

## ORIGINAL ARTICLE

# MANUAL HANDBOOK VERSUS VIDEO TUTORIAL: COMPARISON OF THE EFFECTIVENESS BETWEEN MANUAL HANDBOOK AND VIDEO TUTORIAL OF ENGINEERING MACHINERY ON LEARNING PERFORMANCE

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## ABSTRACT

Video tutorial is one of the instruction methods for teaching. It is a method of transferring knowledge by utilizing the use of video as part of the learning process. Despite the advantages of the video tutorial and the advancement of technology, manual handbook usage is still in place. In comprehending an engineering machinery operation e.g. engineering experiment, it is unknown if the usage of video tutorial may increase the users' learning performance. Thus, the objective of this study is to evaluate the effect of manual handbook and video tutorial on the specific part of engineering experiment - safety precaution, apparatus, procedure, and housekeeping - on users' learning performance. Four videos of four selected engineering experiments - Turning, Arc Welding, CNC Milling, and Bench Work - were prepared based on its manual handbooks. Each video tutorial consists of four parts - safety precaution, apparatus, procedure, and housekeeping procedure of the experiment. In total, sixteen engineering students between 19-20 years of age completed the study. They were pseudo-randomly assigned into either the Manual Handbook or Video Tutorial group - eight participants for each group. Participants that were assigned into the Manual Handbook group were asked to read the manual handbook of the four experiments, while the participants that were assigned into the Video Tutorial group were asked to watch four videos of the four experiments. Participants' learning performance was assessed by the quizzes designed based on the content of the manual handbook/video tutorial after each experiment was learnt. In overall, the results reveal the following; (i) Safety precaution part: Video Tutorial group obtained a higher percentage score (61.11%) rather than the Manual Handbook group (36.11%) and the differences are significant [ $t(14) = 2.679, p = 0.018$ ]; (ii) Apparatus part: Video Tutorial group obtained a higher percentage score (100%) rather than the Manual Handbook group (64.10%) and the differences are significant [ $t(14) = 9.744, p = 0.00$ ]; (iii) Procedure part: Video Tutorial group obtained a higher percentage score (97.60%) rather than the Manual Handbook group (44.10%) and the differences are significant [ $t(14) = 12.481, p = 0.00$ ]; and (iv) Housekeeping part: Video Tutorial group obtained a higher percentage score (88.60%) rather than the Manual Handbook group (45.20%) and the differences are significant [ $t(14) = 3.398, p = 0.04$ ]. Video tutorial is indeed more effective than the manual handbook in all categories. As a conclusion, using a video tutorial as the command of instruction for engineering experiment would make the user comprehending better in comparison to the manual handbook.

**Keywords:** Manual Handbook, Video Tutorial, Learning Performance

## INTRODUCTION

A manual handbook is a written reference material used by users as guidance in completing a certain designated task. It is a compilation of step by step instructions that rely on well-written explanation as well as supported by photographs, schematic drawings and graphical illustrations. Meanwhile video tutorial is a visual recording (video) of step-by-step instruction that can be referred by users. It is a visual translation of well-prepared written instruction into choreographed actions.

Nowadays, there are many people who used video as instructional media than paper manual tutoring. One version of the video is on-screen videos. According to Ertelt (2007), on-screen videos can show what is happening on a

computer screen. Atlas et al. (1997) mentioned that on-screen video is a full-motion recording of the computer screen or as a show-me-how instruction. As stated by Ertelt (2007), on-screen videos can be used to train and acquire skills for the more complex content of the multimedia learning materials in the step-by-step demonstration. Therefore, the tutorial can be easier for students to understand what is not understood. Burke (1996) suggested that the use of electronic tutorials may be advantageous for students who are uncomfortable to speak up in class, whereas Laaser (1998) has reported that online tutorials have enhanced communication between students in a situation where attendance in tutorials is low.

Besides, there are also students who prefer to study alone. Through an online tutorial, students

can "attend" a course at any time, from anywhere. According to Idris (1993), online learning is the chance they create for students, particularly those who are working in isolation, to promote more active learning. Student isolation has been revealed as a common problem in distance education and is often perceived as a contributing factor in student attrition (Woodely, de Lange & Tanewski, 2001). Brown and Duguid (1996) reported that online tutorials promote an environment where individuals readily learn from each other, discover that others share common problems, and discuss topical issues in depth.

Videos open the opportunity to demonstrate application possibilities within a multimedia learning environment with an authentic context. In other words, videos are not only a further development of integrating screenshots into the manual but they are also the multimedia version of a worked-out example. Subsequently, it is also believed that by showing what is happening on the computer screen with similar realistic objects, learning a new computer application, such as formatting text in Microsoft Word, can be more easily enhanced in videos. Another advantage is the flexibility ascending by reducing time constraints and the opportunity to get assistance without having to wait for set class times or office hours (Burke, 1996, Laaser, 1998). As stated by Ertelt (2007), video is also very suitable to convey a large amount of information in a relatively short of time. If pictures are said to be worth a thousand words, an illustration is considered as worth ten thousand words (Mayer and Sims, 1994).

Teachers/educators are now expected to make use of video for mass media teaching or learning. Television is one example of mass media that requires seeing and hearing qualities that make for more effective teaching and learning. Alaku (1998) stated that video play a vital role in teaching and learning. When used efficiently, it stimulates interest among the learners and induces longer retention of factual ideas as the students come into contact with what is being taught.

Learning performance can be improved by using a video tutorial. According to Alaku (1998) teachers' effectiveness depends on their use of appropriate instructional strategies and audio-visual aids. Appropriate instructional strategies portray good teaching techniques and successful learning. They help students to enjoy and understand lessons easily especially when they are attached with appropriate methodology. Oguntuase (2008) stated that it as a record on any medium through which a moving image may by any means be produced. They are derivative works which are usually based on original literary, dramatic, musical and artistic works.

Kindler (2006) as quoted by Fakunle (2008) declared that people generally remember 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they hear and see, 70% of what they say and 90% of what they say as they do a thing. Also, National Teacher Institute (2006) stated that Chinese had concluded that: I hear; I forget, I see; I remember, I do; I understand. Hence, since the video has to do with hearing and seeing it could be suggested that it is a vital tool of learning and teaching.

Tutorial performance of the group as a whole and each of its members (including the tutor) is estimated on a regular basis throughout each term (MUGSI, 2008). Nitko (2001) stated that a performance assessment: (1) present a hands-on task to a student; and (2) uses clearly defined criteria to evaluate the performance of the student on the learning target. He also wrote that during a performance assessment, the students must apply their knowledge and skills from multiple areas to show they can perform the learning target. A performance assessment may require a student to make something, produce a report, and give a demonstration.

This study evaluated the importance of video tutorials for engineering Workshop Technology course at the International Islamic University Malaysia (IIUM). With the advantages of the video tutorial, it may help the students to understand better about the experiment that is taught in a course. It focuses on the safety precautions, apparatus used, experiment procedures, as well as the housekeeping procedures of the experiments. Thus, the objective of this study is to evaluate the effect of manual handbook and video tutorial on the specific part of engineering experiment content - safety precaution, apparatus, procedure, and housekeeping - on users' learning performance. As a result, this study will provide extra information about the effect of the use of manual handbook and video tutorial on student's learning performance.

## METHODS

### *Participants*

Sixteen participants were participated in the study. They were: (i) undergraduate students from the Faculty of Engineering at the International Islamic University Malaysia (IIUM), (ii) between 19-20 years of age, (iii) never have taken Workshop Technology course offered by the Faculty. This is to ensure the participants are not familiar with the experiment procedures of the machines that were used in the study. Gender, ethnic background, first language, and minority status, were not taken into consideration in the study.

### *Apparatus and Stimuli*

**Manual Handbook:** The Workshop Technology course consists of fourteen experiments. These experiments were categorized into four categories based on its nature of the experiment. They are Materials Remover, Joining Materials, Programming-based Experiment, and Hand Tools Works. One experiment from each category was selected for the study, and they are: (i) Turning experiment (using the Lathe machine); (ii) Welding experiment (using the Arc Welding machine); (iii) Milling experiment (using the CNC Milling machine), and (iv) Bench Work experiment (using the Bench Work Workspace). The manual handbook to conduct these four experiments were used in the study.

**Video Tutorial:** Based on the manual handbook for the four experiments mentioned above, four video tutorials were developed - one for each. Each video consists of four parts - safety, apparatus, procedure, and housekeeping. In the safety part, all the safety precautions for a particular experiment were addressed. For instance, in the Turning experiment, switch for the spindle rotation need to be activated correctly for user safety. In the apparatus part of the video, all the apparatus used in a particular experiment were introduced. For example, in the Bench Work experiment, the Vernier calliper, threading tools, and L-block were introduced. In the procedure part of the video, the step-by-step procedures in conducting the experiment were well explained. Lastly, in the housekeeping part of the video, the routine of housekeeping tasks for a particular experiment was addressed. The prepared videos were verified with the respective personnel who are familiar with the experiments that include the Course Coordinator and the technician of the machines. This is to make sure that the content of the videos is correct and similar to its manual handbook. In addition, the videos were also verified in term of the language used. Based on the recommendations during the verification processes, the final video tutorials were developed.

**Laptop & Headphone:** A regular laptop (Acer aspire) and a headphone (Beats by Dr Dre) was used in the experiment. The same laptop and headphone was used throughout the study to maintain the similar stimuli quality (i.e. video tutorials) were exposed to the participants.

**Quizzes:** One quiz was prepared for each experiment. Thus, there are four quizzes were developed for the study. The quizzes contain four parts that follow the four parts of the video tutorial - safety, apparatus, procedure, and housekeeping. Example of the question for the quiz are as follows: (i) Safety (*List two safety precautions that you need to follow during the Bench Work operation*); (ii) Apparatus (*Figures below are the equipment used in the Bench*

*Work operation. Name the equipment*); (iii) Procedure (*Below are the steps of procedure in the Bench Work operation, please arrange the steps in a correct order*); and (iv) Housekeeping (*List two housekeeping tasks that you need to do after the Bench Work operation*).

**Administrative Forms:** Participant Form and Payment Voucher was used in the study. Participant Form was used to record participants' demographic information as well as to record all the collected data from the experiment. The Payment Voucher was used to record the compensation made to the participants.

#### *Design of the Study*

**Experiment Time:** The experiment was conducted during the weekdays only. Weekend was excluded in the assumption that participants' mood and behavior may be different between these two periods. In addition, the experiment was only conducted during the same period of time of the day which is from 2:00 PM to 5:00 PM in order to maintain the similar comprehension level among the participants.

**Stimuli Counterbalancing:** In the experiment, each participant was stimulated either with four manual handbooks or four video tutorials. Thus, in order to avoid the ordering effect of the stimuli, the arrangement of the stimuli was counterbalanced using the Latin Square method. Table 1 list the details of the arrangements. In explanation, for instance, participant 1, he or she was given to learn Turning experiment, followed by Welding experiment, then CNC Milling experiment, and end with Bench Work experiment.

**Table 1 Arrangement of the order of stimuli using the Latin Square method**

Pax	Turn	Weld	Bench	CNC
1	1	2	4	3
2	2	3	1	4
3	3	4	2	1
4	4	1	3	2
5	1	2	4	3
6	2	3	1	4
7	3	4	2	1
8	4	1	3	2
9	1	2	4	3
10	2	3	1	4
11	3	4	2	1
12	4	1	3	2
13	1	2	4	3
14	2	3	1	4
15	3	4	2	1
16	4	1	3	2

#### *Procedure*

Participants were asked to fill in the demographic information in the Participant Form. After that, he or she was pseudo-randomly

assigned into either the Manual Handbook or Video Tutorial group. Then, participants were briefed on the experiment procedure, that they will be given four manual handbooks (for Manual Handbook group) or four video tutorials (for Video Tutorial group) to learn the details of the four experiments. After that, participants were informed that they will be assessed on their understanding of the experiment through a set of quizzes (one quiz per experiment).

**Learning the experiment materials:** Manual Handbook group was given one manual handbook of a particular experiment at a time to be learnt, while the Video Tutorial group was given one video tutorial of a particular experiment to be watched. Participants were given ten minutes to learn the manual handbook or to watch the video tutorial.

**Quiz Session:** Immediately after the learning period is over, participants were assessed by a short quiz on the content of a particular experiment, where they were given five minutes to complete the quiz.

The processes (learning the experiment materials and quiz session) were repeated for the other three experiments. In the end, a participant was compensated MYR 15 for completing the study.

#### *Variables and Hypotheses*

**Dependent Variable:** Percentage of the score on the quizzes (by category - safety, apparatus, procedure, and housekeeping). To total mark for safety, apparatus, procedure, and housekeeping are 9 marks, 8 marks, 21 marks, and 8 marks respectively.

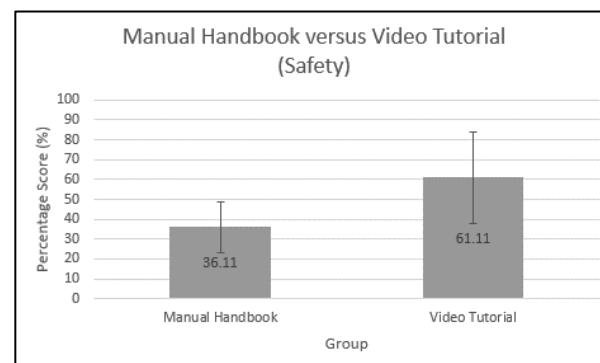
**Hypothesis:** Video Tutorial group will score more (a larger percentage of the total score) on the quizzes (for all categories) rather than the Manual Handbook group because as quoted by Fakunle (2008), people generally remember 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they hear and see, 70% of what they say and 90% of what they say as they do a thing (Kindle, 2006). As the video Tutorial group will have an opportunity to hear and see the experiment materials, they will remember more in comparison to the Manual Handbook group who only able to read about the experiment materials. In addition, Ertelt (2007) mentioned about the advantage of the video in acquire information that are complex, large amount of information, in a short period of time. Thus, as many of the engineering experiments are complex and contain lots of information, the Video Tutorial group is expected to perform better than the Manual Handbook group.

## RESULTS

The data collected were separated into four sections based on the criteria being assessed - safety precaution, apparatus, procedure, and housekeeping tasks. For each section, the percentage score for both the Manual Handbook and Video Tutorial group were calculated and compared. After that, the difference between the scores was further analyzed by using SPSS software (version 23). Independent Sample T-Test model was utilized because there are only two variables being compared, and the participant of the Manual Handbook and Video Tutorial group were independent to each other - i.e. different participant (Barret et al., 2013).

#### *Safety Precaution*

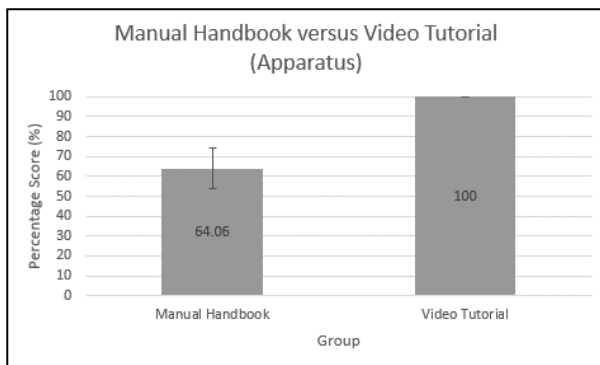
Figure 1 illustrates the comparison of the effect of manual handbook and video tutorial on the users' learning performance of the safety precaution part of the experiment materials learnt. By comparing the percentage score of the quizzes, the Video Tutorial group (61.11%) performed better than the Manual Handbook group (36.11%). Further analysis reveals that there was a significant different in the percentage score by Video Tutorial group ( $M=61.11$ ;  $SD = 12.94$ ) and Manual Handbook ( $M=36.11$ ;  $SD = 23$ ) at  $p < 0.05$ , condition;  $t(14) = 2.679$ ,  $p = 0.018$ .



**Fig. 1 Comparison of percentage score of Manual Handbook and Video Tutorial on learning performance (Safety)**

#### *Apparatus*

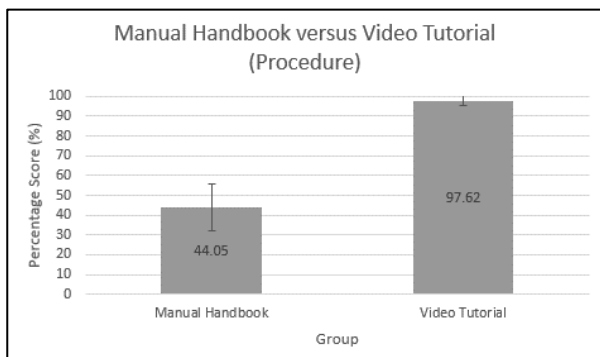
Figure 2 illustrates the comparison of the effect of manual handbook and video tutorial on the users' learning performance of the apparatus part of the experiment materials learnt. By comparing the percentage score of the quizzes, the Video Tutorial group (100%) performed better than the Manual Handbook group (64.06%). Further analysis reveals that there was a significant different in the percentage score by Video Tutorial group ( $M=100$ ;  $SD = 0$ ) and Manual Handbook ( $M=64.06$ ;  $SD = 10.43$ ) at  $p < 0.01$ , condition;  $t(14) = 9.744$ ,  $p = 0.000$ .



**Fig. 2** Comparison of percentage score of Manual Handbook and Video Tutorial on learning performance (Apparatus)

### Procedure

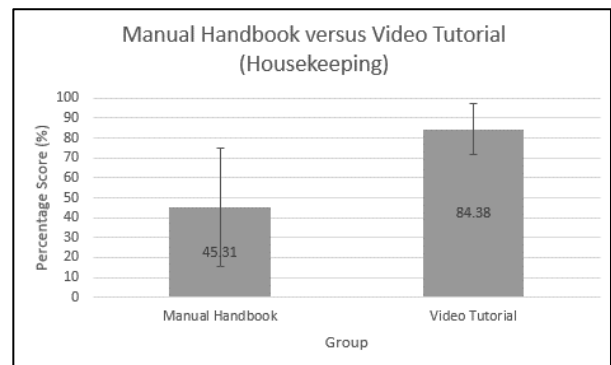
Figure 3 illustrates the comparison of the effect of manual handbook and video tutorial on the users' learning performance of the procedure part of the experiment materials learnt. By comparing the percentage score of the quizzes, the Video Tutorial group (97.62%) performed better than the Manual Handbook group (44.05%). Further analysis reveals that there was a significant different in the percentage score by Video Tutorial group ( $M=97.62$ ;  $SD = 2.55$ ) and Manual Handbook ( $M=44.05$ ;  $SD = 11.87$ ) at  $p < 0.01$ , condition;  $t(14) = 12.481$ ,  $p = 0.000$ .



**Fig. 3** Comparison of percentage score of Manual Handbook and Video Tutorial on learning performance (Procedure)

### Housekeeping

Figure 4 illustrates the comparison of the effect of manual handbook and video tutorial on the users' learning performance of the housekeeping part of the experiment materials learnt. By comparing the percentage score of the quizzes, the Video Tutorial group (84.38%) performed better than the Manual Handbook group (45.31%). Further analysis reveals that there was a significant different in the percentage score by Video Tutorial group ( $M=84.38$ ;  $SD = 29.83$ ) and Manual Handbook ( $M=36.11$ ;  $SD = 12.93$ ) at  $p < 0.05$ , condition;  $t(14) = 3.398$ ,  $p = 0.04$ .



**Fig. 4** Comparison of percentage score of Manual Handbook and Video Tutorial on learning performance (Housekeeping)

## DISCUSSION

As expected from this experiment, video tutorial proved to be more effective than the manual handbook. According to Ertelt (2007) video is very appropriate to deliver a large amount of information in a relatively short of time. Thus, as the engineering experiments mostly content a lot of scientific information and the duration given for the participants to learn could be considered as short, video tutorial seems to be more practical in enhancing the users' learning performance.

In this experiment, in the apparatus part of the learning materials, participants are required to label pictures of apparatus that were shown in the manual handbook and video tutorial. From the results shown, it is proven that participants using the video tutorial have higher percentage score with 100% compared to the ones that are using manual handbook. Oguntuase (2008) stated it as a record on any medium through which a moving image may by any means be produced. They are derivative works which are usually based on original literary, dramatic, musical and artistic works. Furthermore, participants that are using video tutorials also have a high score in transferring structural knowledge. For instance, participants are required to list down the safety precautions and also arranging the correct procedure of each experiment which tests on their structural knowledge transfer. From the data, it shows that participants have a higher score on structural knowledge transfer when using the video tutorial compared to the manual handbook. Therefore, it is better to use video tutorial as it provides better understanding and positive effects in the learning performance.

The current study evaluates the learning performance using quizzes of the content of the materials. However, if the effect remains the same on the hands-on performance of the experiment only can be answered by future study.

## CONCLUSION

As a conclusion, the current study found that the use of video tutorial as a learning medium (for engineering machinery) increase learning performance when compared to the manual handbook. The comparisons were done by part of the materials being learnt - safety precaution, apparatus, procedure, and housekeeping - in which the differences of the performance between the two groups (video tutorial and manual handbook) are significant in all categories.

The results from this study provide additional information regarding the advantage of the video tutorial as the medium instruction for engineering experiment in comparison to the traditional manual handbook.

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