Designing Procedures as a Foundation for Instructions

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Procedures telling users what to do in which situation should not only be accurate and clearly stated; they should also be optimally effective, efficient, transparent and easy to remember. In this paper a set of principles is introduced that help technical communicators to design procedures that meet these four criteria. A key role proves to be played by the sequential order of the instructions.

Introduction

User instructions for consumer electronics, software manuals, brochures about complicated regulations, online help, government forms and instructions on how to fill them out, cookbook recipes, and many other "instructional documents" often contain procedures to enable readers to reach specific goals or to solve specific problems. For the *presentation* of such procedures, technical communicators can rely on specialist textbooks that - at least to a certain extent - are based on theories and empirical research about the way people read, understand and apply textual information, and that provide useful guidelines for presenting instructions verbally and/or graphically. Before procedures can be presented, however, they have to be *designed*. The writer has to decide which steps the reader should perform in which situation, in how much detail each step should be elaborated, and in which order the steps should be arranged. Only after such decisions have been made, matters of presentation (text, tables, pictures, animations) become relevant.

This paper is about basic decisions that have to be made in designing a procedure. Our point of departure is that each procedure that is presented to the reader should meet four basic criteria. They are listed below in decreasing priority.

- The procedure should be *effective*: it should be accurately executable by all (or at least the vast majority of) the intended readers. This criterion is obvious: the instructions should enable the audience to reach their goals.
- The procedure should be *efficient*: it should take the "average reader" as little time and effort as possible. People do not read software manuals and VCR-instructions for pleasure, not even as a way to exercise their brains; neither do they fill out forms for fun.
- The procedure should be *transparent*: it should enable the reader to understand the logic behind the instructions. Transparency gives evidence of respect for the reader, and insight into a given procedure as a whole may help the reader to understand otherwise mysterious instructions that are part of it.

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- The procedure should be *easy to remember*, especially if the task at hand has to be performed often. Many users of consumer electronics and computer software try to avoid consulting the manual as much as possible. Consequently, technical communicators should try to make procedures memorable enough to be recalled after only one reading.

The question now of course is what a technical communicator should do to make his procedures meet these four criteria. Below we will discuss a number of principles that may help with the design of high-quality procedures. We will focus on effectiveness and efficiency, but transparency and learnability will not be completely ignored.

Making procedures effective

Effectiveness is doubtlessly the most important criterion for a procedure. If the readers do not understand what to do and make mistakes in performing their actions, then the other criteria are not relevant any more.

The effectiveness of a procedure is primarily determined by the different instructions which constitute it. The more readers are capable of performing these instructions, the more effective the procedure will be. In practical circumstances, however, a score of 100% may not always be attainable. Sometimes the equipment, the software, or the government regulation is so complicated that it is unrealistic to expect that all readers will be able to follow all the instructions without error. In such a case, it is more realistic to strive for as many users as possible who will understand exactly what to do. Principles that may help the writer to increase a procedure's potential for successful implementation are: (1) adding extra steps, (2) replacing actions by equivalent but easier actions, and (3) improving the order in which the actions must be performed.

Extra steps

Let us start with an example: the operating instructions for a certain video cassette recorder. In the installation part (translated here from Dutch into English) it is stated that:

> The PAL/MESECAM switch should be set to the television color system that will be used during recording:
> - PAL: when PAL-signals are received,
> - MESECAM: when SECAM-signals are received.

The problem here is not that the instructions are incorrect. The problem is that they are incomplete, at least for a reader who is not familiar with the distinction between PAL and (ME)SECAM. Such a reader - and it is no wild guess that there are many of them amongst the buyers of this VCR - is not helped by a translation of the abbreviations into the full words. From the manufacturer's perspective the instruction given may seem sufficient and clear, from the perspective of the consumer (which should also be the perspective of the writer) more information is necessary. What the readers need here is an extra instruction, telling them in concrete and specific terms how they can find out what type of television color system is used in the country where they live. Even better would be to present them with a table where they can look up the required information immediately.

For the sake of clearness: this is not a plea for endless detailing or fragmenting of the instructions in a user's manual. Readers can get bored if not irritated by all too elementary instructions such as "first put the plug into the socket", or by constantly repeated reminders like "after choosing an option from the menu, press the Enter key." Too radical a fragmentation can lead to an unacceptable increase in the length of the final instructional text or form, and an extensively fragmented procedure can lead to a loss of clarity and to a decline in motivation. But since the number of errors in the final result is the sum of the number of errors committed in individual actions, the norm for each instruction should be set really high: for all sub-tasks error-free implementation must be achievable by as many readers as possible.

Equivalent, but easier actions

Suppose a government regulation contains the condition that the applicant's annual taxable income when multiplied by 4.5% may not exceed 43,000 guilders. Furthermore, suppose that the corresponding instructions in a brochure about this regulation are as follows:

Version A:
[1] Calculate your taxable income.
[2] To account for inflation: increase it by 4.5%.
[3] Is the result more than 43,000 guilders?

How obvious and clear this translation of the regulation into instructions for the users may seem, an equivalent but less complicated procedure proves to be possible:

Version B:
[1] Calculate your taxable income.
[2] Is this more than 41,184 guilders?

Leaving out the most difficult step here simplifies the procedure and reduces the risk of calculation errors. An objection that could be voiced is perhaps that the transparency of the procedure might be diminished. Most people reading version A, will accept a rounded-off amount being used as limit, just as they will understand the argument for increasing their income by 4.5%. The information in version B, however, that the income must be less than 41,184 guilders (43,000 / 1.045) will undoubtedly come as a surprise. Since, as stated above, effectiveness is the foremost criterion, in our view reduced transparency should not block the replacement of the original three-step procedure by its simplified version.

Improved order of instructions

Ladies and gentlemen, we are now approaching the railway station Utrecht-Centraal. In Utrecht this train will be split up. Train number 4021 and train number 4041 will proceed to Rotterdam, and train number 2068 will proceed to The Hague. You will find the number of your train above the sliding-door of your compartment.

As elementary as this information may seem, it may raise a problem for travellers. When they start examining the numbers above the sliding-door, many of them may have forgotten which number will take them to Rotterdam and which number to The Hague.

The requirement at stake here can be described as follows: *When the result of an action is required for implementation of another action, the first action should be described before the second one.*

Although this requirement of "first things first" may seem too obvious for words, many instructional documents exist in which this condition is not met. To give some examples: we have come across a government brochure where the income limit was specified before it was explained which income was meant (in this case: the taxable income of the partner earning the most). We have seen directions for putting up a tent where the instruction that plastic rain caps should be put on top of the poles was presented after the moment that the tent had been erected in all its splendour. And finally, we have encountered many procedures where essential instructions that should be put upfront were disguised as warnings that came only after all the other instructions had been presented.

A second requirement should be kept in mind when striving for an effective order of instructions. It stems from the fact that sometimes the outcome of a first action must be remembered while a second action is performed. In such a case, shortening the distance between the two actions may reduce the burden on the reader's memory. The requirement can be stated as follows: *When the result of an action must be remembered for implementation of another action, the distance between the two actions should be as short as possible.*

To illustrate this requirement of minimal memory burden, we give an example inspired by the same Dutch government regulation that we have referred to before.

Version A:
[1] Calculate your income.
[2] Calculate your partner's income.
[3] Add 4.5% to your income.
[4] Add your partner's income to your income (with 4.5% added).

Version B:
[1] Calculate your income.
[2] Add 4.5% to your income.
[3] Calculate your partner's income.
[4] Add your partner's income to your income (with 4.5% added).

In version A, the result of [1] must be remembered until [2] has been completed; likewise the result of [2] must be remembered until [3] has been completed. In version B, only the result of [2] has to be remembered until [3] has been completed; the result of [1] can now immediately be processed. Version B is to be preferred.

The requirement of minimum memory burden cannot simply be translated into the number of instructions that may be presented between the two actions in question. Memory burden is the result of other factors as well. One of these is the difficulty of the intermediate actions. An elaborate calculation in a text about a subsidy scheme will be more of an obstacle to correctly recalling the information than will supplying an answer to a question such as "are you a US citizen?" or "do you have a cd-rom player installed?". Another factor that may attribute to the memory burden is the nature of the

information to be remembered. A rounded-off figure such as 2,000, for instance, will be easier to remember than 2,163.83.

Suppose now that a certain action is only possible after two other actions have been performed, as in the following example.

Version A:
[1] Take 5% of your taxable income.
[2] How many years have you worked for a government body?
[3] Multiply the amount by the number of years worked.

Version B:
[1] How many years have you worked for a government body?
[2] Take 5% of your taxable income.
[3] Multiply the amount by the number of years worked.

It seems a justifiable assumption that most readers will find it easier to remember how long they have worked for the government while calculating 5% of their income, than the other way around. Hence, version B is to be preferred. Putting the instructions in this order 4reduces the memory burden for the user, increases the possibility of a correct application of each instruction, and consequently enhances the effectiveness of the procedure.

Making procedures efficient

Suppose in a personnel recruitment advertisement in a US newspaper, issued by a tourist agency, applicants are encouraged to respond if they meet the following requirements[1]:

[1] the applicants should have some experience in the tourist industry,
[2] and their age should be between 25 and 45,
[3] and they should be familiar with Windows95,
[4] and they should speak impeccable Dutch.

Chances are that many readers interested in the job will be disappointed when arriving at condition [4]. "Why didn't they say that in the first place?" is a natural reaction. And indeed, when [4] is put upfront, it will take the average reader less time to decide whether or not an application might be worthwhile. The reason is simple: with [4] as the first requirement to be encountered, most readers may stop reading with a clear conscience. For them the rest of the text is not interesting any more: they don't speak Dutch, so they don't qualify in any case. For these readers, putting [4] upfront means a reduction of time and effort. There is another group, however, for whom this change in the order of instructions implies an increase in time and effort to be spent: the readers who do speak Dutch, but don't have experience in the tourist industry, or don't have the right age, or cannot work with Windows95. Considering the size of the various groups, it seems probable that all-in-all there is more to be gained than to be lost by changing the order of these instructions.

Let us consider another example. Suppose a regulation of a certain organization states that employees are entitled to an extra allowance under the following conditions:

[1] they should be married,

[2] and they should have children living at home,
[3] and their total net family income over the last two years should not exceed the average income of comparable families in this city,
[4] and they should be over 48.

Again, readers may wonder why the last condition was not mentioned earlier. That would have saved a lot of inquiry and calculation time, time that is now spent in vain by employees younger than 49. For them, condition [4] comes far too late. Apparently, it is not only the size of the groups that determines what - on average - the most efficient order of instructions will be, another important factor is the amount of time that the individual instructions take to follow. What we see at work here, is the "principle of the average least effort": actions should be ordered in such a way that users need a minimum time to come to a decision.

In Jansen & Steehouder (1989; 1996) we have demonstrated in detail how the most efficient order of instructions can be calculated, provided that for each condition in a procedure it is known (or can be estimated) what percentage of the readers meet that condition, and how much time it takes the readers on average to decide whether or not the condition is met. Here, we will not elaborate on this issue - for now it may suffice to state that in order to achieve maximum efficiency:

- procedures should preferably start with the instruction that will take the average reader the shortest time to verify,
- procedures with a conjunctive structure (condition 1 *and* condition 2 *and* condition 3 *and*..) should preferably start with the condition that will probably apply to the smallest part of the audience,
- procedures with a disjunctive structure (condition 1 *or* condition 2 *or* condition 3 *or*..) should preferably start with the condition that will probably apply to the largest part of the audience.

Making procedures transparent and easy to remember

However important effectiveness and efficiency may be, care must be taken that readers can get an adequate idea of what they are involved in, and are capable of remembering what may be important on later occasions. To achieve transparency and learnability:

1. it must be made clear which principles govern the working of the equipment or determine the regulation involved,
2. the broad outlines of the task to be carried must be made apparent,
3. actions referring to the same topic must be dealt with immediately one after the other, so that the reader is able to limit his attention temporarily to that topic
4. the order of the instructions must reflect a didactical approach:
    - basic functions should be dealt with before the more sophisticated possibilities,
    - simple directions should precede more complicated instructions,

- frequent tasks should be introduced before topics that most users will encounter only occasionally,
- the instruction should encourage users to actually do something (and see the results) as quickly as possible.

In practice these requirements may be difficult to achieve simultaneously. To take but one example: a Dutch regulation for obtaining tax remission is built around three factors: material possessions, income and expenditure. To reflect this, the form that applicants have to fill out, is divided into three corresponding parts. But regrettably, this leads to several questions about the same topics being asked in three places. Questions about housing, for instance, occur under material possessions (does the applicant own or rent his house?), as well as under income (does the applicant receive rent subsidy or house purchase subsidy?) and again under expenses (how much does the applicant pay in rent or mortgage interest?). Complying with the first requirement here results in the impossibility for the writer to follow the third requirement: reflecting the regulation in the text rules out discussing each topic only once.

Unfortunately, it is impossible to formulate in general terms which requirement should be given priority in cases like this. The advantages and disadvantages of each option need to be weighed one against the other. Moreover, the value of efforts to improve transparency and learnability cannot be assessed separately from their impact on effectiveness and efficiency. For the present, there is no approach available that writers can follow in order to combine a set of instructions into a procedure that in all respects is "guaranteed to be the best" for the average user. Contributing to such an approach seems an interesting and rewarding challenge for document design researchers.

Note

1. This example is inspired by Landa (1974), who used it to introduce the "principle of average least effort" in a discussion of methods for designing algorithms for the teaching of Russian Grammar.

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