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The Design of Product Instructions

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1. Introduction

This chapter follows the chapter 3 (Product Instructions in the Digital Age) in *Industrial Design - New Frontiers* (2011) and describes the design process used in designing effective hard copy and interactive digital instructions for a selected product, which was a photo table. In this research, the printed and multimedia instructions had to be planned, using exactly the same contents, text and illustrations, in different formats to find out the impact of different media on instructions. The authors referred to literature, related research and design examples then developed the product instructions and developed a practical design process for designing product instructions.

2. Suggested design process

Pettersson (2002) suggests a design process for instructional messages, which comes with six steps: 1) Analyse requirements; 2) Plan contents; 3) Design language of messages to communicate; 4) Deliver and present messages; 5) Testing; 6) Refine designs.

This paper gives an overview of what to do when dealing with instruction design but further details are not explained. Two aspects of these steps, the design of language and testing are also recognised as important by other researchers. Sherman & Craig (2003) used case studies to understand the design of user documentations and instructions. Their study involved both the language communication and evaluating/ testing of documentations; the overall design processes were not mentioned. Similarly, ISO/IEC GUIDE 37(1995) suggested two types of assessing methods for general user instructions: desk research and user testing. Again it did not make suggestions on the design process of general instructions.



Figure 1. Examination of the product

3. The actual design process

In this research, the authors referred to suggestions on instructional message design and produced two sets of product instructions: printed instructions and multimedia instructions. They both used exactly the same contents, text and illustrations. The shared information was vital to ensure equality comparison of the effectiveness between both sets of instructions. To guarantee its quality, the product was examined first, then the user profile was reviewed and tasks were analysed. Contents were then decided and written according to the recommended communication rules, followed by the design of visuals and the production of instructions. This research focused on the instructions which accompany the product, therefore instructions on packaging and the product itself were not studied.

3.1. Examination of the product

In the examination, all parts of the product were inspected and measured (Figure 1). Although this research focused on the instructions which accompany the product, labels had to be added in term of using the accompanying guides properly (Figure 2). Further, experiments on using the product, for example installing and operating were performed (Figure 3). The process was observed and recorded by a camera.

3.2. User profile

After the examination of the product, its user profile was created. This process ensured that all instructions would satisfy the product's appropriate user groups and meet their special requirements if there were any.



Figure 2. Labels were added onto product parts.

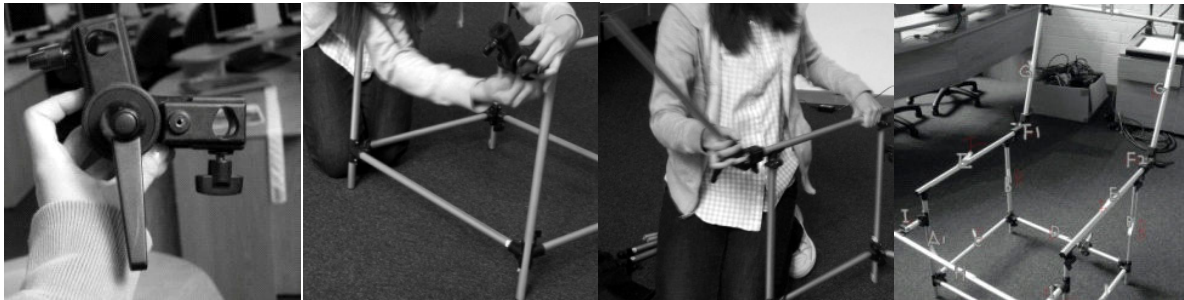


Figure 3. Examine the installing and operating procedures.

The chosen product was designed for photography practitioners, including both experts and novices. Photography experts might have more chances to expose themselves to similar products before but it was a simple product therefore separate instructions for experienced and new users were not necessary. The redesigned instructions should require the minimum knowledge from users and be able to be used by people from all experience levels. It was important that users should be physically capable of carrying out the required actions because the product needed installation and adjustments for use (Table 1):

Product name: Photo table	Model: ST-0613T			
User knowledge and experience:				
Reading level:	low	medium	high	<u>all levels</u>
Product experience:	experienced		novice	<u>both</u>
User of similar products:	many	some	little or none	<u>all</u>
Physical characteristics:	not mobility impaired			

Table 1. User profile of photo table ST-0613T.

3.3. Possible tasks

Users mainly need instructions either for learning to use a product, for troubleshooting or for both. In this experiment, the main purpose of the instructions should be providing sufficient information so that users could set the photo table up to use safely. The possible tasks, sub tasks, actions and their ideal solutions, acceptable/ alternative solutions even possible errors were listed and analysed (Table 2). This detailed task analysis was a foundation for planning the contents of instructions.

	Ideal solution	Acceptable solution	Possible errors
Finding general information			
Locating information	Locate information quickly	Locate information slowly	Cannot locate information
Reading information	Read information correctly		Read information incorrectly
Preparing the product for assembly			
Unpacking	Unpack all parts		Miss parts
Matching every part to instructions	Check and match all parts before assembling	Check and match parts during assembling	Mismatch parts
Assembling the product			
→ Making the frame base	Making the correct frame base in designed order	Making a correct frame base in any order	Can not make a correct frame base
<ul style="list-style-type: none"> ♦Preparing A(L), "A(R)", "B" × 2; <ul style="list-style-type: none"> -finding A(L) -positioning A(L) -finding A(R) -positioning A(R) -finding "B" × 2 -positioning "B" × 2 ♦Connecting "C" × 2 to "A" legs and "B" legs; <ul style="list-style-type: none"> -finding "C" × 2 -positioning "C" × 2 -connecting first "C" and A(L) -tighten the knobs -connecting first "C" and "B" -tighten the knobs -connecting second "C" and A(R) -tighten the knobs -connecting second "C" and "B" -tighten the knobs 	<ul style="list-style-type: none"> ♦Right parts face correct directions; ♦Right parts are fixed in the right joints; Parts are safely fitted into each other; Knobs are tightened; 	<ul style="list-style-type: none"> ♦Use wrong parts; Right parts face wrong directions; ♦Connect wrong legs; Connect right legs in wrong joints; Parts do not sit into a secure position; Knobs are not tightened properly; 	

Table 2. Examples of possible tasks for using the photo table ST-0613T and the required actions.

3.4. Planning contents

Having the users' needs in mind, the contents of the instructions were then redesigned. Compliance checklists from the standards ISO/IEC GUIDE 37(1995) and the BS EN 62079:2001/IEC 62079 (2001) were used as references. The contents applicable for the chosen contents were organised to cover five key elements: product identification, product specification, preparing the product, operating instructions and health and safety information (Table 3). This particular product is very simple and does not require trouble-shooting instructions.

Product identification	Brand and type	Falcon Eyes ST-0613T Photo Table
	No. of model	ST-0613T
	Date of publication of the handbook	The product instructions were redesigned on August 2009
	Producer/supplier, Distributer	Manufacturer: Falcon Eyes Limited BENEL BV; Nabliudatelnyje Pribory Ltd.
Address, etc. of producer/ service agency		Contact details of both manufacturer and distributors
Product specification	Dimensions	130x60cm (back height is 60cm) (words combined with illustrations/animations)
Preparing the product	Unpacking	Parts list (in both words and illustration)
	Installation and assembly	Assembly Instructions (words combined with illustrations/animations)
Operating the instructions	Complete for correct intended use	Operation Instructions (words combined with illustrations/animations)
Safety and health information	Warnings	Not suitable for children
		It is not a chair
		Keep the instructions for future reference

Table 3. Contents of the revised product instruction.

3.5. Planning the communication of written instructions

To communicate successfully, the product instructions were written in a clear style and active voice. The instructions were in short sentences; each sentence gave one command and the commands were direct (Table 4). The written instructions followed the communication process and offered users a continuously improved understanding. Terms, information and communication styles were consistent in all parts of the product information.

Before revision	After revision
Connect 2 "A" and 2 "B" onto "C" tubes as per photo. Then, put on the 2 "D" onto it.	Use "C" to connect "A"x2 and "B"x2"; Tighten the knobs. Use one "D" to connect A(L)and A(R), another "D" to connect B and "B".

Table 4. An example of rewritten instructions.

3.6. Designing the visuals

The main challenge for the visual design in this research was to be clear and make sense. Luckily many studies recommended visual principles for making images for instructional use. For example, Szlichcinski (1984) found factors that affect the comprehension of pictographic instructions. Heiser et al. (2003) recommended some cognitive design principles for visualizations. Also, a research focused on effective step-by-step assembly instructions was carried out (Agrawala et al., 2003). Schumacher (2007) reviewed other studies and did more up to date research on pictorial assembly instructions. Together, these studies made clear suggestion for making illustrations, especially in assembly instructions.

The authors used these findings, created a huge amount of illustrations to describe the product, demonstrate the product parts and help to explain the assembling and operating process. To ensure the accuracy of details in illustrations, 3D models of the product were created in Autodesk Maya using the exact proportions (Figure 4).



Figure 4. models reflected the real product.

All models were kept simple and basic. The details of product parts were controlled to the minimum level for easy recognition and 3D models were then rendered as vector images (Figure 5).

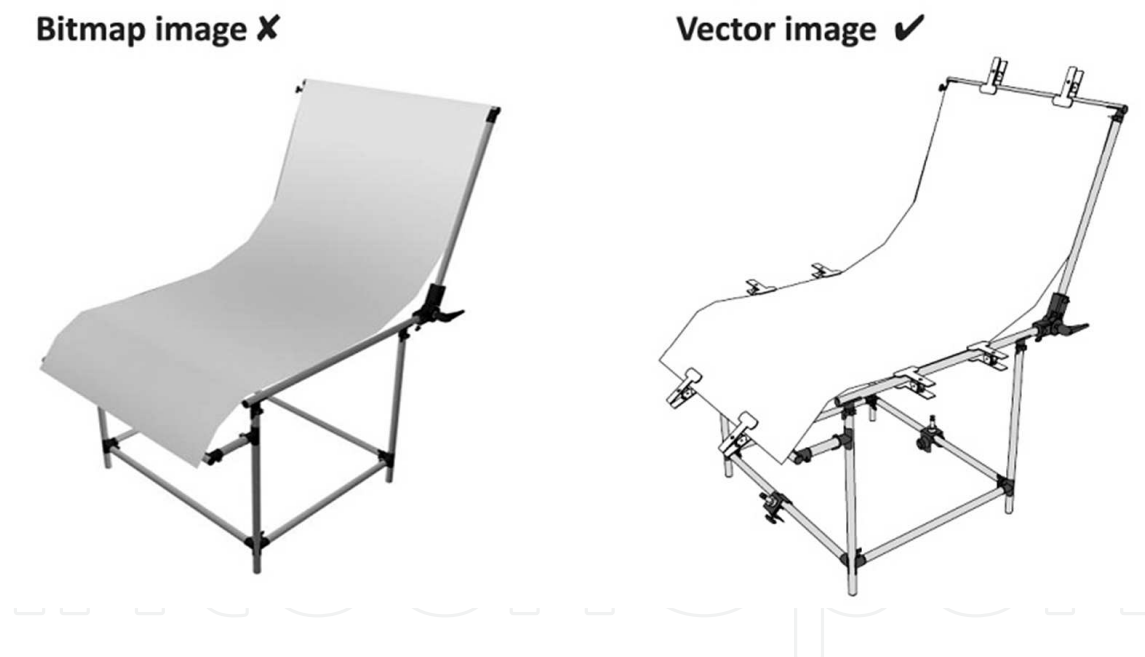
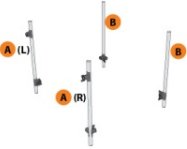
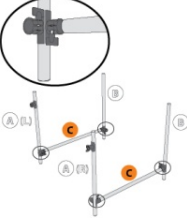
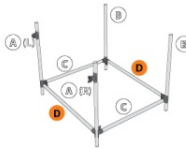
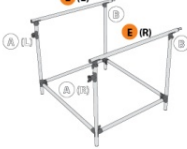
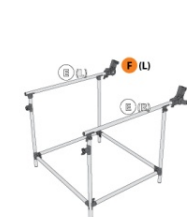


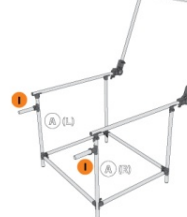


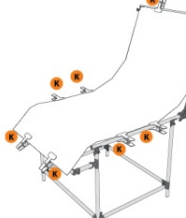



Figure 5. Rendered image examples of the product.

3.7. Colours and text size

The majority of information was designed in greyscale. An orange colour was used to highlight numbers and some icons (Figure 6). All information was guaranteed to be recognisable when printed out in black and white. Text was designed in black on a white ground to ensure a high colour contrast on both print and digital media. Font sizes varied between titles and body text and they were clearly legible.

2 Assembly Instructions

- 
1. Prepare "A(L)", "A(R)", "B"x2;
- 
2. Use "C" to connect "A"legs and "B"legs; Tighten the knobs.
- 
3. Use one "D" to connect A(L) and A(R), another "D" to connect "B" and "B".
- 
4. Fix "E" tubes above "A" and "B".
- 
5. Fix two tilting brackets "F" onto the end of "E"; Tighten the knobs.
- 
6. Fix two "G" tubes onto the other end of tilting brackets "F".
- 
7. Fix one "H" tube onto the "G" tubes.
- 
8. Fix "I" tubes onto the front side of "A" legs.
- 
9. Use another "H" to connect the "I" tubes.
- 
10. Place the translucent plastic "J" onto the top of the frame.
- 
11. Use "K" clips to hold "J" tightly.
- 
12. Attach "L" clips to any required position.

3 Operation Instructions

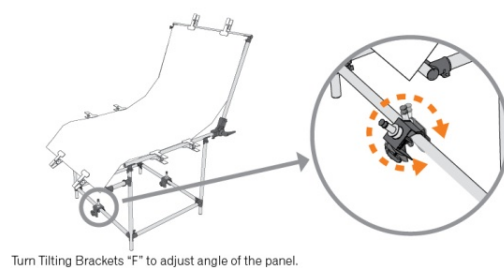
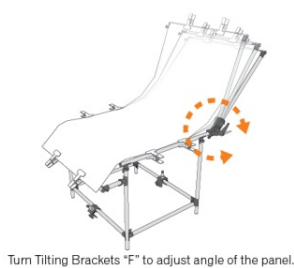


Figure 6. Colours used in prototypes.

3.8. Numbering and highlights

The parts, tasks and steps were organised by numbers and their appearances were designed to be coherent. All essential information was either enlarged or emphasized by colours. For example, the warning message was highlighted with a yellow colour to raise attention (Figure 7).

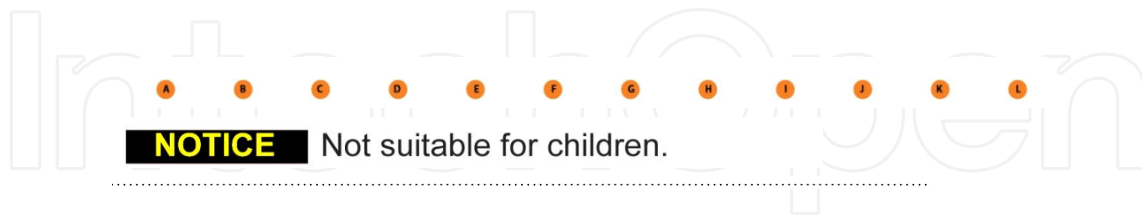


Figure 7. An example of highlighted warning message.

3.9. Producing the printed and multimedia instructions

The printed instructions followed the tradition of using text and images to make sense. It was printed on double sides of durable paper and the layout was carefully planned to ensure readability.

Interactive multimedia production instructions were created based on the same contents as that used in the printed instructions. Instead of a linear presentation, information was delivered by re-structured contents. They were re-categorised and designed to be interactive so that users should be able to search and locate information easily. Main visual elements, for example, the written instructions and illustrations remained the same as they were in the printed instructions. Other media like sound and animations also have been integrated together with images and text to provide more effective guidance for users.

3.10. Evaluation based on standards

For the evaluation, the assessment guide provided by international standard, ISO/IEC GUIDE 37 (1995) was referred to (Table 6). Both printed and multimedia instructions satisfied all required and applicable requirements. For the multimedia instructions, the evaluation criteria on their interactivity, user experience etc. are not given in the standard.

Very good	Good	Average, just acceptable	Poor	Very poor	Not applicable/not necessary
++	+	#	-	--	0

Table 5. Add Caption.

3.11. Diagnostic testing

The product instructions were tested to identify any problem in use. Participants were asked to use given instructions to perform a set of tasks. During the test, the participant was required

Items to be checked	Evaluation (++/+/#/-/0)	Comments
Legibility		
→ On-product information		
♦ Type size depending on reading distance	+	All parts are labeled to enable easy assembling. Although this is not part of this investigation.
♦ Brightness contrast (needs to be more than 70%)	+	
♦ Instructions incorporated in material of product	+	
→ Handbooks, manuals, leaflets		
♦ paper quality	+	Black type on white high quality paper, legible. Different font size for headings. Clear. Orange for highlights. Yellow for warning messages. Page layout is considered
♦ type size	+	
♦ line spacing	+	
♦ use of different typeface, type size etc.	++	
♦ captions easy to read	++	
♦ brightness contrast (needs to be more than 70%)	+	
♦ use of colours	+	
♦ general impression of the page is balanced and uncluttered	+	

Table 6. Examples from the evaluative checklist for the re-designed printed instructions.

to “think aloud”, speak out her/his thoughts. The participants’ actions and voice was observed and recorded for analysis. The results were evaluated by dialogue analysis and error observations.

3.12. Dialogue analysis

The categories for the dialogue contents included confusion, statement of problems, decision made, solution found, statements of intention, considering, statements of feeling, comments on the product and activities like reading instructions and actions. They were marked using different colour codes (Table 6). Physical activities like reading instructions and doing things were marked by blue colours in different tones. Negative thinking processes that involved difficulties and problems were represented by warm oranges. Positive judgments towards some decisions and solutions were drawn in greens and pinks were used for the others.

Thinking activities	Physical activities
Confusion	Reading instructions
Statement of problems	Action
Decisions made	
Solutions found	
Statements of intention	
Considering	
Statement of feelings	
Comments on the product	

Table 7. Categories for the recorded dialogue contents.

Timing for each activity category was recorded and wrote down and it was discovered that overall the tasks were performed well with both instructions. Participants were spending most of the time on physical actions; a reasonable amount of time was used for considering and making decisions. The users also had some problems and expressed confusions (Figure 8).

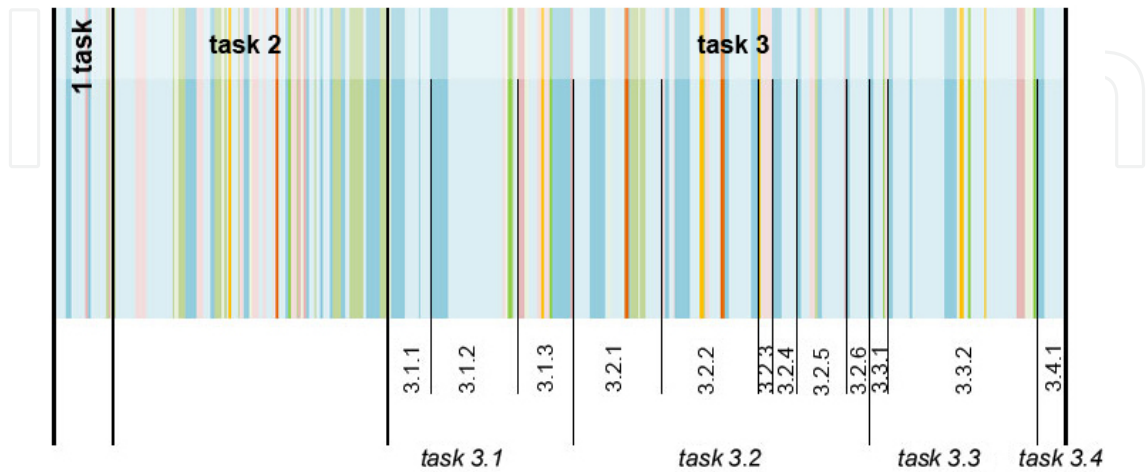


Figure 8. An example of different activities in all tasks presented by colours.

The majority of time had been spent on task 3, assembling the product and this was also the stage where most problems occurred. For example, the time spans for task 3.2.1, task 3.2.2 and task 3.3.2 were much longer than the others and there were negative responses involved in these steps. To clarify details of where the problems were, coloured square icons were used in the following table (Table 8) to indicate confusions and stated problems:

Task No.			Confusion	Stated problems	No reported problem	
1					✓	
2			◆	■		
3	3.1	3.1.1			✓	
		3.1.2			✓	
		3.1.3		■		
	3.2	3.2.1	◆			
		3.2.2	◆	■		
		3.2.3		■		
		3.2.4				✓
		3.2.5				✓
		3.2.6				✓
	3.3	3.3.1				✓
3.3.2				■		

Table 8. An example of the distribution of confusion and stated problems

The negative expressions from the participant like the confusions and problems were listed and analysed (Table 9). These subjective expressions from the participants explained what problems they had been feeling. By inspecting the instructions, some of the problems (Task 2 and 3.1.3) were discovered to be misunderstandings and some of the real problems in Task 3.2.2 were solved.

3.13. Error observations

The dialogue analysis showed that participants were confused at some stages, for example when trying to complete Task 3.2.2 and Task 3.3.2, problems and confusions were pointed out. To study real problems of the product instruction more objectively, the user test results were analysed again by reviewing the video, checking times for each task and observing errors during the test (Table 9).

Through the observations, one error was found while the participant was carrying out Task 3.2.2 using the multimedia instructions, when an “F” bracket was fixed onto the opposite side at the beginning. The error was identified and corrected by the user himself after checking against the instructions. This showed that the product instructions explained the operation process but they could be clearer and more effective in terms of preventing misuse of the product.

Sometimes participant pointed out a few problems and the time span for certain tasks was observably longer than others. However, no error was discovered in the process of finishing it.

Overall, both the printed and the multimedia product instructions performed well and no major mistake was discovered. Still, improvements were carried out to reduce users’ confusions therefore shorten the time for some tasks, for example task 3.2.2 and task 3.2.2.

3.14. Refine instructions

Findings from the diagnostic tests suggested some major improvements for the instructions. These changes were applied to both the printed and the multimedia instructions. However, in this experiment, after making changes, the instructions still would not fix all discovered problems. This was because of design deficiencies in the product itself and instructions could not and should not compensate for those product inadequacies. Due to the aim of this investigation being focused on the usability of instructions; the minor confusions caused by the design deficiencies were ignored.

4. Conclusion

As stated in 1.1, the current research and study on the design of general product instructions is relatively rare. It is to the authors’ surprise that no existing clear suggestion on the instruction creation process has been found and the method of instruction creation is also undefined. Moreover, there are no easy guidelines for designers to follow. The standards on user instruc-

Tasks No.	Thinking activity	Time (s)	Contents	Analysis	Can problems be solved by altering instruction?	Solutions
Task 2	Statement of problems	4	There should be another one... like that.	The participant could not find the part "A(R)". It was found in 4 seconds.	Has been solved	
Task 2	Confusion	5	So, why was that? Have I miss something in it?	The participant could not find one of the "B" parts. It was found in 5 seconds.	Has been solved	
Task 3.1.3	Statement of problems	4	Obviously I have made a mistake.	The participant assumed that "A" pipes were fitted in incorrect positions. However, he proved them to be right after checking instructions.	Has been solved	
Task 3.2.1	Confusion	6	Ah! Why wouldn't I be able to...Where was those two?	The participant was trying to figure out the correct direction of using A pipes and B pipes.	Yes	The illustrations for pipe ends should be further enlarged for easy checking.
Task 3.2.2	Statement of problems	6	Ah, this is left right.	The participant fixed the "F(L)" part in the position for "F(R)" part. The problem was identified by using instructions and on product labels.	Has been solved	
Task 3.2.2	Confusion	8	Em... I would expect that to be...	The participant intended to fix the two brackets "F" in the wrong direction. The problem was identified and solved by using instructions.	Has been solved	
Task 3.2.3	Statement of problems	4	The biggest problem I got was - have to move backwards and forwards.	The participant had to move backwards and forwards to read instructions on screen and take some actions. The instructions were displayed on a portable laptop computer. Therefore this could be avoid by taking the computer and place it closer to the product parts.	No	The tested participant was not familiar with the digital device. The situation varies depend on how much each user is accustomed to different devices. Also, this problem would not occur if the product instructions were displayed on smaller and more portable devices for example smart phones.
Task 3.3.2	Statement of problems	6	These are bit... It doesn't seem to say any particularly. So ...	The participant was trying to find out which side of clip "K" should face up.	Yes	This can be solved by slightly enlarge the illustrations for this part. However, this does not influence the use of the product. Either side of a "K" clip could face up.
Task 3.3.2	Statement of problems	2	It's a bit awkward.	The plastic "J" was left too long at the bottom of the frame and could not be clipped on. This was partly caused by the design deficiencies of the product however can be solved by clarify the assembling order in the product instructions.	Yes	The instructions could explain that the "K" clips on top should be fixed first. Then the plastic "J" should be adjusted to catch the bottom of the frame. Although this cannot fully cover the design deficiencies of the product, it should improve the results.

Table 9. The analysis of confusions and problems in the diagnose test for the multimedia instructions.

Task	Ideal solution	Acceptable solution	Error
3.2.2 Fixing "F" × 2 onto "E" × 2;	♦Right parts are fixed safely;	♦Handles on "F" × 2 face out;	♦ One longer side and one shorter side of "F" × 2 are connected to "E" × 2;
3.2.2.1 -finding "F(L)"			(Corrected by the user)
3.2.2.2 -finding "F(R)"	♦Handles on "F" × 2 face out;		
3.2.2.3 -positioning "F(L)"		♦Both longer sides of "F" × 2 are connected to "E" × 2;	
3.2.2.4 -positioning "F(R)"	♦Both shorter sides of "F" × 2 are connected to "E" × 2;		
3.2.2.5 -fixing "F(L)" onto the end of "E(L)"			
3.2.2.6 -tighten the knobs	♦Knobs are tightened;		
3.2.2.7 -fixing "F(R)" onto the end of "E(R)"			
3.2.2.8 -tighten the knobs			

Table 10. An example of observed errors in the diagnostic testing of the multimedia instruction.

tions are difficult to understand and also very dated. The British standard is relatively new compared to the ISO/ IEC 37. Still it has been out for more than one decade. The guidance on multimedia and digital instructions in these regulations is not sufficient to use. The authors believe that a design process model and an easy guide for producing general product instructions would be very useful and beneficial for instruction designers.

5. Recommendations

To conclude the findings from this research, the authors suggest a design process for instruction planners (Figure 9).

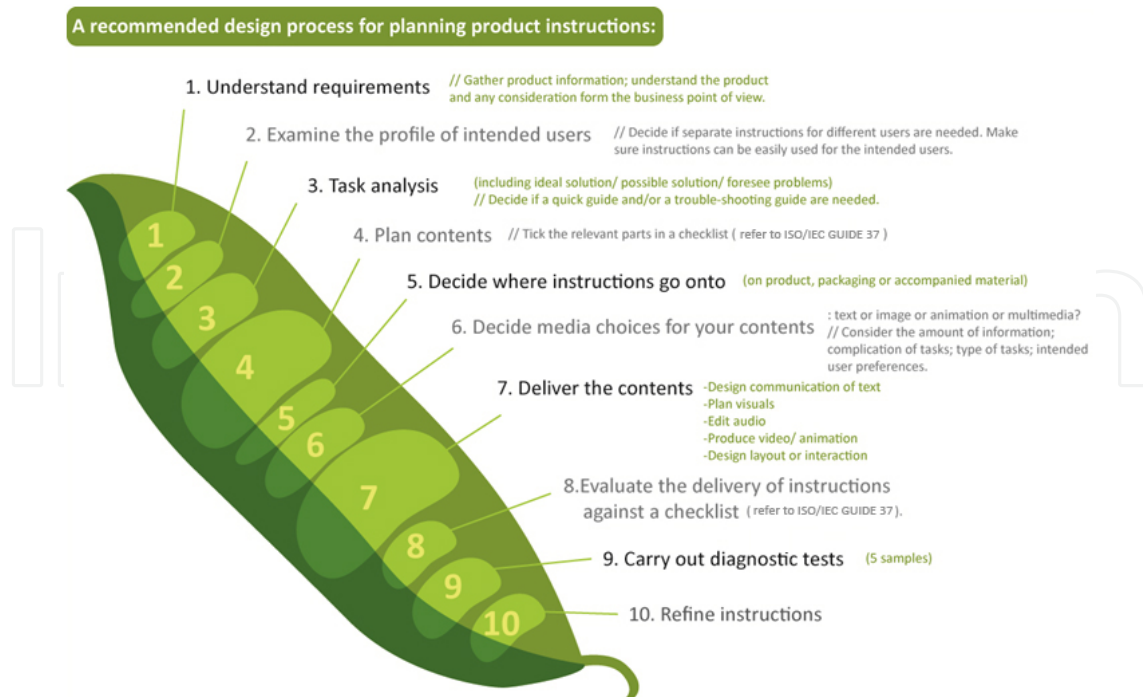


Figure 9. A recommended design process.

This recommended process can be used in combination with the checklist provided by ISO/IEC GUIDE 37 (1995) and the checklist can be updated when the ISO guide is refreshed. It is simple, visual and easy to follow. It should help instruction designers especially those new to planning product instructions. It can also contribute to the development of instruction planning tools.

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