable (Buscombe, 2013; Cheung, 2016; Ng, 2014).	Use out-of-video text to inform the learners (Brame, 2016). Use visual cues or music to highlight the objectives (Choe, 2017).

Event	Considerations for Teaching Procedural Skills	Examples of Video Use
3. Stimulate recall of prior learning	Concepts that are known and that should be used in recognizing a situation can support the acquirement of a procedure. Learners may have previously learned procedures that were less complex that will be combined with other procedures to form a new and complex procedure (Smith & Ragan, 1993). Use questions and images related to previously learned information to stimulate recall (Belfield, 2010; Miner et al., 2015; Ng, 2014). The content should be well organized and should address the learning objectives (Buscombe, 2013; Khadjooi et al., 2011).	Use visual cues or music to stimulate recall (Choe, 2017). Images could also assist learners to recall information (Miner et al., 2015).
4. Present the content	Provide learners with the opportunity to view the procedure through a demonstration of the procedure (Angros Jr et al., 2002; Belfield, 2010; Cheung, 2016; Khadjooi et al., 2011; McCormick, 1997; Grantcharov & Reznick, 2008; Rickel & Johnson, 1999; Wearne, 2011; Wong, 2018; Woo, 2016).	Showcase the procedure using the video (Choe, 2017). Allow learners to view video multiple times to see what they could have missed the first time (Beck et al., 2002).

Event	Considerations for Teaching Procedural Skills	Examples of Video Use
4. Present the content (Cont..)	The trainer can describe the steps as they are performing the procedure (Buscombe, 2013; Grantcharov & Reznick, 2008; Khadjooi et al., 2011; Qutieshat, 2018; Wearne, 2011; Wong, 2018; Woo, 2016).	Incorporate various angles of a scene (Brook,2014).
	The steps should be listed such that they are not ambiguous (Larson & Lockee, 2020; Miller & Hudson, 2007).	Provide examples within the video (Pryor & Bitter, 2008).
	Provide opportunities for learners to learn how to recognize situations that may need a particular procedure, complete its steps, recall the steps in the procedure and ascertain if the procedure was applied properly (Smith & Ragan, 1993).	Use video to highlight important points (Borko et al., 2008, Brunvand, 2010). Use visual metaphors where necessary (Choe, 2017; Koumi, 2006).
	The procedure to be demonstrated should be relatively simple, about seven steps or fewer and even fewer for younger learners. Decision points should be fewer as well (Smith & Ragan, 2005).	If the lesson is long, segment the video (Biard et al., 2018; Choe, 2017).

Event	Considerations for Teaching Procedural Skills	Examples of Video Use
5. Provide learning guidance/Elicit performance (practice)	Learners can be presented with situations in which the procedure might be useful. Learners could then be asked to determine whether or not the procedure should be applied (Smith & Ragan, 2005). Provide opportunities for practice (Angros Jr et al., 2002; Foshay & Kirkley, 2003; Miner et al., 2015; Ng, 2014; Qutieshat, 2018). Learning procedures may require a significantly higher rounds of practice (Academies of Sciences, Engineering, and Medicine, 2018). Each individual step within a procedure could be practiced (Grantcharov & Reznick, 2008; Smith & Ragan, 2005). After practicing the step, the learners should then **practice the entire procedure** for multiple times (Kneebone, 2005; Smith & Ragan, 2005). Learners could practice recalling the pattern and nature of the steps in the procedure, after practicing how to execute the procedure (Smith & Ragan, 2005).	Allow learners to view video multiple times to see what they could have missed the first time (Beck et al., 2002). Incorporate guiding questions within the video so that learners can have an opportunity for self-assessment (Brame, 2016). The learner could record themselves and send the video for review to the experts (Brook, 2014; Grantcharov & Reznick, 2008; Santagata et al., 2007). Video can also be used as a tool for self-assessment allowing learners to review their own behavior /performance and evaluate themselves (Yoo et al., 2009; Zick et al., 2007). Learners can view their own performance and rerecord if they are not satisfied with their performance (Winters et al., 2003).

Event	Considerations for Teaching Procedural Skills	Examples of Video Use
5. Provide learning guidance/Elicit performance (practice) (cont...)	Determining whether a procedure was correctly completed should be part of the practice (Smith & Ragan, 1993). Feedback on the performance could accompany the practice (Khadjooi et al., 2011; Kneebone, 2005; Ng, 2014).	
6. Assess performance/ Provide feedback	Provide opportunities for the learners to demonstrate the whole procedure without guidance or prompt (Khadjooi et al., 2011; Wong, 2018). Use a debriefing session to provide feedback regarding the learner's performance procedure (Grantcharov & Reznick, 2008). Feedback provided to the learners should be objective (Belfield, 2010; Buscombe, 2013; Cheung, 2016). Was the situation allowing the use of the procedure correctly identified? Provide the reason why or why not. The learners could be provided with feedback on the accuracy of how they completed each step of the procedure (Smith & Ragan, 1993).	The learner could record themselves and send the video for review to the experts (Brook, 2014; Grantcharov & Reznick, 2008; Santagata et al., 2007). Use tools which allow video commentary so feedback can be provided (Brunvand, 2010). Video can also be used as a tool for self-assessment allowing learners to review their own behavior /performance and evaluate themselves (Yoo et al., 2009; Zick et al., 2007).

Event	Considerations for Teaching Procedural Skills	Examples of Video Use
6. Assess performance/ Provide feedback (cont..)	For procedures involving decision steps, the feedback should include feedback on whether the learner made the right decision, thereby correctly selecting the correct path in the procedure (Smith & Ragan, 2005). It is important to make a distinction between decisions/steps that are fitting, but not important, and those that should be present (Farmer & Page, 2005). The feedback provided to the learners should indicate whether the procedure that was given was completed correctly. A detailed explanation of why a decision was made might be included in the general feedback (Smith & Ragan, 2005). Feedback could be provided at the end of the task (Bould et al., 2009; Miner et al., 2015).	Learners can view their own performance and rerecord if they are not satisfied with their performance (Winters et al., 2003).

Event	Considerations for Teaching Procedural Skills	Examples of Video Use
7. Enhance retention and transfer	Summarize the nature, form, and variation of the procedure and incorporate complementary materials (Smith & Ragan, 2005).	Reinforce repetition by using different angles (Koumi, 2006).
	Direct learners to opportunities available for them to use the skills acquired (Buscombe, 2013; Ng, 2014).	Use video to highlight important points (Borko et al., 2008; Brunvand, 2010).
	Provide learners with opportunities to practice the procedure (Khadjooi et al., 2011; Qutieshat, 2018).	
	Describe other contexts in which the procedure can be applied (Cheung, 2016).	

Appendix B

Initial Guidelines

Table 8:

Initial General Considerations for the Use of Video for Learning

Guideline	Example
a) Video Format/Quality	Include more than 1 format of the video e.g, MOV, MP4, e.t.c and ensure that the video is of good quality.
b) Length	As brief as possible based on learning outcome. Long videos should be segmented.
c) Context	Use 'everyday' language when necessary depending on the lesson.
d) Characters/Information Visual Cues/Actions	Information and characters should be limited to what is needed to make the point. Actions and visual cues should be directly related to the goals/purpose of the lesson.
e) Accessibility/User interface	Provide closed captioning or transcripts for deaf or hearing-impaired learners. Enable control tools such as pause, play rewind and fast forward.

Table 9:

Initial Guidelines for Using Videos to Teach Procedural Skills Based on Gagné's Nine Events of Instruction.

Gagné's Event of Instruction	Considerations for Teaching Procedural Skills	Examples of Video Use
1. Gain attention	Elicit **suspense, entertain, fascinate/captivate**.	Show a funny or fascinating short clip. Alternatively, the instructor can show a video related to the lesson showing an example of the application of the procedure.
2. Inform learners of objectives	Let the learners **know what they will be able to do** upon completion of the lesson. Tell them **what to expect.**	Use text or images to display objectives in the video. Ensure that the objectives are measurable and learner oriented.
3. Stimulate recall of prior learning	**Spark curiosity** by using what the learners are familiar with to make what they are unfamiliar with familiar. Use what learners may have previously learned about a procedure which was less complex to **combine with other procedures** to form a new and complex procedure.	Text and images can be used to display key highlights from previous lesson. Instructors can use a prerecorded clip highlighting key information from previous lesson.

Gagné's Event of Instruction	Considerations for Teaching Procedural Skills	Examples of Video Use
4. Present the content	The instructor should demonstrate the procedure. The procedure to be demonstrated should be relatively simple, about seven steps or fewer and even fewer for younger learners. The procedure should also have few or no decision points. However, for more complex procedure with many steps and decision points, an overview could be a summary of the procedure grouping several steps. Content should emphasize relevance and should align with the lesson objectives.	The expert could demonstrate the procedure using video. Use visual metaphors and images to emphasize important points. Make sure words do not duplicate images.
5. Elicit performance (practice)/Provide "learning guidance"	Provide situations in which the procedure might be useful and encourage them to determine whether or not the procedure should be applied. Encourage learners to practice each individual step within a procedure soon after it is presented. After practicing the step, the learners should then practice the entire procedure for multiple times until they or the instructor are satisfied with their performance. Determining whether a procedure was correctly completed should be part of the practice.	When using recorded video, use repetition, different angles, compare and contrast, and re-exemplify. Use guiding questions to engage the learners. The questions can be displayed as text within the video or voice/clip of the instructor asking the questions. The learner could record themselves practicing the procedure and can send the video to the instructor or the expert for review.

Gagné's Event of Instruction	Considerations for Teaching Procedural Skills	Examples of Video Use
6. Assess performance /Provide feedback	Allow learners to capture themselves performing the procedure and provide feedback in the following areas: Was the situation allowing the use of the procedure correctly identified? Provide the reason why or why not. The learners should be provided with feedback on the accuracy of how they completed each step of the procedure. For procedures involving decision steps, the feedback should include feedback on whether the learner made the right decision, thereby correctly selecting the correct path in the procedure. The feedback provided to the learners should indicate whether the procedure that was given was completed correctly. A detailed explanation of why a decision was made might be included in the general feedback. Include opportunities for learners to list the steps in the procedure, list applicable situations, apply the procedure, determine whether the procedure was applied correctly.	To assess the learners, the instructor can provide instructions for learners to record themselves performing the procedure. The learners can then send the recording to the instructor so that the instructor can assess the performance. The instructor could provide their feedback using a video. The video recording should incorporate the recommendations on the left. Instructors can use tools which enable video commentary. The instructors could provide opportunities for self-assessment by allowing learners to record and view themselves performing the procedure. The learners can rerecord themselves if not satisfied with their performance before sending the final version to the instructor or expert.

Gagné's Event of Instruction	Considerations for Teaching Procedural Skills	Examples of Video Use
7. Enhance retention and transfer	Summarize the nature, form and variation of the procedure and incorporate complementary materials. Provide guidance to the learners on how they can apply the skills acquired.	Text or graphics can be used to highlight key-components from the lesson. Use different angles to reinforce key scenes in the lesson. Repetition can also be used to emphasize key concepts.

Appendix C

IRB Approval

VIRGINIA TECH

Division of Scholarly Integrity and
Research Compliance
Institutional Review Board
North End Center, Suite 4120 (MC 0497)
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-3732
irb@vt.edu
http://www.research.vt.edu/sponsor/irb.php

MEMORANDUM

DATE: January 21, 2020

TO: Barbara B Lockee, Kizito K Mukuni

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires October 29, 2024)

PROTOCOL TITLE: Developing Guidelines for Teaching Procedural Skills in an Online Learning Environment

IRB NUMBER: **19-1148**

Effective January 21, 2020, the Virginia Tech Human Research Protection Program (HRPP) and Institutional Review Board (IRB) determined that this protocol meets the criteria for exemption from IRB review under 45 CFR 46.104(d) category(ies) 2(ii).

Ongoing IRB review and approval by this organization is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities impact the exempt determination, please submit a new request to the IRB for a determination.

This exempt determination does not apply to any collaborating institution(s). The Virginia Tech HRPP and IRB cannot provide an exemption that overrides the jurisdiction of a local IRB or other institutional mechanism for determining exemptions.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

https://secure.research.vt.edu/external/irb/responsibilities.htm

(Please review responsibilities before beginning your research.)

PROTOCOL INFORMATION:

Determined As:	**Exempt, under 45 CFR 46.104(d) category(ies) 2(ii)**
Protocol Determination Date:	**January 21, 2020**

ASSOCIATED FUNDING:

The table on the following page indicates whether grant proposals are related to this protocol, and which of the listed proposals, if any, have been compared to this protocol, if required.

Appendix D

Expert Review Recruitment Email

School of Education,
Virginia Tech
Blacksburg, VA 24060
USA
February 19, 2020

Dear_____ ,

RE: Invitation to provide feedback on Guidelines for Teaching Procedural Skills Using Video.

My name is Kizito Mukuni and I am a PhD candidate in the Instructional Design and Technology program at Virginia Tech. Because you are a recognized expert, I would like to invite you to evaluate guidelines that I have designed and developed as part of my dissertation work under the supervision of my advisor, Dr. Barbara Lockee (Lockeebb@vt.edu). Your participation in this study is voluntary.

The purpose of this study is to develop guidelines for teaching procedural skills using video based on Gagné's Nine Events of Instruction. The study is using a design and development research methodology with the following stages: Analysis, Design, Development and Revision, and Evaluation. In the analysis stage, I conducted a comprehensive literature review on procedural skill instruction, Gagné's Nine Events of Instruction, video in education, and other related theories. In the design phase, I proposed how Gagné's Nine Events of Instruction (Gagné, 1975) can be applied to teach procedural skills as well as how video can be used in support of these strategies. The development stage involved designing the guidelines based on relevant literature. The evaluation stage requires that the guidelines be formatively evaluated by experts for recommendations and improvement.

Additional study details are provided in the consent form on the project website. No signature is required, and you will have the opportunity to indicate your voluntary consent to participate as an expert reviewer on the first page of the online survey document.

Upon your acceptance of this invitation, you will be provided with a link to the website which has all the information you will need, including an overview of the dissertation, the informed consent details, the proposed guidelines, and the survey. Your participation would take approximately an hour of your time, but can be extended over a two-week review period. You will also be provided with the option of being acknowledged by name for your contribution as an expert reviewer or having your identity kept confidential.

I hope that you are able to participate. Please do not hesitate to contact me if you have any questions.

Thank you, in advance, for your valuable time and expertise.

Sincerely,

Kizito Mukuni
PhD Candidate, Instructional Design & Technology,
Virginia Tech

Kizito1@vt.edu

Appendix E

Directions for Expert Review

Dear Dr._____,
I would like to thank you for your response and willingness to serve as an expert reviewer for my dissertation study. I organized the elements of the research into one place on a website for easy access. The website is organized into three sections: the Homepage, the Institutional Review Board (IRB) informed consent details, and the Guideline Elements section.

1. The homepage provides an overview of the dissertation study.

2. The IRB informed consent details which provides more information about human subject participation in the study and related risks.

3. The section for Guideline Elements consists of five subpages:

    a) The study background provides information on the need of the study.
    b) The proposed guidelines for the use of video to procedural skills, based on Gagné's Nine Events of Instruction (Gagné, 1975).
    c) The detailed guidelines with supporting literature.
    d) Additional background information links to Chapter Four of the dissertation which describes how the guidelines were created.
    e) Expert review survey includes all the questions included in the online survey.

Please take some time to read the IRB informed consent details, as you will be required to provide your consent to participate in the online survey. Before taking the survey, please take a look at the guidelines to serve as a reference while providing the feedback. Finally use the survey to record your feedback and recommendation for the considerations. Your participation would take approximately 1 hour of your time or can be stretched over a two-week review period (By ____, 2020).

Thank you again for your invaluable time and potential participation in my study. Should you have any questions at any stage of the process, please contact me (kizito1@vt.edu) or my advisor Dr Barbara Lockee (lockeebb@vt.edu).

Sincerely,

Kizito Mukuni
PhD Candidate, Instructional Design & Technology
School of Education,
Virginia Tech.
Kizito1@vt.edu

Appendix F

Reminder Email

Dear Dr. _____,

I recently contacted you to request your participation as an expert reviewer for my dissertation research on guidelines for teaching procedural skills using video (see below for original email).

If you have completed the expert review, I want to thank you for your time and participation. If you have not completed the expert review yet, I eagerly wait for your input. Here is the link to the website.

Please complete the review by ____, 2020. Let me know if you have any further questions.

Thank you for your time.

Sincerely,

Kizito Mukuni

PhD Candidate, Instructional Design & Technology
School of Education, Virginia Tech

Appendix G

Consent Form

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Informed Consent for Participants
in Research Projects Involving Human Participants

Title of Study: Design and Development of Guidelines for Teaching Procedural Skills in an Online Learning Environment

IRB # 19-1148

Investigators Name(s): Kizito Mukuni, School of Education, Virginia Tech
E-Mail: kizito1@vt.edu
Research Advisor: Dr. Barbara Lockee
Email: lockeebb@vt.edu

1. Purpose of this Study

The aim of this study is to develop guidelines for using videos to teach procedural skills in an online learning environment by incorporating literature review and expert reviewer feedback. Once developed, the guidelines will be accessible for course designers and instructors to follow when designing lessons for teaching procedural skills using videos.

2. How the results will be used:

The results of the study will be used for research purposes and may be published and/or presented at a conference.

3. Eligibility

Participants in this study must be 18 years or older.

4. Procedure

The initial guidelines for using videos to teach procedural skills, a document explaining the review process and a Qualtrics rubric including the informed consent will be distributed to the reviewers via email. The reviewers will be allowed up to two weeks to complete the review and provide necessary feedback using the online rubric in Qualtrics.

5. Time commitment

The Survey/ feedback will take approximately 1 hour of your time to complete it from beginning

to end over a 2-week period.

6. Risks

The risks associated with participating in this study are considered to be minimal.

7. Benefits

There could be no specific benefit of the study to you as a participant. The results of the study will provide insights into ways that lessons should be designed to impart distance learning through the use of video.

8. Extent of Anonymity and Confidentiality

You will have the option of having your name, affiliation, title and field published with the study by filing that out in the Qualtrics survey. Participation in this study is confidential and your name will only be known to the study investigators. Every effort will be made to ensure your identity in this study will be treated confidentially unless you indicate another preference in writing to the investigator.

9. Compensation

You will not receive any form of compensation for participating in this study.

10. Freedom to Withdraw

It is important for you to know that your participation in this study is entirely voluntary and that you are free to withdraw from this study at any time without penalty. Also, your refusal to participate will result in no penalty or loss of benefits to which you are otherwise entitled. If you choose to withdraw from the study, the survey will end and no data will be used. Please contact the researcher Kizito Mukuni (kizito1@vt.edu) or Advisor Dr. Barbara (lockeebb@vt.edu)

11. Participants Responsibilities

- Complete the online survey and return it to the investigator.
- Submit the evaluation, electronically once complete.
- (Optional) Indicate in writing if you would like to be acknowledged by name in the reporting of this research as an expert reviewer (otherwise, your name will be held in confidence).

12. Participant's Consent

I have read the Consent Form and the conditions associated with this study. I have also had all of my questions answered. Consent is indicated with submission of the survey. I hereby acknowledge the above and give my voluntary consent:

○ Yes

○ No

13. Questions or Concerns

If you have any questions or concerns about this study, you can contact the investigators (Kizito Mukuni : kizito1@vt.edu, Faculty Advisor: Dr. Barbara Lockee: lockeebb@vt.edu)

If you have any questions or concerns about how this study is conducted or about your rights as a participant, or if you need to report a research-related injury or event, you can contact Virginia Tech Institutional Review Board Phone: 540-231-3732, email: irb@vt.edu .

Appendix H

Evaluation Rubric

The purpose of this study is to develop guidelines for using video for teaching procedural skills based on Gagné's Nine Events of Instruction. The proposed guidelines may assist course developers and instructors when developing lessons to teach procedural skills in an online learning environment. We recommend that you use this survey as a rubric and record your notes as you review the guidelines, which may be accessed here: **Guidelines for using Video to Teach Procedural Skills Based on Gagné's Nine Events of Instruction**.

There are three sections in this survey. The first section focuses on ***Table 1. General Considerations for Using Videos for Learning,*** while the second section focuses on **Table 2. Guidelines for Using Videos to Teach Procedural Skills Based on Gagné's Nine Events of Instruction**. The third section focuses on the effectiveness, practicality and possible real-world constraints in the use of the guidelines as a whole. Your feedback is greatly appreciated. Please direct any questions or concerns to Kizito Mukuni (kizito1@vt.edu) at any stage during the process.

I have read the consent form and I hereby give my voluntary consent by answering the questions in this survey.

Yes
No

Optional: (If you provide this information, then you agree to be acknowledged by name when the study is published)

Name:
Affiliation:
Title:
Field:

Section 1

This section provides general guidelines for using video for learning (Table 1. General Considerations for Using Videos for Learning).

1. The guidelines for the **video format/quality (a)** are clear and easy to understand.
    a. Strongly agree

b. Agree
c. Neutral
d. Disagree
e. Strongly Disagree

2. Please provide any additional feedback regarding how to improve the **video format/quality (a)** section of the guidelines.

_____
_____
_____

3. The guidelines for the **length (b)** of the video are clear and easy to understand.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

4. Please provide any additional feedback regarding how to improve the **length (b)** section of the guidelines.

_____
_____
_____

5. The guidelines for the **context (c)** of the video are clear and easy to understand.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

6. Please provide any additional feedback regarding how to improve the **context (c)** section of the guidelines.

_____
_____
_____

7. The guidelines related to the use of **characters, information, visual cues and action (d)** in a video are clear and easy to understand.
    a. Strongly agree
    b. Agree
    c. Neutral

d. Disagree
e. Strongly Disagree

8. Please provide any additional feedback regarding how to improve the information in this section of the guidelines.

_____
_____
_____

9. The **general considerations for using video for learning** are clear and easy to understand.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

10. Please provide any additional feedback regarding how to improve the **general considerations for using video for learning.**

_____
_____
_____

Section 2

This section focuses on Table 2. Guidelines for using Video to Teach Procedural Skills Based on Gagné's Nine Events of Instruction. The guidelines present each of the nine events with correlating considerations for teaching procedural skills and examples of video use for each event. Please provide feedback related to each of these aspects of the guidelines.

11. The guidelines for **(1) gaining attention** using video are clear and easy to understand.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

12. Please provide any additional feedback regarding how to improve this section of the guidelines.

_____
_____
_____

13. The guidelines for **(2) informing learners of objectives** using video are clear and easy to understand.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

14. Please provide any additional feedback regarding how to improve this section of the guidelines.

    _____
    _____
    _____

15. The guidelines for **(3) stimulating recall of prior learning** using video are clear and easy to understand.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

16. Please provide any additional feedback regarding how to improve this section of the guidelines.

    _____
    _____
    _____

17. The guidelines for **(4) presenting the content** using video are clear and easy to understand.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

18. Please provide any additional feedback regarding how to improve this section of the guidelines.

_____
_____
_____

19. The guidelines for combined events **(5) providing learning guidance and (6) eliciting performance (practice)** using video are clear and easy to understand.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

20. Please provide any additional feedback regarding how to improve this section of the guidelines.

    _____
    _____
    _____

21. The guidelines for the combined events **(7) assessing performance and (8) providing feedback** using video are clear and easy to understand.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

22. Please provide any additional feedback regarding how to improve this section of the guidelines.

    _____
    _____
    _____

23. The guidelines for **(9) enhancing retention and transfer** using video are clear and easy to understand.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

24. Please provide any additional feedback regarding how to improve this section of the guidelines.

_____
_____
_____

Section 3
This section focuses on the effectiveness, practicality and possible real-world constraints in the use of the guidelines for using video to teach procedural skills based on Gagné's Nine Events of Instruction.

25. On a scale of 1-5, indicate how you agree or disagree that the following indicators are applicable to the guidelines with **1** representing **strongly disagree** and **5 strongly agree**

1 2 3 4 5

a. Usefulness: The guidelines are useful for practical application.

b. Functionality: The guidelines support their intended purpose.

c. Feasibility: The guidelines are feasible for real world use.

d. Relevant: The guidelines are appropriate for the field of IDT (Instructional Design and Technology).

e. Easy to understand: The guidelines are clear and easy to follow.

f. Reliable: The information in the guidelines can be trusted.

g. Adequate: The guidelines are comprehensive and sufficient.

26. Please indicate to what extent you believe the following factors could affect the use of the guidelines.

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
a) Budget					
b) Time					
c) Complexity of the procedure to be taught					
d) Technical nature of the content to be developed					
e) Level of expertise					

27. How effective do you perceive the guidelines to be in achieving their targeted goal of teaching procedural skills using video, based on Gagné's Nine Events of Instruction?

    Very effective Somewhat effective Not effective

28. If you selected **Somewhat effective** or **Not effective**, please explain your response.

    _____
    _____
    _____

29. The guidelines are designed in an organized format which can support their purpose and use.

    Yes.
    No.

30. If you selected no, please indicate how to better improve the organization and format of the guidelines.

    _____
    _____
    _____

31. Please provide any additional recommendations or suggestions on how to improve the guidelines for using video to teach procedural skills based on Gagné's Nine Events of Instruction.

    _____
    _____
    _____

Thank you for your feedback.

Appendix I

Guideline Application Example

Table 10:

Guideline Application Example

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use	Example: How to Replace a Flat Tire
1. Gain attention	• Engage learner informing them of the efficiency of the procedure over trial and error (Smith & Ragan, 2005). Arouse interest and curiosity through the use of questions related to the procedure (Buscombe, 2013; Khadjooi et al., 2011; Wong, 2018). • Emphasize why the procedure is a practical skill to acquire (Cheung, 2016).	• Use a funny or fascinating video clip to engage the learner (Berk, 2009; Choe, 2017). • A short video showing the procedure can be used (Ng, 2014; Qutieshat, 2018; Wong, 2018; Woo, 2016). • Short video related to the topic can be shown (Miner et al., 2015).	Show a funny video clip of someone driving a vehicle with a flat tire and how a vehicle can be damaged from driving on a flat tire.

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use	Example: How to Replace a Flat Tire
2. Inform learners of objectives	• Let the learners know what they will be able to do upon completion of the lesson (Gagné, 1975; Smith & Ragan, 2005). • Use introductory terms to inform learners what they will be able to accomplish upon completion of the lesson. The objective should be student centered and measurable (Buscombe, 2013; Cheung, 2016; Ng, 2014).	• Use out-of-video text to inform the learners (Brame, 2016). • Use visual cues or music to highlight the objectives (Choe, 2017).	List the following objectives in the video: By the end of this lesson, learners will be able to: • Identify which tire needs to be replaced • Select appropriate tools for the procedure • Demonstrate how to replace a flat tire with spare tire These objectives can be mentioned by the instructor.

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use	Example: How to Replace a Flat Tire
4. Present the content	• The content should be well organized and should address the learning objectives (Buscombe, 2013; Khadjooi et al., 2011). • Provide learners with the opportunity to view the procedure through a demonstration of the procedure (Angros Jr et al., 2002; Belfield, 2010; Cheung, 2016; Khadjooi et al., 2011; McCormick, 1997; Grantcharov & Reznick, 2008; Rickel & Johnson, 1999; Wearne, 2011; Wong, 2018; Woo, 2016). • The trainer can describe the steps as they are performing the procedure (Buscombe, 2013; Grantcharov & Reznick, 2008; Khadjooi et al., 2011; Qutieshat, 2018; Wearne, 2011; Wong, 2018; Woo, 2016).	Showcase the procedure using the video (Choe, 2017). Allow learners to view video multiple times to see what they could have missed the first time (Beck et al., 2002). Incorporate various angles of a scene (Brook,2014). Provide examples within the video (Pryor & Bitter, 2008). Use video to highlight important points (Borko et al., 2008, Brunvand, 2010). Use visual metaphors where necessary (Choe, 2017; Koumi, 2006).	Start the lesson by describing how to identify a flat tire. A flat tire can be identified by the following: • Tire Pressure Monitoring System (TPMS) warning in your vehicle if your vehicle is equipped with one (Show images of TPMS warning) • Vehicle making sounds at a particular speed (show clip of vehicle with flat tire sounds) • Excessive vibrations/ steering wheel shaking (Show clip of car vibrating and steering wheel shaking) Proceed to describing the steps involved in replacing a flat tire. Visually list the following steps clearly and unambiguous:

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use	Example: How to Replace a Flat Tire
4. Present the content (Continued)	• The steps should be listed such that they are not ambiguous (Larson & Lockee, 2020; Miller & Hudson, 2007). • Provide opportunities for learners to learn how to recognize situations that may need a particular procedure, complete its steps, recall the steps in the procedure and ascertain if the procedure was applied properly (Smith & Ragan, 1993). • The procedure to be demonstrated should be relatively simple, about seven steps or fewer and even fewer for younger learners. Decision points should be fewer as well (Smith & Ragan, 2005).	If the lesson is long, segment the video (Biard et al., 2018; Choe, 2017).	1. Identify which tire needs to be replaced 2. Find all the tools (a jack and a lug wrench with a socket on one end and a pry bar on the other, wheel chocks) 3. Remove spare tire 4. Block car by placing wheel chocks under rear two tires which will not be removed 5. Place jack on the designated place (consult car manual for the best place to secure your jack) 6. Use wheel/lug wrench to loosen lug nuts, but not completely 7. Raise the car using the jack so that the tire/wheel to be removed is about 10 inches from the ground 8. Remove lug nuts completely from wheel 9. Remove the wheel

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use	Example: How to Replace a Flat Tire
4. Present the content (Continued)			10. Replace with the spare wheel. 11. Place lug nuts on the spare wheel and tighten with a wrench, but not fully. 12. Lower car using the jack. 13. When all wheels/tires are on the ground, safely remove the jack from the designated area. 14. Fully tighten the lug nuts until unable to tighten. • After listing the steps, proceed to demonstrate how the procedure, explaining each step. 1. Identify which tire needs to be replaced (Show each tire of the vehicle and indicate which might only need pressure and which tire needs to be replaced. Stress the importance of recognizing when it is appropriate to perform the procedure and when it is appropriate to add pressure to a tire).

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use	Example: How to Replace a Flat Tire
4. Present the content (Continued)			2. Find all the tools: A jack and a lug wrench with a socket on one end and a pry bar on the other and wheel chock (Show where each of the tools could be located in a vehicle and describe the function of each one of them. Show images of possible places the tools might be located in other vehicles). 3. Remove spare tire (Demonstrate how to remove spare tire from where it is stored in the vehicle. Remind viewers to consult their car manual for specifics). 4. Block car by placing wheel or tire chocks under two tires which will not be removed (demonstrate how to place the wheel/ tire chocks and describe other items which can be used in case the tire chocks are not available. Show images of these items). 5. Place jack on the designated place. Consult car manual for the best place to secure your jack. (Demonstrate how to correctly place a jack at the designated area. Show images of other areas that the jack can be placed). 6. Use wheel/lug wrench to loosen lug nuts, but not completely (While demonstrating this step, discuss why it is necessary not to completely remove the lug nuts. Show which direction tightens and which direction loosens. Use arrows to indicate these directions).

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use	Example: How to Replace a Flat Tire
4. Present the content (Continued)			7. Raise the car using the jack so that the tire/ wheel to be removed is about 10 inches from the ground (show images of the recommended space between the ground and the tire to be removed). 8. Remove lug nuts completely from wheel (demonstrate how to remove the lug nuts from the wheel). 9. Remove the wheel (demonstrate how to remove the wheel). Replace with the spare wheel (demonstrate how to replace flat tire with the spare tire). 10. Place lug nuts on the spare wheel and tighten with a wrench, but not fully (demonstrate how to place lug nuts on the spare tire while explaining the importance of not fully tightening the lug nuts). 11. Lower vehicle using the jack (demonstrate how to safely lower the jack, explaining some of the dangers not safely lowering the vehicle). 12. When all four tires are on the ground, safely remove the jack from the designated area (demonstrate how to remove the jack from the vehicle). 13.Fully tighten the lug nuts until unable to tighten (demonstrate how to fully tighten the lug nuts and explain the importance of this step). If the video is more than 25 minutes, segment the video based on the steps.

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use	Example: How to Replace a Flat Tire
5. Provide learning guidance/Elicit performance (practice)	• Learners can be presented with situations in which the procedure might be useful. Learners could then be asked to determine whether or not the procedure should be applied (Smith & Ragan, 2005). • Provide opportunities for practice (Angros Jr et al., 2002; Foshay & Kirkley, 2003; Miner et al., 2015; Ng, 2014; Qutieshat, 2018). • Learning procedures may require a significantly higher rounds of practice (National Academies of Sciences, Engineering, and Medicine, 2018). • Each individual step within a procedure could be practiced (Grantcharov & Reznick, 2008; Smith & Ragan, 2005).	• Allow learners to view video multiple times to see what they could have missed the first time (Beck et al., 2002). • Incorporate guiding questions within the video so that learners can have an opportunity for self-assessment (Brame, 2016). • The learner could record themselves and send the video for review to the experts (Brook, 2014; Grantcharov & Reznick, 2008; Santagata et al., 2007). • Video can also be used as a tool for self-assessment allowing learners to review their own behavior /performance and evaluate themselves (Yoo et al., 2009; Zick et al., 2007).	• Ask learners to determine when they can call for roadside assistance. • Encourage learners to practice each step, especially steps that could be hard to perform. • Remind the learners to re-watch the step in the video and practice until they can perform all the steps. • Encourage learners to record themselves performing the whole procedure and re-watching themselves performing it until they are satisfied with their own performance.

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use	Example: How to Replace a Flat Tire
5. Provide learning guidance/Elicit performance (practice) (Continued)	• After practicing the step, the learners should then practice the entire procedure for multiple times (Kneebone, 2005; Smith & Ragan, 2005). • Learners could practice recalling the pattern and nature of the steps in the procedure, after practicing how to execute the procedure (Smith & Ragan, 2005). • Determining whether a procedure was correctly completed should be part of the practice (Smith & Ragan, 1993). • Feedback on the performance could accompany the practice (Khadjooi et al., 2011; Kneebone, 2005; Ng, 2014).	• Learners can view their own performance and rerecord if they are not satisfied with their performance (Winters et al., 2003).	

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use	Example: How to Replace a Flat Tire
6. Assess performance/ Provide feedback	• Provide opportunities for the learners to demonstrate the whole procedure without guidance or prompt (Khadjooi et al., 2011; Wong, 2018). • Use a debriefing session to provide feedback regarding the learner's performance procedure (Grantcharov & Reznick, 2008). • Feedback provided to the learners should be objective (Belfield, 2010; Buscombe, 2013; Cheung, 2016). • Was the situation allowing the use of the procedure correctly identified? Provide the reason why or why not. The learners could be provided with feedback on the accuracy of how they completed each step of the procedure (Smith & Ragan, 1993). • For procedures involving decision steps, the feedback should include feedback on whether the learner made the right decision, thereby correctly selecting the correct path in the procedure (Smith & Ragan, 2005).	The learner could record themselves and send the video for review to the experts (Brook, 2014; Grantcharov & Reznick, 2008; Santagata et al., 2007). Use tools which allow video commentary so feedback can be provided (Brunvand, 2010). Video can also be used as a tool for self-assessment allowing learners to review their own behavior /performance and evaluate themselves (Yoo et al., 2009; Zick et al., 2007). Learners can view their own performance and rerecord if they are not satisfied with their performance (Winters et al., 2003).	• Learners can record themselves performing the procedure. Learners can self-assess by viewing themselves performing the procedure and re-recording themselves if they are not satisfied with their performance. • Learners can also send the video to the instructor. The instructor can view the video and provide objective feedback on the following areas: 1. Did the learners correctly describe the situation in which they can either replace a flat tire or add pressure to the tires? Provide feedback such as why the situation was wrongly described.

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use	Example: How to Replace a Flat Tire
6. Assess performance/ Provide feedback (Continued)	• It is important to make a distinction between decisions/steps that are fitting, but not important, and those that should be present (Farmer & Page, 2005). • The feedback provided to the learners should indicate whether the procedure that was given was completed correctly. A detailed explanation of why a decision was made might be included in the general feedback (Smith & Ragan, 2005). • Feedback could be provided at the end of the task (Bould et al., 2009; Miner et al., 2015).		2. Where the steps of replacing the tire performed appropriately? Provide specific feedback indicating which step could have been completed better. • Instructors can incorporate the feedback in the video and distribute the video to the learner.

Event	Considerations for Teaching Procedural Skills	Considerations for Video Use	Example: How to Replace a Flat Tire
7. Enhance retention and transfer	• Summarize the nature, form, and variation of the procedure and incorporate complementary materials (Smith & Ragan, 2005). • Direct learners to opportunities available for them to use the skills acquired (Buscombe, 2013; Ng, 2014). • Provide learners with opportunities to practice the procedure (Khadjooi et al., 2011; Qutieshat, 2018). • Describe other contexts in which the procedure can be applied (Cheung, 2016). • Provide examples and situations the procedures might be applied (Gagné, 1975). • Provide opportunities for learners to reflect how they could apply the skills in real life. • Provide materials such as job aids or downloadable handouts.	• Reinforce repetition by using different angles (Koumi, 2006). • Use video to highlight important points (Borko et al., 2008; Brunvand, 2010).	Show key steps using different angles: When showing which direction to turn the wrench when removing the tire, capture the scene on various angles to show how the step can be completed. Highlight key points such as important safety precautions (where to stand when removing the tire). Encourage the learners to practice the procedure repeatedly based on their needs. Provide the learners with the opportunity reflect on situations they can replace a tire or add pressure. Provide learners with job aids showing key steps necessary to complete the procedure.