

# The Use of Virtual Models for Training Procedural Tasks

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## Abstract

*This paper reports on a research project investigating the use of virtual models to support the training of maintenance personnel at the company "Hollandse Signaalapparaten B.V.". On the basis of interviews and a literature study an experiment is being planned to investigate appropriate design criteria (leading to effective task performance) for virtual models that are used to train procedural tasks. It is expected that for training simple procedural tasks a simultaneous presentation of information (coaching and virtual model) will be advantageous.*

## 1 Introduction

The use of virtual models in industry is increasing because this method of designing and testing products is relatively quick, inexpensive and safe.

"Hollandse Signaalapparaten B.V.", a Dutch company that produces naval combat systems and trains their customers to operate or maintain these systems also, uses virtual models. The company uses virtual models particularly as means of communication, both between personnel from different departments and between Signaal personnel and their clients.

The department of International Training at Hollandse Signaalapparaten B.V. also wants to make use of these virtual 3D models for training purposes.

Interviews were conducted with instructors at Signaals' in-house training centre to explore the context within which these virtual models were to be used [1].

Based on interview conclusions and a literature study [2], it is hypothesised that using virtual models as individual practice tools may be a safe and cost effective manner to help students master the subject matter. To investigate this hypothesis it is planned to investigate how

to design these three-dimensional models in order to improve task performance.

In this paper we will discuss why it seems useful to do so and what the design of the virtual models should be like.

## 2 Virtual models for training procedural tasks

Procedural tasks are defined as tasks in which the operator has to follow repeated similar actions step by step to achieve a goal. Certain aspects are important for efficient human information processing during training procedural tasks:

- Providing situational context information [3]
- Providing all information of a procedural task in its entirety (whole task practice) [4]
- Providing information exactly when it is needed [4]
- Providing or eliciting motion [5]
- Eliciting active participation to strengthen the link between knowing (declarative knowledge) and doing (procedural knowledge) [6].
- Providing feedback immediately after an action [7]

Virtual models do provide students with situational context information. It is possible to represent the whole system at once in a virtual model while in a corresponding manuals (the working of) systems are described with a series of texts and technical drawings of the separate parts of the system. In addition dynamic virtual models are more compatible with real task performance than the static manuals.

In contrast to these advantages, the use of virtual models for coaching may be problematical. Coaching is more dependent on language than on moving images as a great deal of human communication goes via symbols and signs. The question here is how instruction (which involves theory and practice) can be provided best when making use of virtual models. Should instruction be provided in advance of practising with the 3D models or

should instruction and virtual models be provided simultaneously?

There are several studies that address to the question of whether text should be presented in advance or simultaneously. A study from Benshoof and Hooper, showed that a serial manner of presentation forced students to process information more deeply and accurately, resulting in better task performance [8].

A study that investigated the Parallel Instruction Theory of Min showed that better results were obtained with information presentation on multiple windows than on a single window. The difference between these results and those from the Benshoof and Hooper study is caused by the fact that here learners were dealing with strategy free tasks that were not as memory intensive [13].

Other evidence for the advantage of simultaneous presented information comes from literature about cognitive psychology. Actively associating information as mental images appeared to be a good mnemonic strategy [6].

In short, there are arguments for and against the merging of instruction and practice. These depend on the kind of task and on the type of target group. This and our previous knowledge about the situation at the company led to the design of an experiment to test our expectations. Expectations and the experiment will be described in the next section.

### 3 Designing virtual models for training procedural tasks within the context of Hollandse Signaalapparaten B.V.

A simple procedural task was selected for our experiments. Based on the literature and on the information gained from the interviews it is hypothesised that it is best to present information together with the virtual models as much as possible. This is expected because we are dealing with a simple task [6] in which task performance is required more than knowledge-based problem solving [3] and with a target group with a low entry-level [8]. Therefore it seemed better to support students and to manoeuvre them into an efficient learning situation. This will be done by providing them with appropriate 'just-in-time' information (hints and feedback) during the procedure. It is possible to do this either by pop up texts in a computer program, by auditory instructions or by means of visualisations in a computer program.

*Research design* We will use a between-subjects design where groups of 15 subjects will each be assigned to one of the four conditions. The first condition will be a serial presentation of an instructional text and the virtual model. Conditions 2, 3, and 4 will respectively deal with instruction that is presented within the virtual models:

auditorily, by visual text and by visual imaging. The experiment will be performed by people with a good and people with a low command of the language used in the courses.

*Procedure* Subjects will be given a paper instruction in which they will be asked to study the materials in order to be able to perform a task afterwards. After this they will have to perform the task on the real system. Finally, they will be asked to fill in a questionnaire about the perceived difficulty and their level of satisfaction.

#### *Data Analysis*

The time it takes to perform the task together with the number of failures they made will be scored. A 2 x 4 MANOVA will be performed on these data. Responses to the questionnaires will be summarised, recorded and then classified on the basis of their contents.

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