UNIVERSITY OF TWENTE.

Video vs. text: Assessing the effectiveness of a video tutorial on the procedural- and factual knowledge of production workers and its potential benefits over a tutorial with text and still graphics.

A Quasi-Experimental Study Conducted at a Global Manufacturing Company

Master Thesis

Nick Scheurwater

Educational Science and Technology, Human Resource Development

University of Twente

Acknowledgement

This master thesis accounts for the completion of the master programme of Educational Science and Technology, with the focus on Human Resource Development, at the University of Twente. I conducted this study in combination with an internship at Apollo Vredestein, a global tyre manufacturer based in Enschede. First of all, I would like to express my gratitude to all the production workers and production coordinators that participated in this study. Although you had to deal with a daily production quota and the corresponding workload, you still managed to facilitate several tests, which stand as a basis for my research. Furthermore, my special appreciation goes out the department of education at Apollo Vredestein (George Sanders, Herman Steunenberg and Hylle de Beer) and specifically to Klaas Woudstra. Klaas was a constant, positive and valued contact who guided me and my study through the entire organization and helped me encounter several obstacles in gathering the data I needed in reaching a successful ending. There were some real struggles in getting the involvement of a sufficient amount of participants, however with our combined creativity and effort we managed to create the support we needed to bring this study to the finish line. Additionally, I would like to say thank you to my supervisor Bas Kolloffel who guided me through the study and was always there to provide me with the critical feedback I needed to maintain the quality. Finally, thank you to my second supervisor Hans van der Meij, for taking the time to critically review my study and provide me with the feedback I needed to improve where needed.

Nick Scheurwater

February, 2017

Abstract

The aim of this study was to provide and add clarity on the topic of the effectiveness and efficiency of video as a learning tool and media for training employees. Specifically, if video as a learning tool is more effective and efficient than using text and still graphics (PDF), for production workers in becoming acquainted with an online system within a global manufacturing company. A sample group of 190 production workers were part of a quasi-experimental design in which they followed a pre-test, intervention and post-test process. Additionally, from the sample group 57 participants conducted a third and final test to measure the retention rate of the participants. The sample group was divided into two conditions. One hundred participants were trained on an online software program via a video tutorial and ninety participants were trained on the same topic however through a PDF tutorial containing the same theory.

Results revealed that within this context, video proved itself as an effective learning tool for the participants to significantly improve themselves in factual- and procedural knowledge about interpreting and using an online system called QMS. However, multiple data analysis failed to provide evidence that benefits video as a learning tool over PDF. Furthermore, the data revealed no significant difference between groups on the mean post-test results, procedural knowledge, factual knowledge, learning gains and retention rate. On the contrary, there was a significant difference found on the training time between groups in favor of the PDF condition. Meaning that the PDF –group needed significantly less time to follow the training and finish the test than the video-group, producing similar results.

Key words: Video learning, Procedural knowledge, Factual knowledge, Production workers

Table of Contents

Introduction

Organizations providing employees sufficient knowledge needed for a successful job performance, contributes to the overall organizational performance of manufacturing firms (Epple, Argote & Murphy, 1990) and provides a basis for competitive advantage in firms (Argote & Ingram, 2000). Although providing employees with sufficient knowledge through training and education stands as a central pillar in many organizations, the effectiveness of these training methods varies considerably (Argote, 1999). Effective training might eventually lead to higher productivity, improved work quality, higher motivation, higher commitment, higher morale and fewer errors leading to a stronger competitive position (Salas et al., 2006). A possible method to train employees and offer them the knowledge that is required is through online and digital tools. Digital learning or E-learning is defined as instruction that is delivered on a digital device and is intended to support learning. Digital learning generates more personalisation for students and thus contributes to deeper learning and provides students with motivation and persistence (VanderArk & Schneider, 2012).

Modern day multimedia offers teachers, coaches, and trainees a wide variety of digital and textual opportunities for knowledge accumulation. However, a question arises concerning what medium is most effective for what situation. Within the field of education and business, organizations use training tools varying from video, written papers to online tools. Looking more closely at these tools, scholars have presented the effectiveness of (interactive) instructional videos as a tool that benefits the learning process of students worldwide in various disciplines and sectors (Schwan & Ramp, 2004; Zhang et al, 2006). Video in general is seen as a rich and powerful medium that consistently presents information in an attractive way (Zhang, Zhou, Briggs & Nunamaker, 2006), and offers opportunities to distribute information realistically by combining motion with audio, visual and textual information (Wetzel, Radtke & Stern, 1993). Subsequently, students who use video for learning, experience them as a helpful tutoring resource that gives the students control by pausing the video when needed, learning at their own pace and accessing the information in the preferred environment (Bridge, Jackson & Robinson, 2009; Simpson, 2006).

Although video is a widely accepted medium for instruction in educational studies, the effectiveness of video as a learning tool compared to traditional learning tools is often unknown. Within this current research article, video as a learning tool is compared with a more traditional paper-based learning tool, namely PDF. The aim of this study is to provide and add more clarity on this topic. While most scholars within this topic focussed specifically on an educational context, this study took place within a real-life global manufacturing company. Therefore, this study provides more clarity about the possible effectiveness of

learning through video in comparison with a more traditional tool like learning through text and still graphics (PDF), in a business setting amongst actual production workers. Specifically, production workers being trained on how to find, understand and use a software system they had to work with in daily practise.

Effects of video learning on learning outcomes.

Looking more closely at the ongoing debate of the topic in hand, the question remains on what previous research has found about the effect video learning actually had on the learning outcomes. Examining the diversity of the results of various studies on this topic, it is a question that is not simply answered. First, Lewis (1995) explored the influence video learning has on the impact on students' grade and attitudes by replacing standard tutor instructions to video instructions. The videos had the identical content as the standard tutor instructions and failed to present itself as an improvement. Furthermore in line with Lewis (1995), Kim, Yoon, Whang, Tversky and Morrison (2007) examined the impact on student learning about bicycle pumps by presenting the theory in still graphics and animation. Data showed that the animation did affect the students' perception but failed to improve the test scores. Other studies showed similar results by studying graphics vs. animation (Jolly, 2003) and text plus static graphics vs. text plus animated graphics (Morrison and Tversky, 2001).

Examining studies that specifically measured a possible effect of video tutorials on software learning outcomes in educational settings, similar varying results were found. First, multiple studies did not reveal a significant difference between the video- and paper-based condition concerning a software drawing program on the Macintosh (Payne, Chesworth & Hill, 1992), an experiment in which participants were instructed on how to find articles in an online system (Mestre,2012), and an empirical study in which participants were instructed on how to use word in a software system and creating table of contents (Alexander, 2013). Based on these researches one might conclude that scholars failed to provide evidence that benefits the likes of video learning over more traditional methods. However, the results are too diverse and complicated making this a bold statement.

On the contrary, several studies covering the same topic, did actually find evidence favoring video over other learning tools. Hoffler and Leutner (2007) executed a comprehensive meta-analysis of 26 primary studies, yielding 76 pair-wise comparisons of dynamic and static visualizations, demonstrating conflicting results from the previously mentioned articles. Their overall conclusion indicated a medium-sized overall advantage of instructional animations over static pictures, making it educationally significant. Looking more closely at their research, it is stated that animations are superior to static pictures if they refer specifically to

the topic to be learned and if they presented an adequate level of realism. Furthermore a statement was made that “the advantage of animations becomes particularly evident under specific combinations of relevant circumstances” (p.6). Meaning that video might be effective if the context optimally addresses and strengthens the learning tool. These findings were in line with several studies that did find a significant difference between video and paper-based tutorial. First, van der Meij and van der Meij (2014) found evidence that clearly favored video instruction over paper instruction where the participant had to conduct several software tasks. Secondly, Palmiter and Elkerton (1993) found similar results in a similar context as they stated that participants who viewed the video tutorial completed the training faster and more accurately.

Conclusively, there seems to be a lack of consistency between researchers leading to a ‘generalization problem’ of the topic in hand. Furthermore, it is of critical essence to keep in mind that these studies not just lacked to provide unambiguous results, but also lacked generalizable conditions. Meaning that although video is used as a learning tool in all of these studies, the goals and contexts of the studies differed, varying from learning how to use a bicycle pump to learning a software drawing program. In the remainder of this thesis there will be more focus on the possible effects of disparate learning tools and contrasting contexts.

Looking for reasons that might explain this ‘generalization problem’, Muller (2008) builds upon the statement Hoffler and Leutner (2007) made about specific combinations and relevant circumstances. First, his research focuses on the increased motivation the students demonstrated in experiments while watching videos instead of more traditional methods. Muller (2008) claims that due to the novelty, methodological cofounds, not ensuring socioeconomic statuses and even a Hawthorne effect likely account for most of the success in these articles. Second, and perhaps most important he mentioned that different methods of instructional media could be made equally effective in contrasting contexts. Leading to research results that are impossible to generalize over contrasting learners and contexts. Clark (1983) symbolically illustrated this with the metaphor “Media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition,”(p.445). This research article will specifically focus on using video learning as a tool for training and measuring its effect on learner outcomes within a production company, versus a traditional paper-based training. Aiming to provide evidence that could be of added value for the overarching topic of the effectiveness of learning though multimedia.

Cognitive processes in learning.

Video and other learning methods can be tools to develop trainees' knowledge and lead to an effective learning process. However, within this learning process there should be multiple variables considered concerning cognitive processes. These variables are essential to understand in discussing possible explanations for the potential effectiveness and efficiency of video as a learning tool and what competences a learner has which can be addressed by video as a learning tool.
In his article on multimedia learning, Mayer (2001) claims that the learners' 'information system' is responsible for effective multimedia learning. The information system is defined as the learners' separate channels for visual and verbal processing. This information system requires a coordinated processing system for each channel. Structuring these systems requires an effective training adapted specifically to the cognitive processes of the trainee (Mayer,2001). Meaning that the training in which the theory is offered should be designed in a way that the learner can coop with the pace and it is presented in an understandable manner according to the cognitive level and competences of the learner. Specifically by selecting relevant words and images, a coherent organization of verbal presentations and pictures, and integrating these with each other and prior knowledge.

Mayer (2001) addresses these cognitive processes by relating them with concrete practical learning applications. A number of these applications can be relevant for the current study on understanding why video might be an effective tool for the learning process. He states that people learn better when the information presented by multimedia is designed consistent with the way the mind works and according to certain 'research-based principles'. According to these research-based principles, there are several guidelines that can be used towards developing successful multimedia learning designs. First, the multimedia principle states that pictures are more effective in the learning process than words alone. Secondly, he claims that people learn more effectively when they can pace the presentation according to their own learning, in other research adopted as 'cognitive pace' (Wetzel, Radtke & Stern, 1993). Furthermore, the modality principle states that animation in combination with narration is more effective then animation with on screen text (Mayer, 2001), which is supported by Van der Meij and Van der Meij (2013). Shepard (2003) also highlights the importance of narration as support for visualizations and states that videos can be a genuine reflection of real-life situations. Additionally Zhang et al., (2006) state that video provides the student more flexibility in its learning and fosters self-directed and self-paced learning. Summarizing these findings, one might claim that making videos more effective through narration, student control and adapting content to the cognitive pace of the learner might be beneficial for improving the learning process.

Cognitive advantages pinpointed by theory of video- and paper-based tutorials .

Within this study there is a focus on possible differences between the learning effects of a video tutorial and learning through a PDF tutorial. While Clark and Mayer (2001) elaborated comprehensively on the way learning should be adjusted to the students' cognitive processes, it might be relevant to inquire how video and paper-based learning addresses these processes. First, in their study on knowledge development for software tasks, Van der Meij and Van der Meij (2014) compared the effects of a video tutorial versus a paper-based tutorial on the learning outcomes of fifth and sixth graders. They stated that a paper-based tutorial might be favoured over a video tutorial for procedural knowledge development due to its accessibility, control of pace, active processing and if the paper-based tutorial is structured such that provides the user with a clear overview of the contents of the training. Additionally, they state a rather important claim for the current research. It is stated that the speed in which the student processes the information is not dictated by a paper-based tutorial but completely by the user who is in control of his own learning pace. This element seems to address the claim of Mayer (2001) that states that learning is most effective when the theory is presented according to the students' cognitive pace.
Furthermore, van der Meij and van der Meij (2014) state that a paper-based tutorial also invites the student into active processing. A paper-based tutorial is adapted to the student and his tendency to act and calls upon self-explanatory processes. Which might be in line with the study of Clark and Mayer (2012) and addresses the claim in which they emphasize on the importance of active learning as they claim that learners are more likely to understand information when being engaged in relevant cognitive processing.

Looking from the perspective of possible advantages of video tutorials, multiple scholars emphasize the fact that video mirrors practical situations in a realistic and attractive way (Grossman & Salas, 2000; Shepard, 2003; Wetzel, Radtke & Stern, 1993; Zhang et al., 2006), which might benefit video over paper-based tutorials. Burke and Hutchins (2007) stated that realistic practice scenarios help promote active learning, which is believed to maintain the attention of trainees and contribute to transfer. What might be in relation with this phenomenon is that, for the training to be successful, the program must be relevant for the job and the trainee has to understand relationships between the training and work practice (Bates et al., 1997; Kontoghiorghes, 2002). Subsequently, Machin (2002) states that the trainees' attention can be drawn by presenting real-life situations the trainee is familiar with. Although video might seem the best tool to mirror a realistic scenario, PDF can also address this scenario by presenting pictures in combination with a narrated text. However Mayer (2001), states the modality principle allows the video to be more effective in the learning process than animation with on screen text. In line with these findings, van der Meij and van der Meij (2014) describe arguments that might benefit a video tutorial over a paper-based in which they

emphasize on congruity and modelling. Meaning that a video can be displayed through auditory and visual information, which might strengthen each other, and that video displays certain tasks identical as the student experiences in the practical context. Furthermore, they state when students specifically learn about software from video instructions they can easily mimic the observed actions.

Defining factual and procedural knowledge.

Within this research, two types of knowledge were trained and assessed in order to measure possible effects the type of training had on the learning outcomes. Multiple research articles explicitly focused on the effect a video tutorial had on the procedural knowledge of the participants through software tasks (Mestre, 2012; Payne, Chesworth and Hill, 1992), instruction on performing certain acts in practice (Kim et al., 2007) and by using a grading system (Lewis, 1995). However within the current study there was an equal focus on procedural knowledge as factual knowledge due to the fact that the participants need to understand certain concepts in order to perform certain procedures. First, participants were simply required to memorize certain information that was revealed to them in the training. In the remaining article this type of knowledge is referred as 'factual knowledge' or 'declarative knowledge'. Secondly, participants were required to find information in an online system by following a sequence of steps that was demonstrated to them in the training. In the remaining part of the article this type of knowledge is referred as 'procedural knowledge'.

Factual knowledge or declarative knowledge represents awareness of some object, event or idea (Jonassen, 2000). Procedural knowledge is defined in theory in two steps. First, a procedure is a number of steps that has to be accomplished in reaching a goal and secondly, knowledge of these procedures is defined as procedural knowledge (Rittle-Johnson, 2012). Furthermore, the sequential nature of the procedures is what distinct procedural knowledge from other types of knowledge (Hiebert & Lefevre, 1986). There seems to be a general consensus that defines procedural knowledge as the ability to execute action sequences to solve problems (Rittle-Johnson, 2012). In recent history, specifically on software users, paper-based tutorials have been a dominant tool in procedural knowledge development. However, nowadays video is challenging this dominance due to the overtaking of technical barriers to its production and distribution (van der Meij, Karreman & Steehouder, 2009).

In research, procedural knowledge is measured in multiple ways. In the study of Rittle-Johnson (2012), procedural knowledge in mathematics is always focused on solving problems in which the outcome is actually measured. Additionally, the time it took to conduct the assessment is also used as a measure. In conclusion, to effectively measure procedural knowledge in this study, the student has to give the right

answer in which the answer can only be acquired by executing the correct procedure. For factual knowledge the method is often more straightforward for the student. Factual knowledge can be measured simply by memorization and is often less complex than procedural or conceptual knowledge.

Production workers and their view on learning.

Contrary to a large number of other studies covering the effectiveness of video learning, this study was not situated in an educational context but within a global manufacturing company. Consequently, leading to the assessment of actual workers instead of students. To gain more insight in the perspective of production workers Timma (2007) conducted a qualitative study in which workers, active in a food manufacturing company were interviewed on their perspective about learning. She found that the majority of workers demonstrated an eager interest in pursuing learning opportunities. They do so with the ultimate goals of developing their skills, understanding for the job, personal fulfillment and self-improvement. Furthermore, the study revealed that most of the workers prefer on-the-job assessments instead of written assessments because of its realistic nature. The workers preferred assessment that closely matched the activity of the work and skills training and helped them to understand their work better (Timma, 2007). These findings seem to support the statement of a wide variety of studies (Grossman & Salas, 2000; Mayer, 2001; Shepard, 2003; Wetzel, Radtke & Stern, 1993; Zhang et al., 2006) that emphasize on the importance of realistic training scenarios. However, it might be important to consider that the preferred context of the production workers might influence their perception but the effect on the eventual outcomes remains unknown.

Conclusively, Timma (2007) demonstrated that the workers consciously connected their learning and training with the activities of their job and taking responsibility of their own learning. Additionally it was specifically stated that by drawing on the workers' perception and understanding it, a training could be designed accordingly leading to a more effective training. Which might ultimately lead to an adequately skilled and knowledgeable workforce, leading to an efficiently operating company (Riding & Mortimer, 2000). These findings might indicate that workers within this study positively perceive video as a learning tool. Furthermore, by addressing realistic training scenarios through video might influence the learning outcomes benefitting video over a PDF-tutorial.

Within research there seems to be limited knowledge about certain competences of production workers and more specifically on how they learn effectively. However, a large amount of the production workers in the current study attended secondary vocational school. In line with this population, Kolloffel and de Jong (2013) studied the conceptual understanding of electrical circuits amongst secondary vocational students. They

state that inquiry learning is assumed to be too challenging for these students, as it enables them to use a more scientific approach. Although this claim addresses a different type of learning than the current study, it indicates that production workers might have more difficulty in acquiring deeper learning concerning their procedural knowledge than simply memorizing theory in their factual knowledge. Subsequently, Vreman-de Olde (2006) describes these kind of students as do-ers and that they prefer the practical application of their knowledge due to the fact that they are visually oriented. Therefore, in enabling the secondary vocational students to connect reality and theory, he suggests using realistic visualizations in computer simulations. These findings seem to be in line with the perception study of Timma (2007) and support the claim that production workers might learn more effectively when use realistic learning tools, such as a video tutorial.

Research Question

The aim of the study is to investigate to what extent video is an effective learning tool for production workers within a global manufacturing organization. Additionally, examining if video learning is significantly more efficient then learning through PDF, in training them how to use and understand an online system. An important question in this topic is, how does video optimally addresses the learning goals for the workers? The workers had to become acquainted with the system by knowing how to follow certain procedures in order to find the information that was needed. Additionally, memorizing the meaning of certain phrases and abbreviations. Therefore, the participants were assessed specifically on procedural knowledge and factual knowledge enabling to possibly observe what condition is more beneficial to these types of knowledge. Consequently, ideally conclusions can be drawn about whether video is an effective and efficient learning tool for production workers in a global organization, using an online software system.
The research question derived from these topics is:

Is video a more effective and efficient learning tool than PDF among production workers within a global organization, in training them on understanding and using an online system?

The research question aims to provide information on what type of learning tool could be beneficial to effective training and what method is most appropriate according to the cognitive processes of the production workers. Subsequently, it aims to provide data on the sustainability of the provided knowledge over time of both methods. Looking specifically at the effectiveness of both learning tools, there will be several variables measured. Namely the test results, procedural knowledge results, factual knowledge results and the retention rate. Subsequently in measuring the efficiency of the learning tools, specific attention will

be paid to the (training) time it took the participants to finish the test in both the video and text condition. Based on these topics, this study aims to provide empirical evidence for the following hypotheses:
Hypothesis 1: Test results demonstrate that the participants using video as a learning tool score significantly higher on the test results than the participants using PDF. Which would support the findings of Hoffler and Leutner (2007) and van der Meij and van der Meij (2014).
Hypothesis 2: The participants using video as a learning tool need significant less time to complete the test than the participant using PDF. Which is in line with the findings of Palmiter and Elkerton (1993)
Finally, this study aims to provide new insights on the possible difference between conditions on the retention rate. Leading to the last hypotheses.
Hypothesis 3: The participants using video as a learning tool reveal a significant higher retention rate than the participants using PDF.

Method

Research design

For this study an intervention-based quasi-experimental design was constructed. Aiming to measure and analyze possible differences between the effectiveness and efficiency of video learning versus learning through PDF, focusing specifically on the learning outcomes of factual- and procedural knowledge and retention rate. Achieving this goal, requires a distribution of all participants into two contrasting samples. The first sample group followed a pre-test- intervention- post-test process containing a video tutorial as the intervention, ideally demonstrating the effects of the video on the learning process. The second sample group followed the same routine as the first, however using PDF as a substitute for the video. Ideally demonstrating the effects of learning through text and still graphics on the learning process.

Participants were randomly assigned across the first and second sample group. In order to test the retention rate of the first and second sample group, eighty reliable participants were selected and assigned to the retention-test. Both groups consisted of group 1 and group 2 participants, ideally demonstrating the retention-rate of sample group 1 and sample group 2.

Table 1. *Research design*

	Pre-test	PDF-training	Video-training	Post-test	Retention-test
Sample group1	O	X		O	O
Sample group 2	O		X	O	O

Participants

Apollo Vredestein B.V., research facilitator, harbors around 1257 production employees containing the occupations mechanics, operators, instructors, coordinators and process engineers. The production employees vary from background, age and qualifications. Although the amount of differentiation within the production industry is high, producing different products for varying industries and using contrasting processes, the total population (100.000+) reveals similarities on the level of education, gender and background (ROA & CBS, 2014). Due to the fact the study focused on a particular subset of people, namely production workers, a purposive sampling method was used, targeting all 1257 production workers within the company of Apollo Vredestein B.V. For the pre-test all production workers were approached, revealing a response rate of 40.1 % (N=504) from which the test results of 368 participants were considered as reliable. Due to the fact this study specifically investigates possible changes in the learning gain of the participants, the participants scoring 100% on the pre-test were excluded from the analysis. Furthermore, participants were expected to conduct both the pre-test and the post-test. Revealing a conclusive sample group of 191 participants.

Within this group 12.4% had VMBO as their highest education level, .9% had HAVO as their highest education level, 19.7 % had MBO-2 as their highest education level, 30 % had MBO-3 as their highest education level, 25.3% had MBO-4 as their highest education level and 5.2% had HBO as their highest level. The residual participants educational level were either unknown or not significant to be representative. The group revealed a mean age of 43,44 (N=190, SD= 9.9), varying from 18 years till 62 years old.
Due to the exclusion of the participants that scored 100% on the pre-test, the sample group using video learning as the intervention consisted of N=101, and the sample group using PDF as a learning tool consisted of N=90. From these two samples a subset of forty participants per group were randomly approached to execute the retention test. Leading to a response rate of 71% and two sample groups of N=26 for the PDF group and N=31 for the video group which were specifically assessed on retention rate.

Table 2. *Distribution Sample groups reliable for data analysis.*

	N	Mean-Age (SD)
Video group	100	44.83(9.1)
PDF group	90	42.01(10.28)

Materials

Conducting the experiment necessary for this study required the development and implementation of several instruments. In the context of an upcoming audit, Apollo Vredestein had to meet certain specific criteria regarding an online quality management system (QMS). In order to provide all the production workers the requisite knowledge applying QMS, a custom-made training was designed. This study utilized the opportunity to adopt this training and guided it towards the requirements of a scientific research, including a pre-test, two interventions, post-test and retention-test.

Pre-test, Post-test and retention-test.

The goal of the pre-test was to measure the current knowledge the participants had on QMS, this would provide a baseline on which possible differences in learning methods and learning gains could eventually be measured. Because the training was custom-made, aiming to provide the production workers with the necessary knowledge to reach the requirements of the upcoming audit, there was no appropriate existing testing format available that could be applied in this context. Leading to a self-designed ,custom-made test focused specifically on the knowledge and procedures the production workers were desired to know about QMS. More specifically, the participants were assessed on factual questions concerning abbreviations they were required to know and trough what media they could find QMS. Additionally, they were desired to understand the structure of the system and how to apply specific steps to gather relevant information about their daily routines and machines. Although the test was custom-made, the designing of the test was guided by best practices pinpointed by Piontek (2008). A multiple-choice test was designed with the advantages that it can measure various kinds of knowledge. In designing the questions, special attention was focused on writing clearly, keeping the options short with only the information that is needed and plausible yet completely wrong distractors (McMillan, 2001). This would ensure the reliability and validity of the test.

Within the test, the study aimed to measure two variables, namely the current level the participants had on factual- and procedural knowledge concerning QMS. The test consisted of ten questions which were

divided into five factual (E.g. What does the abbreviation Q.M.S stand for?) questions and five procedural questions (E.g. How often, does the process 'transport to cutter' needs to be applied at the machine Bias 7 in the C.P. ?) adapted to the cognitive skill and level of the participants, that was tested during multiple test-assessments and designed in cooperation with the organizations' education department. Due to the fact that the sample group demonstrated a large amount of differentiation regarding to background and education level, this study utilized the same testing system the workers usually were assessed by. Via the online system, Question mark Perception, a multiple-choice test was constructed and data was collected. Both the post-test and retention-test were parallel tests from the pre-test, tested in the same program, containing ten parallel questions. Before analyzing the data, a Cronbach's Alpha test was constructed to measure the reliability of the pre- and post-test. Results revealed that the Pre-test lacked a sufficient Cronbach's Alpha level for it to be considered as reliable (α=.59), it improved when question three was deleted (α=.63), however not improving enough to be considered as completely reliable. Contrasting results were found for the reliability of the Post-test (α=.7) and when question three was deleted (α=.71) . Due to the limited sample size of the retention-test and the fact that all the questions came from the pre-test and post-test no internal consistency test was conducted.

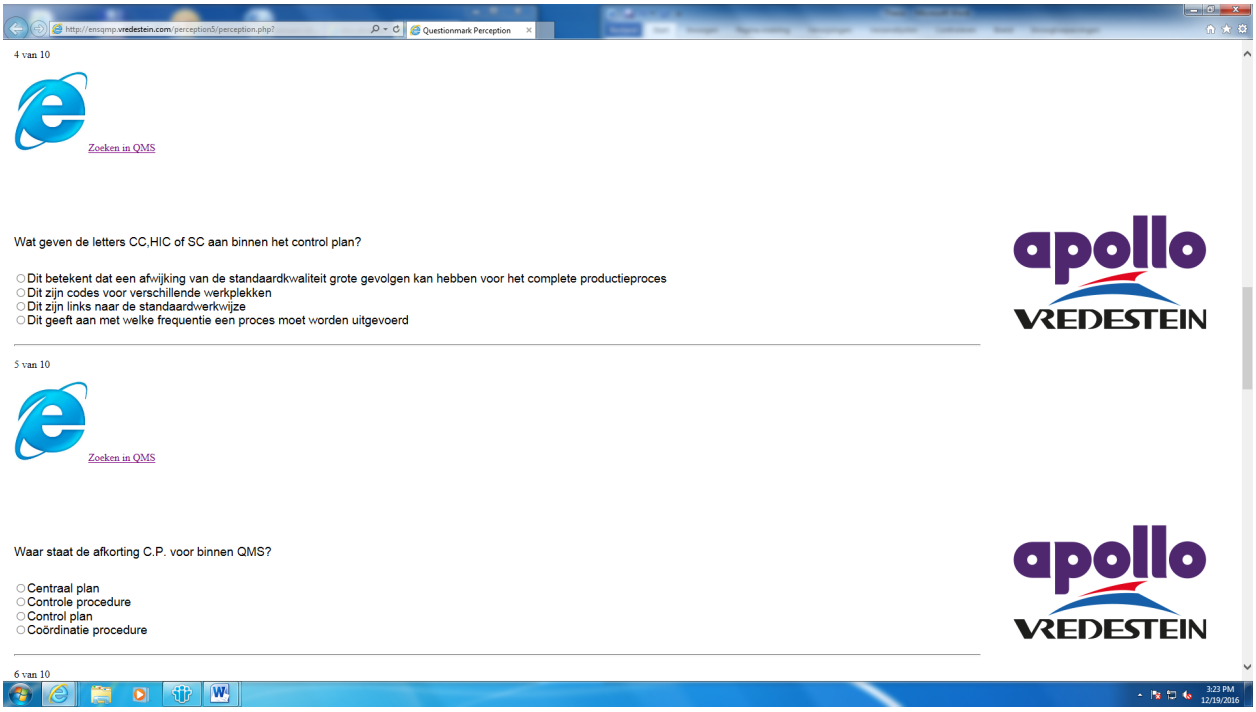

Figure 1. *Shot of two multiple-choice questions within Question mark Perception.*

Video.

Using video as a learning and intervention tool required the development of a video that specifically contained the content needed to provide the production workers the appropriate knowledge concerning QMS. In guidance of developing the video the 'eight guidelines for the design of instructional videos for software training' (van der Meij & van der Meij, 2013) article was used and implemented to assure its scientific quality (Figure 2). The video covered a length of eight minutes, following a step-by-step explanation on the usage of QMS and the practical application of it. Furthermore, it explained the practical relevance of the system and necessity in the context of the upcoming audit. The goal of the training was to present the usage of the online system in the real-life practical context. All the procedures the participant needed to know in order to optimally use the system, was presented in a sequential way. The video training differs from the PDF training due to the fact it contains a continuous video process, explaining the procedures step by step through a spoken narration.

Guideline 1: Provide Easy access 1.1: Craft the title carefully	Guideline 5: Provide procedural rather than conceptual information
Guideline 2: Use animation with narration 2.1: Be faithful to the actual interface in the animation 2.2: Use a spoken human voice for narration 2.3: Action and voice must be in synch	Guideline 6: Make tasks clear and simple 6.1: Follow the user's mental plan in describing an action sequence 6.2: Draw attention to interconnection of user actions and system reactions 6.3: Use highlighting to guide attention
Guideline 3: Enable functional interactivity 3.1: Pace the video carefully 3.2: Enable user control	Guideline 7: Keep videos short
	Guideline 8: Strengthen demonstration with practice
Guideline 4: Preview the task 4.1: Promote the goal 4.2: Use a conversational style to enhance perceptions of task relevance 4.3: Introduce new concepts by showing their use in context	

Figure 2. Eight Guidelines for the Design of Instructional Videos for Software Training. Adapted from *Eight Guidelines for the Design of Instructional Videos for Software Training* by H.van der Meij & J. van der Meij (2013)

Derived from the eight guidelines the video was called 'QMS training video'. The video contained a spoken narration that guided the animation, which is in line with Guideline two of van der Meij and van der Meij (2013). The video was shot in the actual factory the workers were active and used the same computers the workers used in their daily practice. In line with the third guideline the video was paced carefully providing the workers enough time to process the offered theory. Furthermore, the participants were able to pause and rewind the video and the goal was promoted verbally at the beginning of the video. Finally, within the video highlighting was used to focus on specific topics and the theory was presented step-by-step according to the participants' mental plan.

Although the video covered almost every guideline, a lot of theory and procedures had to be explained to the participants eventually leading to an overall length of eight minutes. Leading that the video did not meet the seventh guideline, which stated that the video should be kept short and compact.

Figure 3. *Opening scene where narrator explains the goals of the video*

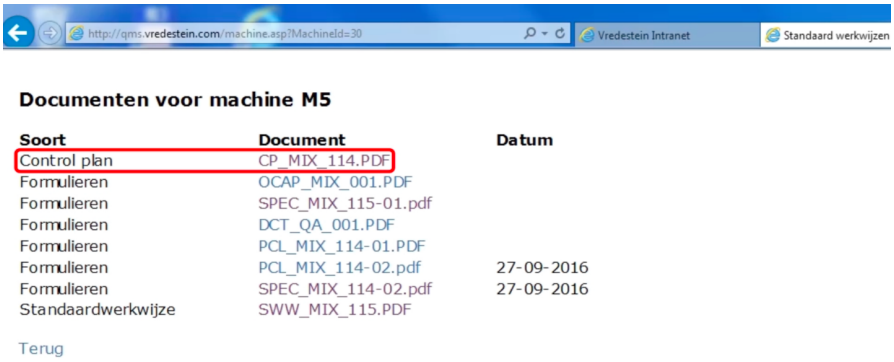

Figure 4. *Scene where a procedure is explained through highlighting.*

Text including still graphics (PDF).

In order to measure the effects of the video in comparison with a traditional learning tool, a PDF-file was designed. To assure that there would be no inconsistencies between the content of the video and the PFD-file benefitting one over the other, the original script of the video was used as a basis for the PDF learning tool. The text the narrator used was copied in the PDF in combination with screenshots from the video in which the same relevant items were explained. The PDF-file contained fifteen pages, following a step-by-step explanation of QMS including a practical application. The PDF training differs from the video training through its written instructions and still graphics.

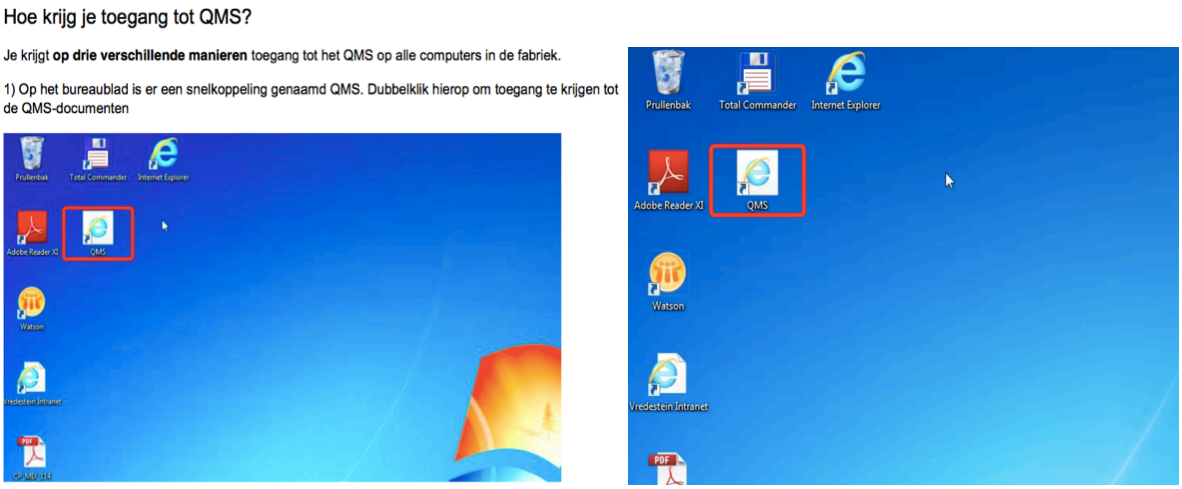

Figure 5. *PDF-page explaining how to gain access to the QMS with written guidelines (Left) vs. Video explanation (right) with spoken narration.*

Figure 6. *PDF-page explaining a concept by highlighting (left) same concept explained in video (right)*

Procedure

Before conducting this research, the research process was reviewed and approved by ethical committee of the University of Twente. The environment selected for this study is the organization Apollo Vredestein B.V. Apollo Vredestein is a global company that manufactures and sells tyres. The factory in Enschede, which facilitated the study, harbors around 1600 employees from which 1257 work in the production department. The production workers are required to use online systems guiding them through daily processes. The knowledge of the workers about these systems was prior to the training not sufficient, having consequences on the production quality. Providing these workers the necessary knowledge requires specified training. One of these systems concerns the Quality Management System (QMS), which contains essential procedures and specifications the employee has to follow in their daily routines and responsibilities. Within QMS, every single machine has a PDF-document containing an explanation on the related procedure and certain machine and material specifications. Because the knowledge prior to the training on how to find QMS and how to use it is not sufficient and is an important part of an upcoming audit, the organization decided to design a training specifically for this problem addressing al production workers. This training is designed in relation with this study and stands as a basis on which this research is build.

Phase 1.

At the beginning of the study the participants received an e-mail informing them about the research process they were going to participate. The participants were told that they were being trained and tested about an online system in the context of an upcoming audit. The test-data was going to be used for the scientific research on video learning. The training consisted of a pre-test, a training and a post-test and the

participants were obliged by the organization to follow it. However, in being part of the research the participants had the opportunity to refuse and if so, their results would not be used in the data collection. No objections were made. A total of 504 participants responded and made the pre-test, from the residual participants a total of 575 responded and made only the post-test, the participants that revealed reliable data were assigned to the post-test only group.

The test was available in an online testing-program called 'Question mark Perception'. Every single participant possessed his own unique login code that would direct them towards the pre-test. Trying to ensure control over the reliability of the test, the program was only accessible within the factory and internal coordinators were responsible for the facilitation and control of the process. The tests were mostly conducted at the office of the coordinator or instructor. Multiple preliminary tests revealed that if a participant was already familiar with the system and knew (some) questions by heart, the test would still have a minimum duration of two minutes and forty seconds. The testing-program collected data on the test-results, duration of the test and at what time the test took place. However, it was ensured that, due to privacy reasons, the participants were assigned a unique number replacing his or her name. Furthermore, the number did reveal information about the level of education and age of the participant. The data was exported into excel and imported into SPSS to conduct relevant tests.

Around 45 coordinators received an e-mail instructing them what was expected from them in the testing and training process. It was expected that they facilitated the training including the tests and provided control over it, meaning that ideally someone would be available to guide the training and tests. In assistance of the coordinators the researcher's help was available during office hours. The pre-test was open for a period of fifteen days, providing all the production workers sufficient time to execute it. At the end of the fifteenth day, the test was closed and data was exported into an excel file.

Phase 2.

The participants that conducted the pre-test were equally and randomly divided into two groups. Group 1 was assigned to the video-training including test and group 2 was assigned to the PDF-training including test. 36 hours after the pre-test was closed, the coordinators and production workers received an e-mail informing them about the training and post-test that was currently open. To empower this message, the email was send by the managing-director of production. Similar to the pre-test, the coordinators were informed and expected to facilitate and guide the training process. For the organization, In order to pass the test, the production workers were expected to score 100% on the test containing ten questions, however the

participants had multiple attempts to pass the test. Only the first attempt the participant completed was used in the data for this study. Due to the importance of the test, all the production workers were provided sufficient time to complete the training, leading to the training and test to be open during a period of four weeks. After exactly four weeks, the test was closed and data was exported into an excel file.

Phase 3.

The last part of the research consisted of the completion of the retention test. Forty participants from both group 1 and 2 were handpicked and assigned to the retention group. However, due to practical limitations the sample group for the retention tests revealed a response rate of in total 57 participants. The coordinators that were concerned with these specific participants were personally approached to emphasize the fact, that because of the sample group size it was of most importance that the test would be controlled optimally. Similar to the previous tests, the tests were completed in the office of the coordinator or instructor. The retention test was open during a period of exactly one month, that was needed to test a sufficient amount of workers from all the selected participants. After the test was closed, data was exported into an excel file

Data analysis

Before performing analyses on the data revealing possible differences between the learning tools, a Cronbach's Alpha test was constructed to measure the reliability of the pre- and post-test. Additionally, means were compared focusing on the learning outcomes and the duration of the tests via a repeated measures test. Correlations concerning possible relations between age, level of education, time and test scores were measured using a regression analysis. Furthermore, to provide evidence for the hypotheses several ANOVA and t-tests were conducted focusing on possible significant differences among the disparate learning methods. Within the data there were a number of demands the participants would have to complete before it could be used for this study. First, multiple preliminary tests showed that the duration of a single test would have to take longer than 2.40 minutes and shorter than thirty minutes, to ensure its reliability. Only the first attempt of the participant is used for the data analysis. Additionally, because this study focuses on learning gains, the participants scoring 100% on the pre-test were excluded from the analysis. Furthermore, to ensure that the two groups both were starting equal regarding education level and age, a t-test was conducted revealing no significant difference on age (P=.253) and a chi-square test was conducted for the education level revealing no significant difference (P=.148).

Results.

Aiming to provide support for the aforementioned hypotheses, several statistical analyses were conducted through SPSS 24. A repeated measures ANOVA test revealed that participants scored significantly higher on the Post-test than on the Pre-test for both the Video group (P=.001, F=1.87) and the PDF group (P=.001, F=1.252), as demonstrated in table 4.

Table 4. Analysis of *sample size, mean score (SD) Pre-test, mean score (SD) Post-test for Video group, PDF group. A maximum of 9 points could be scored.*

	N	Mean score Pre-test (SD)	Mean score Post-test (SD)
Video	100	6.51(1.75)	8.34(1.34)
PDF	90	6.91(1.34)	8.26(1.08)

A similar test was conducted concerning the mean scores of the factual- and procedural questions that were included as a variable in the several tests (Table 5). Results demonstrated that participants scored significantly higher on the factual questions in the Post-test for the Video group as well as the PDF group (P=.00, F=118.67) then the pre-test. Similar results were found concerning the procedural questions for the Video group and the PDF group (P=.00, F=56.441).

Table 5. *Mean scores on factual and procedural questions and standard deviation regarding the Video- and PDF group for both the Pre-test and Post-test. A maximum score of 4 points could be scored for the factual questions, and a maximum of 5 for the procedural questions.*

	Mean score Pre-test Factual (SD)	Mean score Post-test Factual (SD)	Mean score Pre-test Procedural (SD)	Mean score Post-test Procedural (SD)
Video Group	2.91(.85)	3.77(.6)	3.6(1.3)	4.57(.94)
PDF Group	2.86(.77)	3.71(.55)	3.86(1.06)	4.54(.81)

Correlations.

Additionally, results were analyzed to measure possible correlations between the age of the participants, education level, the time they took to finish the test and the test results. However, results revealed no significant correlations between any of the variables.

Hypotheses testing.

Aiming to provide support for the aforementioned hypotheses, results were analyzed to possibly reveal if the participants conducting the video-training and PDF-training significantly differed in the test scores and the time (in seconds) it took them to conduct the test. Exploring these topics, repeated measures ANOVA tests were conducted.

Before executing the analysis and exploring possible differences in the test results, a Levene's test was conducted to test the homogeneity of variance revealing no significant difference between groups (P=.18). Furthermore, an analysis of variance revealed no significant difference between the Pre-test scores for the Video-group and the PDF-group (P= .08).

Although the mean post-test results of the video-group differed from the PDF-group as demonstrated in table 4, ANOVA analysis revealed no significant difference between the Video-group and the PDF group (P= .096 F=2.805) for the post-test results.

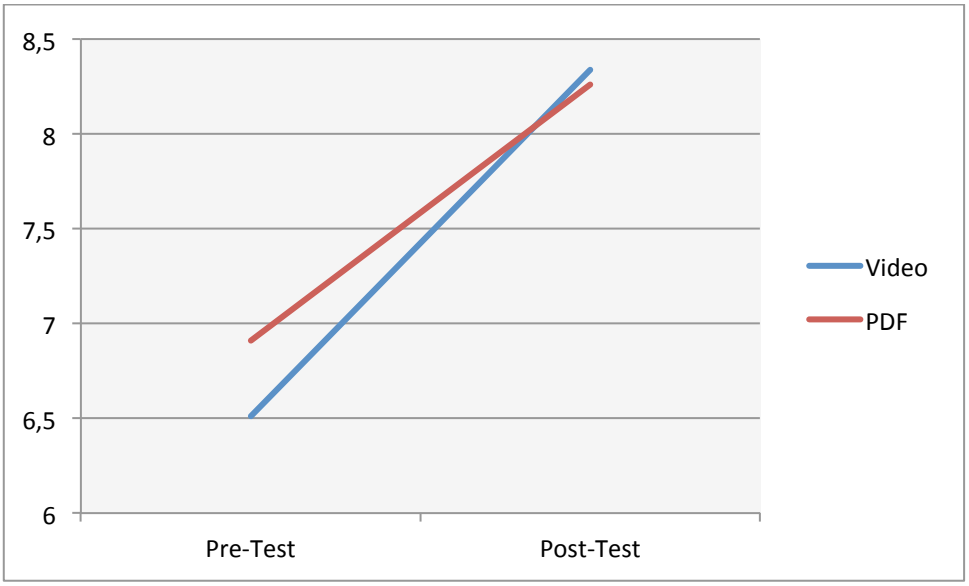

Figure 7. *Graphic containing mean scores Pre-test and Post-test for both conditions*

A similar analysis was conducted concerning the duration of the post-test. A Levene's test was conducted to test the homogeneity of variance revealing no significant difference between groups (P=.18). Furthermore,

an analysis of variance revealed no significant difference between the Pre-test scores for the Video-group and the PDF-group (P= .356).

In contradiction with the test results there was a significant difference found between the Video-group and PDF-group concerning the time it took for the participants to execute the Post-test (P= .007, F=7.505).

Table 7. *Mean time in seconds (SD) for the Video-Group, PDF-Group and Video-Only-Group concerning the Post-test.*

	N	Mean(sec)	SD
Video-Group	100	969.61	354.42
PDF-Group	90	834.83	378.88

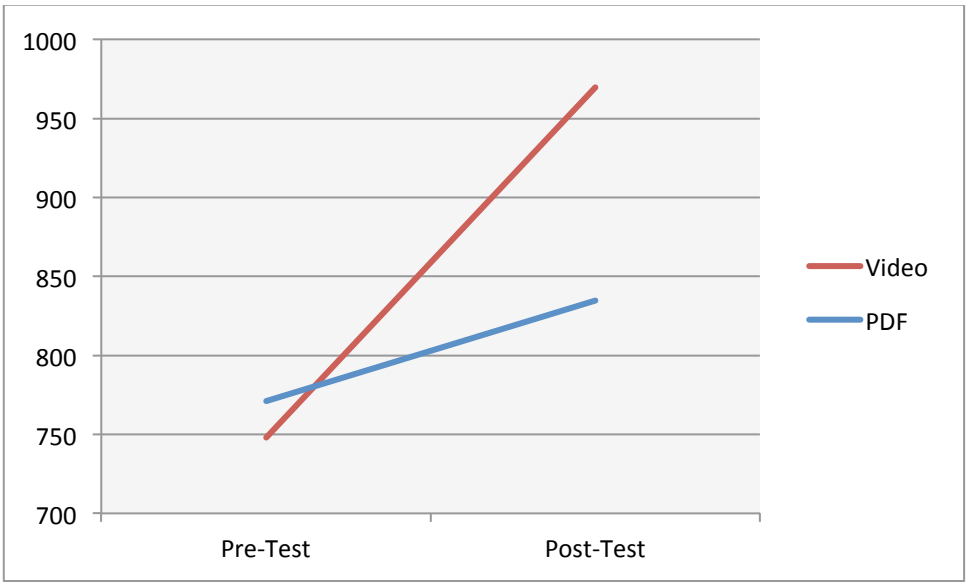

Figure 8. *Graphic containing mean time in seconds Pre-test and Post-test for both conditions.*

In order to measure possible differences concerning procedural- and factual knowledge via an ANOVA test, again a number of assumptions had to be met. First an analysis of variance revealed no significant difference between the Pre-test scores for the Video-group and the PDF-group on factual questions (P= .221). Secondly the data was tested for the homogeneity of variance revealing no significant difference (P=.88), also meeting

the second assumption. ANOVA tests results revealed no significant difference between the Video-group and the PDF group concerning factual knowledge (P= .143, F=2.160).

Additionally a similar process was conducted concerning the procedural knowledge. First an analysis of variance revealed no significant difference between the Pre-test scores for the Video-group and the PDF-group on procedural questions (P= .142). However, the data was tested for the homogeneity of variance revealing a significant difference(P=.04), violating the second assumption. Consequently meaning that the analysis was conducted with a Welch test. The robust test of equality of means demonstrated no significant difference between the groups (P=.205, F=1.621).

Retention rate.

Conclusively, this study aims to provide evidence for the final hypothesis stating that it is expected that the retention rate for the video-group is significantly higher than the PDF-group. Looking at the mean retention scores at table 11*,* data revealed that the mean scores for both groups were higher on the retention-test than the post-test. First, a paired samples t-test revealed no significant difference between the mean post-test scores and mean retention-test scores (P=.284). Before testing possible differences between groups on the retention-score via an ANOVA test, the homogeneity of variance tested with Levene's demonstrated no significant difference (P=.937). Additionally, ANOVA test revealed no significant difference between the video- and PDF-group (P=.308, F=1.203). In line with these results, ANOVA analysis demonstrated no significant difference on factual knowledge (P=.772, F=3.302) and procedural knowledge (P=.829, F=.189).

Table 11. *Mean score post-test (SD) versus mean score retention-test (SD), with a maximum score of 9 points.*

	Mean score post-test (SD)	Mean score retention-test (SD)
Video-group	8.34(1.34)	8.52(.9)
PDF-group	8.26(1.08)	8.57(.99)

In contradiction with the findings for the test duration concerning the post-test, ANOVA analysis revealed no significant difference between the Video-group (M= 574.78, SD= 456.42) and the PDF-group (M=378.65, SD= 256.05, P=.051, F=3.985) in the time it took them to finish the retention-test.

Finally, to measure what effects the two training methods had on the starting knowledge of the participants,

the retention-test scores were compared with the pre-test scores. First, a paired samples t-test was conducted to measure possible differences between the pre-test scores and retention-scores, analysis revealed that the mean score of the retention-test (M=8.54, SD=.94) was significantly higher than the pre-test scores (M=6.59, SD= 1.6, P=.000). Similar results were found regarding the duration of the test. A paired sample t-test revealed that the time in seconds for the pre-test (M=670.41, SD= 262.75) was significantly higher than the time in seconds for the retention-test (M=476.76, SD=379.13, P=.003).

Discussion & Conclusion

The aim of this study was to provide evidence for the aforementioned hypotheses. Somewhat unexpectedly, results did not support any of the hypotheses. Additionally, results concerning the hypotheses that stated that it was expected that participants in the video group would need less time to finish the test, demonstrated contrasting results from what was expected favoring the PDF-training over the Video-training. Looking to provide more clarity on the results and directions for possible future research, the results were compared to other studies arguing possible reasoning for the outcomes.

The size of the sample group and especially the context in which the study was conducted, lead to a number of limitations. Concerning the tests, due to the fact it was a custom-made training the test were self-designed according to the needs of the company. Consequently meaning that the several tests were lacking an existing scientific theoretical framework that has proven its validity and reliability in previous studies. However, to tackle this problem and reducing threats to validity and reliability, the tests were guided by Piontek's (2008) 'best practices for designing and grading exams'. Specifically focusing on the design of reliable and valid questions for the test. Furthermore, these questions were designed in the program 'Question Mark Perception'. A program that was similar to the format of the PDF training. It might have occurred that the participants in the PDF group became more acquainted in using this format; possibly having influence on the results or time it took to finish the test.
Additionally, within the tests there was control provided over the pace of the participant's learning by making it able to pause and rewind the video. Similar control was provided for the PDF-training by making it able to scroll back and forward through the document. However, observations revealed that participants rarely paused or rewind the video, consequently having to adjust their own learning pace to the video. Within the conclusion section of this paper, it was considered that the participants had to adjust there learning process to the type of training and therefore the cognitive pace differed for both training methods.

Secondly, all the participants finished the test within the working hours of the production department. Meaning, that the test was conducted somewhere within a 24-hours cycle because the participants worked either a day- or nightshift. Participants often were self-responsible to execute and pass the test. In relation to these facts, data incidentally revealed deviating or unlikely results (E.g., passing the test within a minute). The lack of control and not being able to observe the procedure in relationship with the obligation to conduct and pass the test should be highly considered in this study. Participants might have felt the pressure to pass the test and reach the demand of the organization. Therefore, data revealed, it might have occurred that participants incidentally cheated their way through the test by working together or sharing answers.

Aiming to reduce the effect these results have on the study, multiple participants were observed and measured during the process regarding the time it took to conduct the test. Results revealed a minimum of two minutes and forty seconds when the participant was already familiar with the system. Within the data, all results that took less than two minutes and forty seconds were excluded from the study. Leading to a smaller but more reliable sample size.

Finally, previous studies which benefitted video over paper-based learning tools, found that participants using a video as a learning tool perceived the video as more beneficial than paper-based tools. Within the current study there was a specific focus on the effectiveness of the learning tools demonstrated in the results and therefore no perception measures were conducted. Meaning that a possible correlation between the perception or motivation of the workers and their learning outcomes remains unknown in the current study.

Hypothesis 1: *Test results demonstrate that the participants using video as a learning tool score significantly higher on the test results than the participants using PDF.*

In line with the findings of Jolly (2003), Kim et al. (2007), Lewis (1995) and Morrison and Tversky (2001) test results failed to provide evidence for this hypothesis. Meaning that in this particular context, a video training failed to present itself as a more effective media than the PDF-training. Looking at the results, both learning tools were equally effective regarding the learning outcomes. However, there should be a number of variables considered that might partially explain this conclusion.

First as the results revealed, the theory that was offered to the participants through the two conditions was of a certain level that was equally effectively transferred. That raises the question; in what format and context is a specific theory more effectively transferred through a video than PDF?

As multiple studies stated, it is beneficial for the learning process if the training mirrors the environment in which the abilities need to be applied (Grossman & Salas, 2001) and realistic practice scenarios help promote active learning and maintain the attention of trainees (Burke & Hutchins, 2007). Video optimally addresses these topics. Although the provided video training within this study mirrors the realistic environment, it revolves around an online system, which was explained in a step-by-step training. Due to the fact that the PDF training had the identical content as the video, the video training did not address the level of realism anymore than the PDF. Additionally, it might have been that the distinctive characteristics of a video were not addressed properly at all for it to be favored over the PDF learning tool. In fact, basically the only aspect that differed was the spoken narration instead of the written narration in the PDF and the way the pictures were presented (still vs. animated).

Within the conclusions, it should be considered that the procedural questions covered online procedures the participant had to follow in finding and reading information about daily practices, rather than procedures on how to operate a machine or other offline activities. Unfortunately, within the data of this study it was not possible to measure how long it took for the participants to follow the procedures, answer the procedural questions and possible differences within groups. However, the overall duration of the tests did not benefit the video learning method over the PDF.

For future research and to provide a broader few on this specific topic, it might be beneficial if the participants are trained via a video and subsequently have to execute a specific command in an offline practice in which they are observed and timed, specifically measuring procedures the participants were mimicking from the video in performing the correct tasks. As previous studies have demonstrated, concerning the topic of video-learning there should be cautiousness considered in generalizing the outcomes. Consequently, the results should be specified to this particular context and does not conclusively provide evidence about possible changes in their behavior in daily practice.

Hypothesis 2: The participants using video as a learning tool need significant less time to complete the test than the participant using PDF.

Unexpectedly, data analysis revealed contrasting results benefitting the participants in the PDF-group over participants in the video-group. Results revealed that participants following the PDF-training and executing the post-test needed an average of 834.83 seconds, which is just less than 14 minutes. Simultaneously, participants in the video-group needed an average of 969.61 seconds, which is just over 16 minutes. It should be considered that the timing includes watching the video and studying the PDF-file. Due to the fact that both training methods offered identical theory but in deviating media, the choice was made that the timing started when the participants either started watching the video or started reading the PDF. Leading to a timing that not just measures the duration of the test, but also the entire process in which the participant consumes the offered theory. Although the results might seem unexpected, multiple researches pinpointed a phenomenon that might explain this outcome.

Mayer (2001) and Wetzel et al., (1993) both introduced or mentioned the concept of cognitive pace. Meaning that the pace of the theory provided to the learner should be adjusted to his or hers own learning. In the context of this study, the cognitive pace of the participants in the video-group had to be adjusted to the pace of the video, which covered the length of eight minutes. On the contrary, the participants in the PDF-group were offered the theory in a PDF-file for them to read in their own pace and providing them control over their own learning.

Within this study, the theory that was provided to the participants through the video might have been presented too slow according to its difficulty. Meaning that the cognitive pace of the participants would have allowed them to consume the theory faster if it was presented with a more rapid pace. This would benefit the participants in the PDF-group over the video-group by enabling them to go through the theory in the exact pace that is needed to understand it. Eventually, leading for the PDF-group to need significantly less time to go through the training and finish the test than the video-group for whom the first eight minutes of the video were fixed. This theory is supported by the analysis conducted on the duration of the retention-test, which demonstrated that the mean time of the PDF-group was lower than the video-group, however not being significant. Similar results were found for the Pre-test, where there was no significant difference between the duration of the test between groups. This might imply that during the post-test the type of training was decisive for the difference in duration of the test.

Hypothesis 3: The participants using video as a learning tool reveal a significant higher retention rate than the participants using PDF.

Data analysis revealed that the preservation of knowledge exactly a month after the training was conducted, was high. Meaning that the results revealed that there was no knowledge lost a month after training in comparison with the post-test results. This conclusion accounts for both procedural- and factual questions. Additionally, in line with previous findings analysis revealed no significant difference on the retention rate between groups, meaning that they were equally effective. However, there should be a number of issues considered within this conclusion.

First, the QMS was introduced to the participants with meaning that they implemented the system in their practice and guided them through questions concerning certain machine and material specifications and processes. Consequently, although it is not likely that the participants interacted with the QMS on a daily practice, it is reasonable to believe that they worked with the system a number of times before executing the retention-test. Meaning that within the period of a month, they had the possibility to maintain and even improve their knowledge about the system by using it in practice. However, results revealed that this practice did not increase their knowledge making it able for the participants to score 100% on the test. Secondly, at the time the participants conducted the retention-test, they already finished the pre-test and post-test that were parallel tests to the retention-test. Leading to a possible effect of the previous tests on the retention-test scores. The retention-test contained questions that were picked from the pre-test and post-test. Simultaneously, in comparing the retention-test results with the pre-test results, it is safe to conclude that both tests were effective in this particular context as a training method for the sample group.

The aim of this study was to provide and add clarity on the topic of the effectiveness of video as a learning tool for gaining knowledge. Specifically, if video as a learning tool is more effective than using PDF as a learning tool, for production workers in becoming acquainted with an online system within a global tyre manufacturer.

Results revealed that within this context, video proved itself as an effective learning tool for the participants to significantly improve themselves in factual- and procedural knowledge about interpreting and using an online system. However, multiple data analysis failed to provide evidence that benefits video as a learning tool over a PDF in this particular context.

The data also revealed there was no significant difference found between groups on the mean test-results, procedural knowledge results, factual knowledge results and retention rate. On the contrary, there was a significant difference found on the training time of the test between groups in favor of the PDF-group. Meaning that the PDF-group needed significantly less time to follow the training and finish the test than the video-group, producing similar results.

These outcomes are in line with several studies (Jolly, 2003; Kim et al., 2007; Lewis, 1995; Morrison & Tversky, 2001) that found similar results in which video failed to prove itself as a more effective learning tool than a more traditional method. The reason for this conclusion might be that the specific content of the theory that was presented to the participants in this study, was transferred equally effectively among learning tools. Apparently, the potential benefits of learning through video over learning through PDF were not utilized properly in this study, for video to be more effective than PDF.

Additionally, it might have seemed unexpected that participants in the PDF-group needed significantly less time to follow the training and finish the test. However, this conclusion can be explained by the theory of cognitive pace. Meaning that the pace of the theory provided to the learner should be adjusted to his or hers own learning (Mayer, 2001; Wetzel et al., 1993).

These outcomes raises a big question for future research; what abilities does a video currently possesses that enables it to be more effective than text and still graphics, and in what context will these abilities expose themselves optimally?

Although multiple scholars claim that video is a realistic training environment (Grossman & Salas, 2011), help promote active learning (Burke & Hutchins, 2007) and presents real-life situations in which the trainee is familiar with (Machin, 2002). It does not imply that by simply implementing a video training instead of a more traditional training with text and still graphics, trainees are trained more effectively.

However, for trainers and trainees a video might seem appealing (Zhang, Zhou, Briggs & Nunamaker, 2006) and research have shown that a video is perceived as a beneficial and helpful tutoring resource (Bridge, Jackson & Robinson, 2009; Simpson, 2006).

In the overall conclusion and as an answer to the leading research question; *To what extent is video a more effective and efficient learning tool than PDF among production workers within a global organization, in training them on understanding and using an online system ?*

It can be concluded that within this specific context, video failed to prove itself as a more effective learning method than learning through PDF. By explicitly looking at the statistics and leaving perception and appearance disregarded, a trainer or organization should consider within each particular context if the content that is transferred, will be transferred more effectively through video than through another media. Subsequently, deciding if the return on investment is large enough to design such a video training.

Due to the fact that the outcomes on video learning within multiple studies differ considerably, it seems impossible to generalize this conclusion or any other conclusion over contrasting contexts. Although, undoubtedly video has certain characteristics that benefits itself over other media, that does not conclusively lead to a more effective training and better learning outcomes. For commercial organizations such as Apollo Vredestein, it is wise to continuously ask itself within each training situation, what is the goal of the training and will the characteristics and strengths of video optimally address this goal for it to be worth the investment and lead to effective outcomes? Furthermore, if the goal is more in line with the strengths of video than other learning tools.

Which comes back and supports the quote of Clark (1983), illustrating this topic with the metaphor “Media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition,”(p.445). However, within this specific context “the truck” did influence the efficiency of the student achievement as the participants using PDF as a learning tool needed significantly less time to complete the test than the participants in the video condition.

Reference:

Alexander, K. P. (2013). The usability of print and online video instructions. *Technical Communication Quarterly,* 22, 237-259*.*

Argote, L. (1999). *Organizational learning: Creating, retaining, and transferring knowledge*. Norwell, MA:Kluwer

Argote, L., Ingram, P. (2000). Knowledge transfer: A Basis for Competitive Advantage in Firms. *Organizational Behavior and Human Decision Processes.* 82(1), 150-169

Baldwin, T.T., Ford, K. F. (1988). Transfer of Training: A Review and Directions for Future Research*. Personnel Psychology*, *41*, 63-105.

Bates, R. A., Holton, E .F., & Seyler, D. L. (1997). Factors affecting transfer of training in an industrial setting. In Torraco, R. (Ed.) *Proceedings of the 1997 Academy Human Resource Development Annual Conference.* Academy of Human Resource Development, Baton Rouge, LA.

Brecht, D. (2012). Learning from Online Video Lectures. *Journal of Information Technology Education: Innovations in Practice, 11*, 228-250.

Bridge, P., Jackson, M., & Robinson, L. (2009). The Effectiveness of Streaming Video on Medical Student Learning: A Case Study. *Medical Educational Online, 14*, 1-5.

Broad, M. L., & Newstrom, J. W. (1992). Transfer of training: Action-packed strategies to ensure high payoff from training investments. Reading MA: Addison-Wesley.

Burke, L. A., & Hutchins, H. M. (2007). Training transfer: an integrative literature review. *Human Resource Development Review, 6,* 263–96.

Chan, L. K., Patil, N. G., Chen, J. Y., Lam, J. C. M., Lau, C. S., Ip, M. S. M. (2010). Advantages of video trigger in problem-based learning. *Medical Teacher, 32* (9), 760-765.

Clark, R. E. (1983). Reconsidering research on learning from media. *Review of Educational Research 53*(4), 445–59.

Clark, R. V., & Mayer, R. E. (2012). e-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning.

Epple, D., Argote, L., & Murphy, K. (1996). An empirical investigation of the micro structure of knowledge acquisition and transfer through learning by doing. *Operations Research*, 44**,** 77–86.

Ford, K. J., & Weissbein, D. A. (1997). Transfer of Training: An Updated Review and Analysis*. Performance Improvement Quarterly, 10*(2), 22-41.

Georgenson, D. L. (1982). The problem of transfer calls for partnership. *Training and Development Journal, 36*(10), 75-78

Goldstein, I. L. & Ford, J. K. (2002). Training in Organizations, Belmont, CA:Wadsworth Thompson Learning.

Grossman, R., & Salas, E. (2011). The transfer of training: what really matters. *International Journal of Training and Development, 15*(2)

Hiebert, J., & Lefevre, P. (1986). Conceptual and procedural knowledge in mathematics: An introductory analysis. *Conceptual and procedural knowledge: The case of mathematics* .Hillsdale, NJ: Lawrence Erlbaum Associates.

Hoffler, T. N., & Leutner, D. (2007). Instructional animation versus static pictures: A meta-analysis. *Learning and Instruction, 17*, 722-738.

Jolly, S. (2003). Studying the effectiveness of animation and graphics on fourth, fifth and sixth graders (Thesis). University of Nebraska, Lincoln.

Jonassen, D. H. (2000). Toward a design theory of problem solving. Educational Technology Research & development, 48(4), 63-85.

Khan, I., Mufti, S., & Nazir, A. N. (2015). Transfer of Training: A Reorganized Review on Work Environment and Motivation to Transfer. *International Journal of Management, Knowledge and Learning, 4* (2), 197-219.

Kim, S., Yoon, M., Whang, S. M., Tversky, B., & Morrison, J. B. (2007). The effect of animation on comprehension and interest. *Journal of Computer Assisted Learning 23*(3), 260–270.

Kontoghiorghes, C. (2002). Predicting motivation to learn and motivation to transfer learning back to the job in a service organization: a new systemic model for training effectiveness. *Performance Improvement Quarterly, 15*, 114-29.

Kozlowski, S.W. J., Weissbein, D. A., Cannon-Bowers, J. A., & Salas, E. (2000). A multi-level approach to training effectiveness. *Multilevel theory, research and methods in organizations: Foundations, extensions and new directions*, 157-210.

Krejcie, V. M., Morgan, W. D. (1970). Determining Sample Size for Research Activities. *Educational and Pshychological Measurement, 30,* 607-610

Lewis, R. A., (1995). Video introductions to laboratory: Students positive, grades unchanged. *American Journal of Physics, 63*(5), 468–70.

Kollöffel, B., & de Jong, T. (2013). Conceptual understanding of electrical circuits in secondary vocational engineering education: Combining traditional instruction with inquiry learning in a virtual lab. Journal of Engineering Education, 102, 375–393. doi:10.1002/jee.20022

Machin, M. A. (2002). Planning, Managing, and optimizing transfer of training. In K. Kraiger (Ed.), *Creating, implementing and managing effective training and development*, 263-301. San Francisco: Jossey-Bass.

Mayer, R. E. (2001). *Multimedia Learning*. Cambridge, NY: Cambridge University Press.

McMillan, J. H. (2001). *Classroom assessment: Principles and practice for effective instruction*. Boston:

Allyn and Bacon.

Merkt, M., Weigand, S., Heier, A., & Schwan, S. (2011). Learning with videos vs. learning with print: The role of interactive features. *Learning and Instruction, 21*(6), 687-704.

Mestre, L. S. (2012). Student preference for tutorial design: a usability study*. Reference Service Review,* 40(2), 258-276

Michalak, D. F. (1981). The neglected half of training. *Training and Development Journal, 35*(5), 22-28.

Morrison, J. B., & Tversky, B. (2001). The (in)effectiveness of Animation in Instruction. *Department of Psychology Short talks*, University of Stanford California.

Muller, D. A. (2008). Designing Effective Multimedia for Physics Education (Thesis). University of Sydney, Australia.

Newstrom J.W. (1984). A role-taker time differentiated integration of transfer strategies. Presented at the 1984 meeting of the American Psychological Association. Toronto, Ontario.

Nikandrou, I., Brinia, V,. & Bereri, E. (2009). Trainee perceptions of training of transfer: an empirical analysis. *Journal of European Industrial Training, 33*(3), 255-270.

Palmiter, S., & Elkerton, J. (1993). Animated demonstrations for learning procedural computer-based tasks. *Human-Computer Interaction*, 8, 193-216

Payne, S. J., Chesworth, L., & Hill, E. (1992). Animated demonstrations for exploratory learners*. Interacting with Computers*, 4(1), 3-22.

Piontek, M. E. (2008). Best practices for designing and grading exams. *Center for Research on Learning and Teaching, 24.*
Research Centre for Education and the Labour Market (ROA) & Centraal Bureau voor de Statistiek (CBS). (2014) *Beroepenindeling ROA-CBS 2014.*

Riding, R. & Mortimer, J. (2000). A study of on-the-job training of production line operatives in manufacturing companies. *International journal of Training and Development.*4(2), 111-123

Rittle-Johnson, B. (2012). Developing Conceptual and Procedural Knowledge of Mathematics. *Oxford Handbook of Numerical Cognition.*

Rose, F. D., Attree, E. A., Brooks, B. M., Parslow, D. M., Penn, P. R. & Ambihaipahann N. (1998). Training in virtual environments: transfer to real world tasks and equivalence to real task training. *Ergonomics, 43*(4), 494-511.

Saks, A. M., & Belcourt, M. (2006). An investigation of training activities and transfer of training in organizations. *Human Resource Management, 45* (4), 515-676

Salas, E., Wilson, K., Priest, H., & Guthrie, J. (2006). Design, Delivery, and Evaluation of Training Systems. *Handbook of Human Factors and Ergonomics*, 472–512.

Schwan, S., & Riempp, R. (2004). The cognitive benefits of interactive videos: learning to tie nautical knots. *Learning and Instruction, 14*, 293-305

Shephard, K. (2003). Questioning, promoting and evaluating the use of streaming video to support student learning. *British Journal of Educational Technology, 34*, 295-308

Simpson, N. (2006). Asynchronous access to conventional course delivery: A pilot project. *British Journal of Educational Technology, 37*(4), 527-537

Timma, H. (2007, April*). Learning, training and assessing on the job: What do workers think?* Paper presented at the AVETRA conference, Evolution, Revolution Or Status Quo? VET in New Contexts, Melbourne.

Van der Meij, H., Karreman, J., & Steehouder, M. (2009). Three decades of research and professional practice on software tutorials for novices. *Technical Communication*, 56(3), 265-292.

Van der Meij, H., & Van der Meij, J. (2013). Eight Guidelines for the Design of Instructional Videos for Software. *Technical Communication, 60* (3).

Van der Meij, H., & Van der Meij, J. (2014). A comparison of paper-based and video tutorials for software learning. *Computer & Education*, 78, 150-159.

VanderArk ,T., Schneider, C. (2012) How Digital Learning Contributes to Deeper Learning. *Getting Smart. Think, Learn, Innovate.*

Vreman-de Olde, G. C. (2006). Look experiment design: Learning by instruction (Doctoral dissertation). Enschede, the Netherlands: University of Twente. Retrieved from http://purl.utwente.nl/publications/73055.

Wetzel, D. W., Radtke, H. P., & Stern, H, W. (1993) Review of the Effectiveness of Video Media in Instruction. *Navy Personnel Research and Development Center*.

Zhang, D., Zhou, L., Briggs, R. O., & Nunamaker, F. J. (2006). Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness*. Information and Management, 43*, 15-27.

Appendix.

UNIVERSITEIT TWENTE. Gedragswetenschappen

COMMISSIE ETHIEK (CE) FACULTEIT GEDRAGSWETENSCHAPPEN

AANVRAAGFORMULIER BEOORDELING
VOORGENOMEN ONDERZOEK DOOR CE, VERSIE 2

1. Achtergrond proefpersonen

1. Betreft het een medisch-wetenschappelijk onderzoek?

NB: Medisch-wetenschappelijk onderzoek wordt in deze context gedefinieerd als 'onderzoek dat als doel heeft het beantwoorden van een vraag op het gebied van ziekte en gezondheid (etiologie, pathogenese, verschijnselen/symptomen, diagnose, preventie, uitkomst of behandeling van ziekte), door het op systematische wijze vergaren en bestuderen van gegevens. Het onderzoek beoogt bij te dragen aan medische kennis die ook geldend is voor populaties buiten de directe onderzoekspopulatie.'

Nee

2. Titel

2b. Datum van de aanvraag

27-09-2016

2a. Wat is de titel van het onderzoek (max. 50 tekens)?

LET OP: Als u van het SONA systeem gebruik gaat maken, moet hier dezelfde titel worden vermeld als de titel die in SONA zal worden gebruikt. Deze titel zal ook zichtbaar zijn voor de proefpersonen (bij gebruik SONA).

The effectiveness of Video learning

3. Contactgegevens onderzoekers/uitvoerders

3a. Voorletters

N.

3b. Achternaam

Scheurwater

3c. Vakgroep (indien van toepassing)

0

3d. Studentnummer

1754378

3e. E-mailadres

n.scheurwater@student.utwente.nl

3f. Telefoonnummer (tijdens het onderzoek):

0647226715

3g. Indien er meer dan één uitvoerder is, dan graag in het onderstaande invulblok de gegevens (voorletters/achternaam/e-mailadres/telefoonnummers) van alle uitvoerders van het onderzoek invullen.

-

4. Contactgegevens hoofdonderzoeker/begeleidend docent

Introduction mail.

Beste allen,

Zoals jullie weten komt er in week 46 een audit van Volkswagen om verschillende processen binnen de fabriek te controleren en te meten. Naar aanleiding van deze audit, en in overleg met het management willen wij jullie helpen om voor 100% op de hoogte te zijn van het Quality Management System en het gebruik daarvan.

Daarnaast zal er een onderzoek naar de effectiviteit van videoleren binnen de organisatie plaatsvinden. In het kader van deze ontwikkelingen vinden er de komende periode een aantal toets momenten plaats die jullie kennis zal toetsen over QMS. Ook zullen jullie worden getraind over het systeem door middel van een video of tekst.

Inmiddels is er voor jullie een QMS toets klaargezet die jullie kunnen maken door in te loggen in Questionmark Perception. Deze toets is bedoeld voor een onderzoek waarin jullie kennis op dit onderwerp wordt gemeten. De resultaten van deze toets zullen verder geen consequenties hebben, ze worden alleen gebruikt om een beeld te krijgen van de huidige situatie en om later de effectiviteit van de training te meten. De toets staat klaar voor jullie om deze zo spoedig mogelijk te maken en zal ongeveer 5 minuten in beslag nemen.

De data voor het onderzoek zal anoniem worden behandelt en zal geen consequenties hebben voor jou als medewerker, het is alleen gericht om te meten in hoeverre videoleren effectief is voor onze organisatie. Wanneer je desondanks geen deel uit wil maken van het onderzoek kan er bezwaar worden aangemaakt door te mailen naar nick.scheurwater@apollovredestein.com,of the bellen naar tst 8620. Dit betekent echter niet dat de training en toetsen niet gemaakt hoeven te worden.
Ik reken op jullie medewerking.
Met vriendelijke groet,
Nick Scheurwater op verzoek van,
Herman Steunenberg
Klaas Woudstra
George Sanders
Afdeling Opleidingen

Mail to coordinators concerning the pre-test

Beste coördinatoren,

Zoals in de eerdere mail te lezen staat er een toets klaar die gemaakt dient te worden door al jullie medewerkers. De toets is van essentieel belang in het kader van de naderende Volkswagen audit en het interne onderzoek. Vanwege de korte periode die we hebben om de werknemers voor te lichten zit er helaas ook een tijdsdruk op. Onze vraag is dan ook of jullie tijdens de komende dagen kunnen organiseren dat deze toets zo spoedig mogelijk gemaakt wordt. Mochten jullie vragen of opmerkingen hebben dan kunnen jullie mailen naar nick.scheurwater@apollovredestein.com, of bellen naar tst 8620.
Ik reken op jullie medewerking.
Met vriendelijke groet,

Nick Scheurwater op verzoek van,

Klaas Woudstra
George Sanders
Herman Steunenberg

Afdeling Opleidingen

Mail concerning training and post-test

Beste allen,

Om jullie zo goed mogelijk voor te bereiden op de Volkswagen audit in week 46 of 47, hebben we een QMS training en de tweede toets voor jullie klaargezet in Questionmark Perception. Jullie kunnen de toets maken op elke pc binnen de productieafdeling en inloggen met als wachtwoord de laatste vier cijfers van je personeelsnummer, tenzij je dit eerder verandert hebt.
Het doel is om jullie te leren hoe het systeem werkt zodat jullie de audit kunnen doorstaan en QMS raadplegen waar nodig is
Als onderdeel van een onderzoek zal een klein deel van jullie een videotraining krijgen en een ander deel een pdf document. Mochten jullie vragen hebben of hulp nodig hebben, dan hoor ik het graag.
Met vriendelijke groet,
Nick Scheurwater op verzoek van,
Het Management team en Afdeling Opleidingen

Beste coördinatoren,

De QMS training en toets staan klaar voor jullie en jullie medewerkers om gemaakt te worden. Zoals eerder vermeld is de training bedoelt om alle productiemedewerkers bekend te maken met QMS, zodat zij de aankomende audit in week 46 zullen doorstaan. Een klein deel van de werknemers zal de training krijgen door middel van een pdf document, dit is een onderdeel van het onderzoek naar videoleren. Het document bevat dezelfde informatie als de video.
De toets dient door alle medewerkers te worden gemaakt met een score van 100%. Wanneer dit niet na 1 keer het geval is, kan de training nogmaals worden gevolgd. De training en toets kan gemaakt worden tot en met zondag 13 november. Wanneer jullie vragen of opmerkingen hebben horen wij het graag.
Met vriendelijke groet,
Nick Scheurwater op verzoek van,
Het Management team en Afdeling Opleidingen

Mail concerning retention-test

Beste Coördinatoren,

De afgelopen periode hebben jullie je ingezet voor de verschillende QMS trainingen en toetsen, waarvoor dank. De toetsen en trainingen maken deel uit van mijn afstuderen waarvoor ik een onderzoek doe naar de effectiviteit van videoleren. Ter afronding van dit onderzoek en mijn afstuderen zou ik graag nog een aantal medewerkers willen toetsen op hun kennis over QMS een maand na de training.

Mijn vraag aan jullie is dan ook om hier nog eenmaal medewerking aan te verlenen door deze toetsen te faciliteren. Omdat ik besef dat jullie de afgelopen periode al behoorlijk hebben geholpen om de QMS training en toets mogelijk te maken, heb ik een kleine selectie gemaakt van een aantal medewerkers. Het gaat per coördinator om maximaal 3 medewerkers die getoetst dienen te worden in de komende 3 weken. Het gaat om de toets QMS 3 die een mix van vragen bevat uit de eerdere toetsen. Omdat ze de toets al kennen en er geen training aan vast zit, verwacht ik dat de toets aanzienlijk minder lang duurt dan voorgaande keren. De toets hoeft slechts eenmaal gemaakt te worden en er zitten geen consequenties aan de resultaten.

Jullie ontvangen van mij later een mail met daarin de willekeurig geselecteerde deelnemers. Ik hoop op jullie medewerking zodat ik mijn afstuderen kan afronden. Mochten er verder vragen zijn dan hoor ik het graag.

Met vriendelijke groet,

Nick Scheurwater

Hallo (naam coördinator),

Hierbij de mail met de geselecteerde medewerkers. Het gaat in jouw geval slechts om 1 deelnemer die bij voorkeur deze maand getoetst dient te worden. Het gaat hier om de QMS 3 toets die inmiddels klaar staat.

Het gaat om de werknemer:

31477

Er staat een computer klaar bij de instructors en bij de afdeling opleidingen indien nodig. Mocht je iemand nodig hebben die de toets even begeleid dan ben ik tijdens kantooruren beschikbaar.

Zou jij dit deze maand kunnen faciliteren?

Met vriendelijke groet,

Nick Scheurwater

Questions QMS Test (Pre-test)

1. Welke informatie is er **niet** te vinden in QMS?
   - Standaard werkwijze.
   - Control plan.
   - Overige Formulieren.
   - Brand en evacuatie voorschriften

2. Loopvlakken worden gespoten op de Quadruplex of de Triplex
   Zoek via QMS de tolerantie van het gewicht van het Vorti loopvlak
   De tolerantie is:
   - 5%
   - 7.5%
   - 8%
   - 9%

3. Welke van de onderstaande stellingen zijn goed**? (Deleted)**
   Je kan toegang krijgen tot het QMS via:
   - Door op de snelkoppeling te klikken
   - Via het extra tabblad als je Internet Explorer opent
   - Via het pictogram in intranet
   - Door het adres qms.vredestein.com in de internet browser te typen
   - Door op de hyperlink te klikken die te vinden is in PIBS

4. Hoe vaak (frequentie) moet het proces 'selecteren en beoordelen mengsel' worden uitgevoerd bij de Quadruplex/Triplex in het C.P ? | 0 | 43067109 | 28329265 | 1 |
   - Elke dienst
   - Elke pallet
   - Elke Kalanderrol
   - Elke Run

5. Hoe vaak (frequentie) moet het proces 'materiaal input' worden uitgevoerd bij de machine Bias2 in het C.P.?
   - Elke Kalanderrol
   - Begin elke Bias rol
   - Einde maatwissel
   - Elke proces wijziging

6. Welke letters binnen het C.P. geven aan dat er extra opgelet moet worden gezien een afwijking van de standaardkwaliteit grote gevolgen kan hebben voor het complete productieproces.
   - Att/TH of AS
   - CC-LL of LC
   - HIC/CC of SC
   - QRS of PHD

7. Wat is de betekenis van de afkorting Q.M.S?
   - Quick Measure system
   - Quality Machine System
   - Quotes Motivating System

- Quality Management System

8. Wat is de doelstelling van het Q.M.S?
   - Hierin staan handleidingen beschreven over hoe je online systemen kan gebruiken
   - Ter informatie over brand en evacuatievoorschriften
   - Hierin staan gedragsregels van de werkvloer beschreven
   - Om ervoor te zorgen dat de machine altijd dezelfde kwaliteit levert

9. Nylon koorden worden berubberd en daarna versneden tot nylon overhead op de Calemard.
   Zoek via QMS de breedte tolerantie op de nylon-overhead
   De tolerantie is:
   - -3/+5 mm
   - -1/+3 mm
   - 6 mm
   - Er is geen breedte tolerantie toegestaan

10. Loopvlakken worden gespoten op de Quadruplex of de Triplex
    Wat is de tolerantie van Lumpy in het loopvlak?
    - 4 millimeter
    - 5 millimeter
    - 3.5 millimeter
    - Er is geen lumpy toegestaan

Questions QMS Test 1&2 (Post-Test)

11. Welke van de onderstaande stellingen zijn goed**? (Deleted)**
    Je kan toegang krijgen tot het QMS via:
    - Door op de snelkoppeling te klikken
    - Via het extra tabblad als je Internet Explorer opent
    - Via het pictogram in intranet
    - Door het adres qms.vredestein.com in de internet browser te typen
    - Door op de hyperlink te klikken die te vinden is in PIBS

12. Wat is de functie van het Control plan?
    - Verdeelt het proces in een aantal stappen en laat weten welke controle je moet uitvoeren tijdens iedere stap.
    - In het control plan staat informatie over arbeidsvoorwaarden.
    - In het control plan vind je de links naar alle machines.
    - In het control plan staat beschreven welke stappen er moeten worden uitgevoerd als de machine defect is.

13. Welke informatie is er **niet** te vinden in QMS?
    - Standaard werkwijze.
    - Control plan.
    - Hyperlinks naar alle machines.
    - Gebruiksaanwijzingen van de machines.

14. Waar staat de afkorting C.P. voor binnen QMS?

- Controle procedure.
- Centraal plan.
- Coördinatie procedure.
- Control plan.

15. Wat geven de letters CC,HIC of SC aan binnen het control plan?
    - Dit zijn links naar de standaardwerkwijze.
    - Dit betekent dat een afwijking van de standaardkwaliteit grote gevolgen kan hebben voor het complete productieproces.
    - Dit geeft aan met welke frequentie een proces moet worden uitgevoerd.
    - Dit zijn codes voor verschillende werkplekken

16. Hoe vaak (frequentie) moet het proces 'identificatie van half fabriekaten' worden uitgevoerd bij de machine M300 in het C.P?
    - Per rol.
    - Begin van iedere kalanderrol.
    - Per drager.
    - Per rol voor elk HF.

17. Hoe vaak (frequentie) moet het proces 'kalander las & transport naar cutter' worden uitgevoerd bij de machine Bias 7 in het C.P. ?
    - Elke proces wijziging.
    - Elke maatwissel.
    - Elke kalanderrol.
    - Einde elke bias rol.

18. Loopvlakken worden gespoten op de Quadruplex of de Triplex
    Zoek via QMS de tolerantie op de totaalbreedte Vorti
    De tolerantie is:
    - +- 3,5 mm HIC.
    - +- 5.5 mm HIC.
    - +- 7 mm HIC.
    - +- 4,5 mm HIC.

19. Nylon koorden worden berubberd en daarna versneden tot nylon overhead op de Calemard.
    Zoek via QMS de tolerantie van de lumpy op de nylon-overhead
    De tolerantie is:
    - Er is geen lumpy toegestaan.
    - Max. 4mm en Min. 100mm tussen de korrels.
    - Max. 4mm en max. 4mm brede ring rond de lumpykorrel.
    - -3/+5 mm.

20. Wat is de controle methode (control method) van het proces 'kalander las & transport naar cutter' bij de machine Bias6 in het C.P.?
    - PLC_CUT_0001.
    - PLC_CUT_9991.
    - PLC_CUT_263.
    - PIBS.

Questions QMS Test 3 (Retention-Test)

21. Wat is de betekenis van Q.M.S? (Deleted)
    - Quick Measure System
    - Quality Machine System
    - Quotes Motivating System
    - Quality Management System.

22. Welke informatie is er **niet** te vinden in QMS?
    - Standaard werkwijze.
    - Control plan.
    - Overige Formulieren.
    - Brand en evacuatie voorschriften

23. Wat is de doelstelling van het Q.M.S?
    - Hierin staan handleidingen beschreven over hoe je online systemen kan gebruiken
    - Ter informatie over brand en evacuatievoorschriften
    - Hierin staan gedragsregels van de werkvloer beschreven
    - Om ervoor te zorgen dat de machine altijd dezelfde kwaliteit levert

24. Welke letters binnen het C.P. geven aan dat er extra opgelet moet worden gezien een afwijking van de standaardkwaliteit grote gevolgen kan hebben voor het complete productieproces.
    - Att/TH of AS
    - CC-LL of LC
    - HIC/CC of SC
    - QRS of PHD

25. Wat is de functie van het Control plan?
    - Verdeelt het proces in een aantal stappen en laat weten welke controle je moet uitvoeren tijdens iedere stap.
    - In het control plan staat informatie over arbeidsvoorwaarden.
    - In het control plan vind je de links naar alle machines.
    - In het control plan staat beschreven welke stappen er moeten worden uitgevoerd als de machine defect is.

26. Nylon koorden worden berubberd en daarna versneden tot nylon overhead op de Calemard.
    Zoek via QMS de tolerantie van de lumpy op de nylon-overhead
    De tolerantie is:
    - Er is geen lumpy toegestaan.
    - Max. 4mm en Min. 100mm tussen de korrels.
    - Max. 4mm en max. 4mm brede ring rond de lumpykorrel.
    - -3/+5 mm.

27. Wat is de controle methode (control method) van het proces ‘Splicing’ bij de machine Bias6 in het C.P.?
    - PLC_CUT_0001.
    - PLC_CUT_9991.
    - Visueel zonder checklist
    - PIBS.

28. Hoe vaak (frequentie) moet het proces ‘identificatie van half fabriekaten’ worden uitgevoerd bij de machine M300 in het C.P?
    - Per rol.
    - Begin van iedere kalanderrol.
    - Per drager.
    - Per rol voor elk HF.

29. Hoe vaak (frequentie) moet het proces 'materiaal input' worden uitgevoerd bij de machine Bias2 in het C.P.?
    - Elke Kalanderrol
    - Begin elke Bias rol
    - Einde maatwissel
    - Elke proces wijziging

30. Loopvlakken worden gespoten op de Quadruplex of de Triplex
    Zoek via QMS de tolerantie op de totaalbreedte Vorti
    De tolerantie is:
    - +- 3,5 mm HIC.
    - +- 5.5 mm HIC.
    - +- 7 mm HIC.
    - +- 4,5 mm HIC.