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Product Instructions in the Digital Age

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1. Introduction

Product instructions are guides with the purpose of helping consumers to use products properly when they cannot be communicated through the design of the product itself. They are usually "on the product itself or its packaging or in accompanying materials" (ISO/IEC GUIDE 37, 1995, iv). They perform many different tasks and the good ones benefit both the users and the manufacturers. They should ensure users can operate products properly and safely. For manufacturers, instructions can add value to the products, encourage sales and reduce time for customer service which makes good business sense.

In recent times, products tend to be designed for intuitive use. However, this is not the case for every user and for every product. Thus product instructions are still necessary and have their unique values. For example, many newly developed products are very complex and involve multiple functions, these functions are experimented with only when necessary and when the user guides are available. Thus, instructions for these products have to be carefully prepared if the current trends are to continue.

In this research, the authors investigate problems of product instructions as well as suggest possible explanations for those problems. The study aims to find solutions to enhance the effective and inclusive performance of product instructions in a commercial environment in this digital age. The ideal was to find a method to produce durable product instructions that can be easily accessed, understood, stored and updated for all; meanwhile fulfilling the requirements of being cheap to produce and environmentally friendly.

2. Product instructions

In the Oxford English online dictionary (2006), the word "product" is defined as "that which is produced by any action, operation, or work; a production; the result. Now that which is produced commercially for sale". Another word "Instruction" is described as "making known to a person what he is required to do; a direction, an order, a mandate (oral or written) (www.oed.com, 2006)". Thus the term "Product instructions" refers to the guides associated with products to provide detailed operating instructions. In one of these international standards, "Instructions for the use of products of consumer interest" are defined as: "the means of conveying information to the user on how to use the product in a correct and safe manner" (ISO/IEC GUIDE 37, 1995, iv).

The initial purpose of instructions is to communicate vital information to users, and help them to use products correctly when this cannot be achieved through the design of products

themselves. They are crucial parts of products and they should allow and promote proper use of manufactured goods also offer direct help to avoid mishandling which may lead to danger. Although they should not compensate for flaws of product design, instructions should be able to reduce risks of damaging products, consequent failures or inefficient operations.

It is believed by Petterson (2002) that the design of product instructions is the design of instructional messages and it is one sub area of Instruction Design. It is closely related to information design and it is an interdisciplinary subject. It takes influences from many established areas of research. The main areas may involve language, art and aesthetics, information discipline, communication, behavioural and cognitive study and so on.

In many perspectives, product instruction design and information design share their similarities. Both these areas are not clearly defined yet and their histories are not easy to trace. The preparation, presentation, analysis and understanding of a message need to be embraced through a selected medium. Also, product instruction design and information design both involve multi-disciplinary and global concerns. They have influences from similar areas and they both need to inform the intended users. When studying the design of product instructions, the authors have taken inspiration from the information design field.

3. The trends and problems

People's demands on product instructions more or less depend on how much information they need for the operation of the products. Therefore the design of product instructions is closely related to the design and development of products. In the product design field, products are restructured and redesigned from time to time to follow different trends. Designers are passionate about using newer technology, creating appealing appearances for products, minimise then simplify them (Redhead, 2000).

The past ten years has been the fastest changing period for technologies; extraordinary changes have been brought to society. The emergence of mass information, new products and redesigned products is more prevalent than ever. New technology allows products to be more complicated to use but their appearance is getting simpler. Users are very often overwhelmed by new technology, products and information. Products both more confusing and more exciting than ever.

The choices for customers are wide,from products like computers and mobile phones to consumer products, for example, shampoo and chairs, almost everything has been rethought from scratch. Consumers, after experiencing high technologies and pleasant appearances of inventions, start to require more control and urge for personalisation. They want products to be "more seductive, more personal, more available" (Redhead, 2000, P54). The trend of customisation allows more customers to personalise their products. For example, Apple's products such as the iPod and iShuffle allow customers to have their own name on the back of the product. Similarly, Nike let the buyers decide the colour, detail and the ID of their own trainers. And now, personalised products are developed in most industries; ranging from fashion products to computers or furniture, even picture frames.

These trends and existing changes on the design of new products require product instructions to follow up and to be as exciting. The change of products needs their instructions to be clearer, quicker to access and easier to understand. However, while we are surfing in the ocean of newer and more charming products, product instructions are not as interesting as they should be. They are not redesigned and updated quickly enough to catch

up with the changes in emerging products. With the majority of product instructions, users are mainly suffering from problems in three design aspects: the effectiveness, the accessibility and the inclusiveness.

3.1 Effectiveness

Although product instructions are important and not replaceable, evidence suggests that existing instructions are not as good as they should be. The fact is that the user satisfaction rate on product instructions is only 31% according to the authors' survey in 2006. Users complain about many problems with product instructions such as they do not explain what the users really need; they are either too wordy or difficult to understand, hold unusual technical terms, contain bad translations and bad visuals (Figure 1).

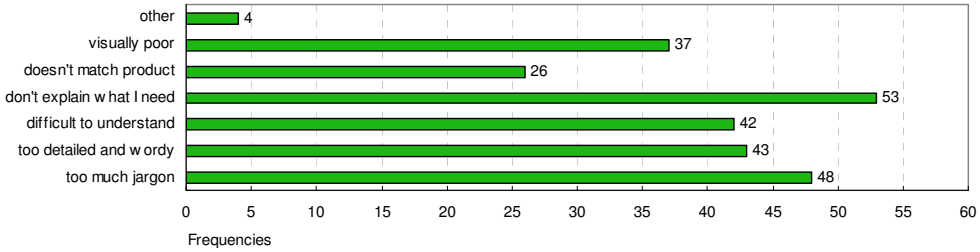

Fig. 1. Problems with instructions (authors' survey 2006).

These criticisms suggest that many accompanying instructions are not effective and they are not designed for all.

3.2 Accessibility

The majority of instructions in accompanying materials are in the physical forms of leaflets, manuals, CD (Figure 2). Another survey carried out by the authors (2008) showed that the vast majority (92%) of product instructions often are printed. Other forms such as CD/DVDs are also adopted but only used by a very small number of users.

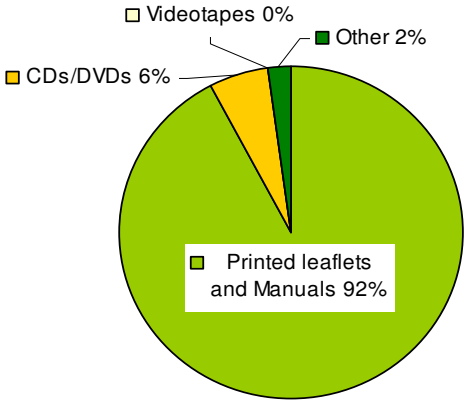

Fig. 2. Types of accompanying instructions.

Many printed instructions take a huge amount of storage space and are not easy to be kept and shared. For example, some products, such as office machines and equipment, are shared or passed around and instruction manuals become lost in the process. For example, in the survey carried out by the authors (2008), 72% of participants (155) intended to keep all instructions which accompany products (Figure 3).

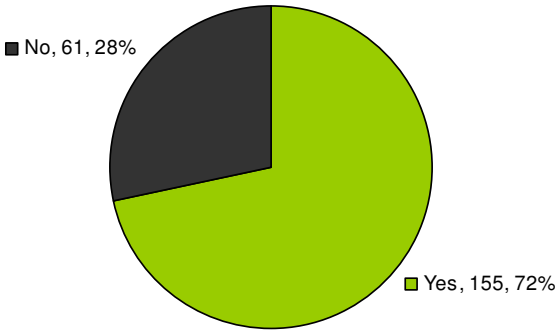

Fig. 3. Do users intend to keep instructions?

Among them, only 5% participants (3%) never lose the instructions and another 37 participants (24%) rarely lose them. 12% participants admit that they lose product instructions very often. The majority users (61%) replied "sometimes" (Figure 4).

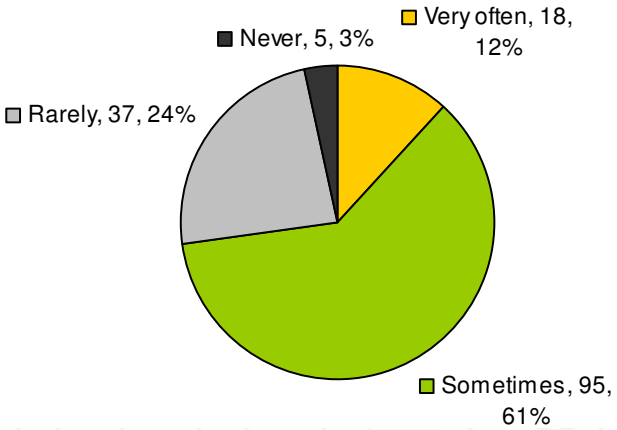

Fig. 4. Do users lose instructions?

On the other hand, for manufacturers, it is expensive to have these accompanying materials produced. Paper based product instructions such as leaflets and manuals are typical examples. Some of them contain many pages as all useful information has to be included (Figure 5).

Costs for producing them have been continuously increasing since the price of energy and paper has climbed. In recent years, there are more and more product instructions available online for free download. However, they are mostly digital or scanned versions of the

traditional instructions, and are still limited compared to other instructions delivered by physical media.

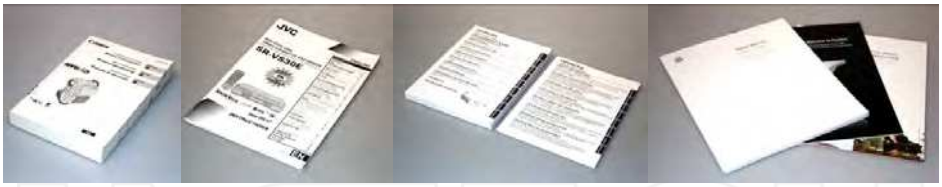

Fig. 5. Examples of paper based product instructions.

3.3 Inclusiveness

Product instructions should help all users to use different products and fulfill different tasks. When designing product instructions, designers are planning instructional materials and in some way designing a learning process for product users. Designed instructions should be easy to follow by users with all kind of intelligence references and learning styles. Therefore the instructions should use varied styles of delivery, be customized for specific people and help everyone to understand and learn. However, this is not achieved in most cases.

Currently, the majority of product instructions are presented by either text, images or a mixture of both. Product instructions dominated by text certainly enable aural learners to follow easily, however, they are not as straightforward to use for other readers with different strengths. Instructions full of pictures and charts can help visual learners to process information effectively and use products quickly but yet again they might not be the best choice for other users, for example, kinesthetic learners.

Additionally, it is difficult to locate a piece of information among instructions, as they are often very lengthy. Users have to scan all information and evaluate them to select the part they need. This works well when the assimilating learning style is favoured. However, when an accommodating learning style is preferred, users will be annoyed, often because they are forced to go through lots of instructions, instead of getting hands on experience quickly.

4. Current solutions

Facing all these problems with product instructions, some actions have been taken to alleviate the frustrations. To make product instructions more comprehensible and effective, standards for formulating instructions are available and textual materials on how to write instructions are provided. Meanwhile, info-graphics have been studied by some designers and academic researchers so that graphics can be used to aid the presentation of information. However, related standards are limited and dated; research focused on the accessibility and inclusive design of product instruction is very rare; problems of product instructions are not completely and successfully solved and users are continuing to suffer from annoyance caused by poor product instructions. It is necessary to carry out a systematic and up to date study to improve the performance of product instructions, especially in this digital age.

5. Possible solutions

The people who are producing product instructions should be trained to write and produce effective product instructions. They should understand standards for formulating instructions and be able to apply them while doing their jobs.

To make product instructions easily accessible, easily stored and updated, they could be created and distributed digitally, through networks, for example Internet or 3G networks. This will provide product instructions available at anytime, from anywhere around the world and could be translated into multiple languages with a very low budget for maintenance. There were 1,966,514,816 Internet users around the world in June 2010. The number has grown by 444.8 % between 2000 to 2010, and it is still growing (internetworldstats.com, 2010). On the other hand, based on Nielsen's estimate (2010), 50% of US mobile subscribers (142.8 million) will be Smartphone users by 2011, which means they could get access to a 3G network very easily on their phones. Similar trends are actually happening everywhere across the world.

To fulfil requirements from users with different intelligence levels and learning styles, instructions could involve multiple media for example, sound, music, animation etc., as well as the traditional media of text and images. Product instructions might also be interactive so that they could be read in almost any order. Once instructions are designed to be interactive rather than linear, they can be read by choice. This should enable the users to reread instructions and to repeat the tasks when an error is discovered. This will also minimise the amount of time spent on reading instructions, especially for those inexperienced users who have little prior knowledge. Also, a combination of minimalist and systematically complete instructions might be able to offer the most productive learning experience.

6. Design challenges

Ideally, multimedia instructions should help people with different leaning styles and strengths to operate products easier, quicker and safer. However, it has been suggested by Tapscott (2009) that Digital Natives (those who have grown up with digital devices) and Digital Immigrants (those who learnt to use digital devices as an adult) learn things differently and have different opinions on digital products and interactive works. Therefore the key challenges for this study were to find differences between improved traditional instructions and multimedia instructions in use; to discover if multimedia instructions are going to perform better in terms of their effectiveness and inclusiveness; to determine if multimedia instructions can be better solutions for all users, including the Digital Natives and the Digital Immigrants.

7. Prototyping and user testing

To find the answers to the above questions, instructions for a particular product, a lighting table (Figure 6) were chosen and rewritten according to the standards and regulations for planning product instructions. Two versions of product instructions were then produced: a printed version combining text and images (Figure 7); a multimedia version of the product instructions, which used the same text and imagery information but involved extra sound, animation and were designed as interactive (Figure 8). Participants for the tests were separated into two groups: Digital Natives and Digital Immigrants.

ST-0613T Photo Table Instruction Manual

Parts list

Normal steps of assembling

1. Connect 2 "A" and 2 "B" onto "C" tubes as per photo. Then, put on the 2 "D" onto it.
2. Put the 2 "F" tubes above the legs "A" & "B". Tightening the knobs.
3. Fix the 2 swivel brackets "G" onto the end of "F". Adjust the angle expected and Tightening the knobs.
4. Fix the 2 "H" onto the other end of the swivel brackets "G".
5. Connect 1 " I" tube with the 2 " H" and then fix the knobs.
6. Connect the 2 "E" with the 2 "A" and then connect another "I" with the Other side of 2 "E".
7. You can put 2 " K" clips with spigot on any position as you requirement.
8. Place the translucent sheet onto the top of the frame. Fix it from the top with clips "J" and hence with the other sides until it is placed tightly.

Fig. 6. A photo of the selected product and its original instructions.

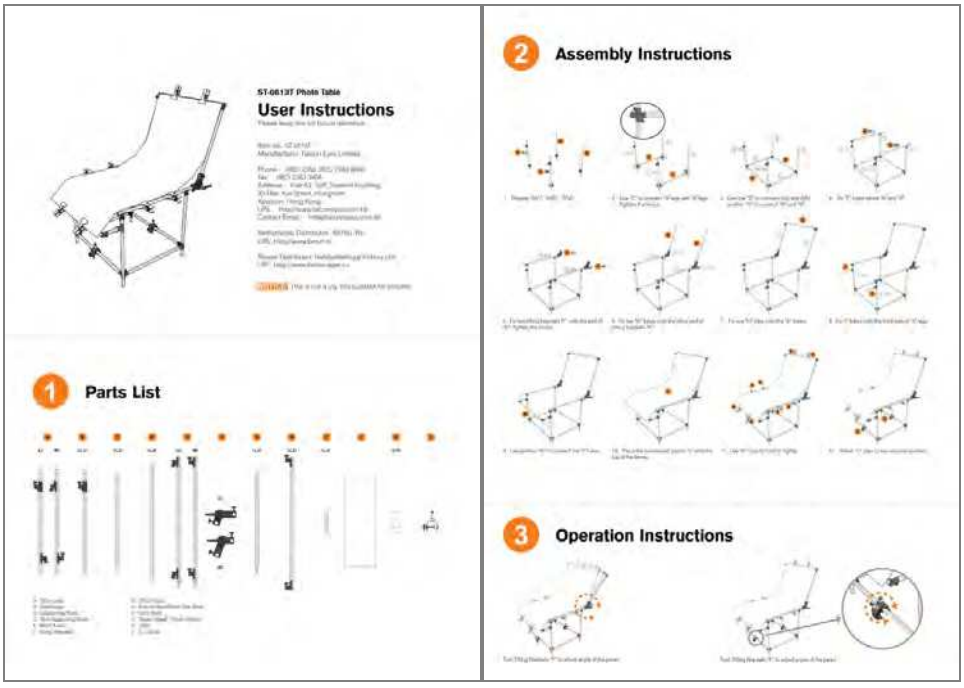

Fig. 7. Layout for the redesigned printed version of product instructions.

Fig. 8. Screen examples for the multimedia version of product instructions.

The choices of the participants had to be carefully planned in order to ensure that their human performance characteristics were checked prior to the beginning of the tests. This was done using a method traditionally used by work-study officers to establish what a hundred percent effort or rating looks like. A full pack of cards is dealt into four hands in a period of 52 seconds. It was ensured that the participants could all carry out this task in periods between 50 and 56 seconds. Thus their human performance characteristics could all be considered similar.

They were asked to follow either the printed instructions for the product or the multimedia ones to complete the same set of given tasks. The tasks included 1) using instructions to find information, 2) checking components of the product and 3) assembling. Their actions were monitored; timing was recorded; errors were observed and feedback was collected at the end.

8. Analysis and interpretation

Data from the experiment was gathered and interpreted to clarify the communicating effects of instructions, mainly from two aspects of task performance: efficiency and accuracy. Results from different user groups were compared and examined to find out which type of instructions were more effective and inclusive in terms of communication.

8.1 Task analysis

In the test, all components of the product were given to the participant and product instructions were provided on either a printed sheet or a laptop computer. By using Hierarchical task analysis (HTA), the main goal and sub-goals of the tasks were expressed as below (Figure 9).

As shown in figure9, tasks 1 and 2 were skill-based tasks. Users were asked to follow clear and simple instructions to carry out actions and they did not have to make judgements on the aim and plan of their actions. Task 3 was more complicated, it contained 12 steps and these 12 little tasks were grouped into different sections: 3-A, 3-B, 3-C and 3-D, depending on their goals. Many parts of task 3 required users to recall or understand some rules then make their own decisions on what action they should carry out, in order to achieve the required results.

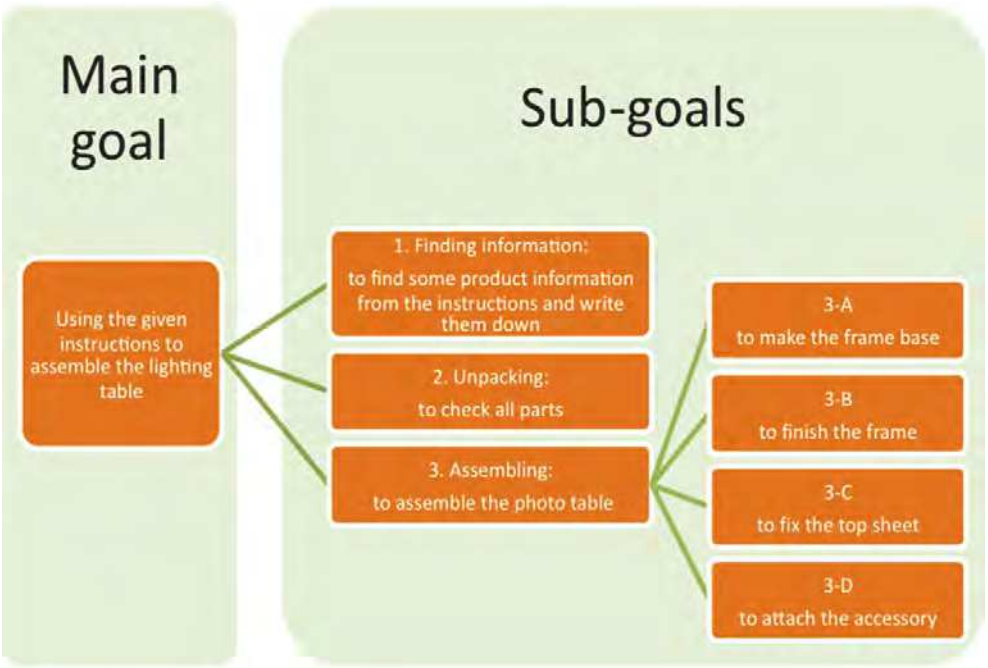

Fig. 9. The main goal and sub-goals of the refined tasks.

8.2 Performance on efficiency

To examine efficiency of different types of instructions, the following indices were used:

1. Time for finishing all tasks, (from the beginning to the end).
2. Time for each task section.

Overall, Data suggested that all participants, who used multimedia instructions, used on average 1379 seconds (22minutes 59 seconds), with a standard deviation of 220 seconds, which seemed to be slightly shorter to those of printed instruction users, who spent 1390 seconds (23 minutes 10 seconds), with a standard deviation of 213 seconds (Table 1). The difference was small therefore the authors were keen to find out if there was statistically significant difference between the total time consumption of different instruction.

Null hypothesis: $T_1 = T_2$

There is no significant difference between the average total time of users using either printed or multimedia instructions.

Alternative hypothesis: $T_1 \neq T_2$

There is a significant difference between the average total time of users using either printed or multimedia instructions.

The authors assumed that there was no statistically significant difference between the groups. A t-test was then carried out. to find out the confidence level of this hypothesis. The 2-tailed t- test returned a P-value of 0.89. Since the P-value (0.89) was greater than the significance level (0.05), the null hypothesis was accepted. This indicated that there was no significant difference between the efficiency of two versions of product instructions.

		Digital Natives (DN)		Digital Immigrants (DI)	
		Average Duration (s)		Average Duration (s)	
Printed product instructions	Average duration (s): ≅1390	Printed (DN)	≅1284	Printed(DI)	≅1497
Multimedia product instructions	Average duration (s): ≅1375	Multimedia (DN)	≅1332	Multimedia (DI)	≅1425
		All DN Average(s)	≅1308	All DI Average(s)	≅1461

Table 1. Average time for all tasks

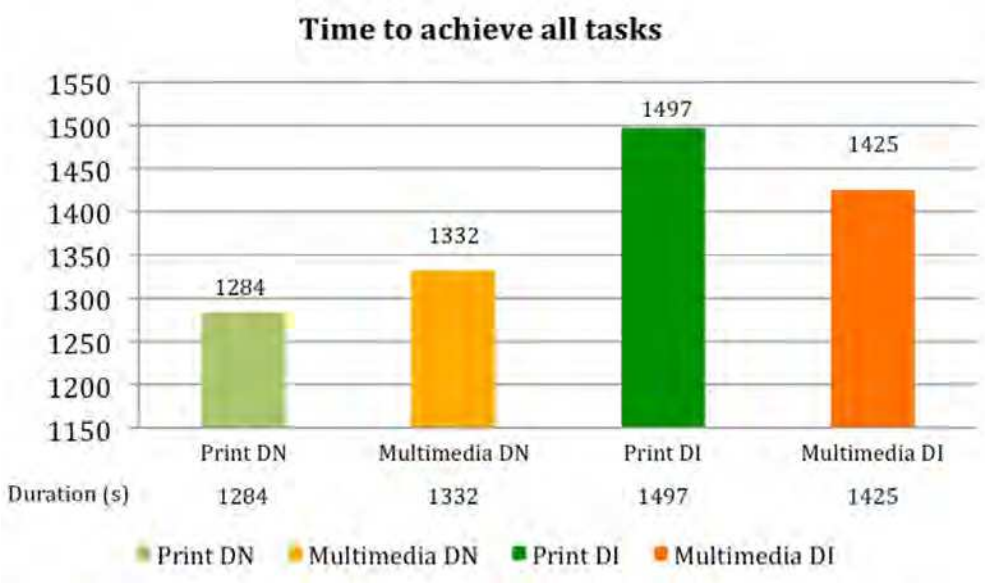

Fig. 10. Time to achieve all tasks in each user group.

Similarly, Figure 10 potentially suggested that the Digital Natives performed better, when using either the printed or multimedia instructions, than the digital immigrants. On the other hand, the Digital Natives seemed to perform better using print instructions than multimedia and the opposite happened with the Digital Immigrants. Again, t- tests were carried out to find out the confidence level of the significant differences.
After another 3 sets of 2-tailed t-tests, the results showed that the amount of time Digital Natives and Digital Immigrants used to complete all tasks was not much different. Also, different types of instructions did not have a huge impact in terms of the overall efficiency. This suggested that multimedia product instructions were as efficient as printed ones for both Digital Natives and Digital Immigrants.

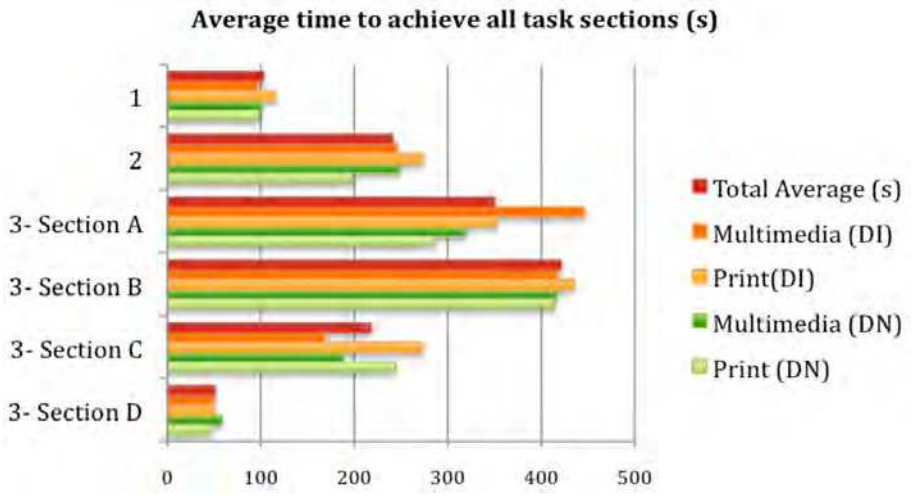

Fig. 11. Average time to achieve all task sections in each user group.

By looking at the time, which has been spent on each task section in detail (Figure 11), it was discovered that multimedia product instructions generally have a positive impact on Digital Immigrants in terms of their efficiency. Yet, this does not apply when a spatial judgement is involved in knowledge- based tasks. For Digital Natives, different types of instructions have different effects on time consumption; depending on the nature of each task. Printed instructions were more efficient to be scanned when skill-based tasks were simple enough to be completed intuitively. When instructions are necessary to follow for skill- based tasks, the time difference between the use of multimedia instructions and printed instructions was very little. Although it also took longer for the Digital Natives to use multimedia instructions to fulfil a complicated job when a spatial judgement was needed; multimedia instructions were significantly more efficient to use for a transferable process (rule-based tasks). Therefore the authors believe that multimedia instructions are not always efficient as expected, for example for particular types of tasks; but they are still more effective in terms of their efficiency in general, especially for Digital Immigrants.

8.3 Performance on accuracy

The accuracy of users' performance was evaluated through error analysis in this investigation and it was achieved by observations. Every time a user failed to achieve the planned goal, a

human error was found and recorded. The failures mainly appeared in two different ways (Hollnagel, 1993): the user's plan was adequate but the actions were deficient; or actions were carried out as planned but the intention was wrong according to the given tasks.
To define and classify human error in the tasks, three questions were referenced (Reason, 1990), and they all closely related to intentions:

1. Were actions guided by prior goals?
2. Have actions been proceed as planned?
3. Was the desired end achieved?

The questions then were used to categorize discovered errors into three main kinds: slips, lapses and mistakes (Figure 12).

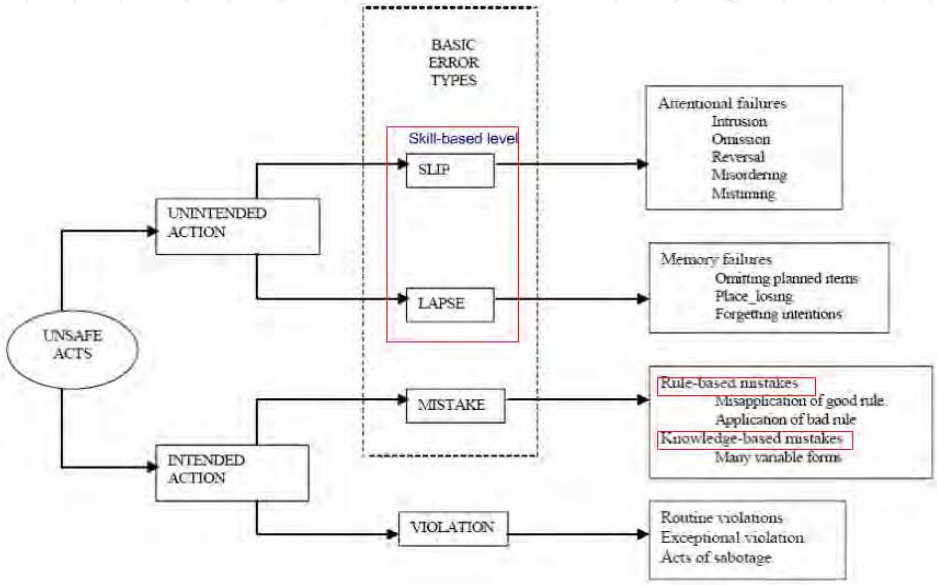

Fig. 12. Generic Error Modelling System (GEMS) (Reason, 1990)

8.3.1 Slips and lapses

Both slips and lapses were errors that happened in the execution process so that users failed to achieve the desired goals. The intentions were proper, but results were not right. A slip mainly involved actions that were not happening as planned, while lapses were the errors that were caused by failures of memory.

8.3.2 Mistakes

Mistakes referred to failures in the planning and/or judgemental processes; they are errors in users' intentions (Norman, 1983). They might involve the selection of objectives, or the decisions of means, even actions for achieving the objectives. They are normally caused by either a failure of expertise or lack of expertise(Reason, 1990). They could be effectively avoided or reduced by communicating sufficient information, in this case, using product instructions. Therefore, the number of mistakes left by users after each test was the main criteria to evaluate the accuracy performance of the product instructions.

	Print DN	Print DI	Multimedia DN	Multimedia DI
Slips	2	1	1	2
Lapses	0	1	0	0
Mistakes	4	2	1	0

Table 2. Error analysis

During the tests, by referring to given instructions, users observed and corrected their own errors in the performing progress. When errors were not detected or corrected by the participants, they were recorded and evaluated (Table 2). In this experiment, Digital Natives and Digital Immigrants have both made errors. The numbers of slips and lapses were similar in two user groups. They were caused by each individual's failures of action or failures of memory. Unfortunately, they cannot be perfectly solved by improving product instructions. When looking at the number of mistakes made by the participants, data revealed that multimedia instructions are better for avoiding mistakes, for both Digital Natives and Digital Immigrants compare to the traditional instructions.

	Tasks	Multimedia (DN)	Print (DN)	Multimedia (DI)	Print (DI)
1	Finding information	0	0	0	0
2	Unpacking- check parts	0	0	0	0
Section 3-A:	Make the frame base	1	0	0	0
Section 3-B:	Finish the frame	0	3	0	2
Section 3-C:	Fix the top sheet	0	1	0	0
Section 3-D:	Attach the accessory	0	0	0	0

Table 3. Mistakes in each task section.

When each task section was examined (Table 3), it was more evident that multimedia instructions can help users to avoid mistakes, especially in some complicated tasks for example task section 3-B. This section contained the most time consuming jobs in the whole experiment. It was a combination of many small knowledge-based tasks and some tasks required users to make critical decisions. Both Digital Natives and Digital Immigrants have made a few mistakes in this job section when traditional instructions were provided. However, when multimedia instructions with equivalent contents were presented, all users either avoided mistakes or realised errors on their own. Thus it is not difficult to conclude that multimedia instructions are better than traditional instructions (with only images and text) in terms of ensuring accuracy of actions.

9. Conclusion

Although multimedia instructions are not always more efficient than traditional ones, the authors believe that they are quicker to use for many types of tasks. They allow more flexibility in action and more importantly can help to reduce human errors significantly in the working process. They are effortless to access, can be transferred between different digital platforms and easy to update or replace. It is also proved that they can be used easily by people who have grown up with or without ubiquitous of digital media.

During the time for the development of this project, technology has changed and improved as fast as usual. Smart phones have become more popular and more portable digital devices like the iPad have come into the market and our daily lives. We are more comfortable with and dependent on with portable digital devices. The authors believe that multimedia instructions could be and soon will be better solutions for many of our daily products, to help us use products easily and safely.

However, this will not cause the complete death of the traditional instructions. Although they are not as good to ensure accuracy of performance, they can still be used in many cases. For example, they are a better choice for performing simple skill-based tasks on products in terms of efficiency, especially for Digital Natives, less patient or busy people. Therefore, in the future, instruction designers may want to analyse tasks for using a particular product, then decide either they need to design traditional instructions or multimedia ones to satisfy users' requirements for efficiency and accuracy of operation.

The authors accept that, as with any research project, there are certain limitations associated with the study. Every effort was made to ensure that the participants chosen had similar levels of human performance characteristics. In other words, they all had the same degree of normal flexibility, intelligence, adaptability and dexterity. However, even with the test applied (dealing cards) and observations made on the participants, it was still impossible to completely eliminate the human factor.

10. Contribution

Overall, for this study, a problem-driven design strategy was adopted. Inspiration was taken from fields like information design, product design, graphic design, and instructional design in education plus cognitive and ergonomic science.

As related studies and standards are not sufficient to solve problems with product instructions especially in this digital age, this research should make an original contribution in this field. It will benefit both users and manufacturers since it aims at finding solutions to improve the quality of product instructions. Furthermore, this study should have economic value as the costs of product instructions can be reduced.

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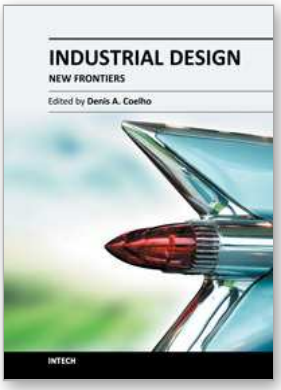

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A new breed of modern designers is on the way. These non-traditional industrial designers work across disciplines, understand human beings, as well as business and technology thus bridging the gap between customer needs and technological advancement of tomorrow. This book uncovers prospective designer techniques and methods of a new age of industrial design, whose practitioners strive to construct simple and yet complex products of the future. The novel frontiers of a new era of industrial design are exposed, in what concerns the design process, in illustrating the use of new technologies in design and in terms of the advancement of culturally inspired design. The diverse perspectives taken by the authors of this book ensure stimulating reading and will assist readers in leaping forward in their own practice of industrial design, and in preparing new research that is relevant and aligned with the current challenges of this fascinating field.

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