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Professional vision in simulated environments — Examining professional maritime pilots' performance of work tasks in a full-mission ship simulator

Magnus Hontvedt *

Department of Education and School Development, Vestfold and Buskerud University College, P.O. Box 2243, N-3103 Toensberg, Norway
Department of Educational Research, University of Oslo, PO Box 1092, Blindern, 0317 Oslo, Norway

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ABSTRACT

This paper reports on a qualitative study of professional maritime pilots who used a ship simulator to train for cruise ship navigation in high winds by the use of Azipod propellers. The instructional design of the exercise involves the participants experiencing work-like situations in the simulators and then reflecting on these situations in debriefings. Interaction analysis of the maritime pilots' training showed that simulator training has distinct advantages. However, the detailed analysis of the pilots' issues with the simulator's accuracy also demonstrated that a lack of photorealism and fidelity in the simulator's visual display may have affected the dynamics of the work tasks for which pilots are trained. The results of the analysis showed that the participants' professional perception of work environments — their professional vision — may come in conflict with an instructional strategy to isolate certain elements of the learning objective from the total experience. The article concludes by arguing that the organisation of simulator training must consider whether the degree of fidelity meets the requirements of the situated work tasks and learning objectives, while also attending to the specific nature of the professionals' expertise.

1. Introduction

Maritime pilots belong to a proud profession with strong historical roots. In the field of shipping, they play a crucial role as local guides with extensive knowledge of the waters for which they are certified. Similar to other professional groups for whom mistakes involve considerable danger and cost, maritime pilots frequently use simulators to develop professional expertise in a safe and flexible environment. Thus, simulators are frequently used for training in professional domains such as aviation, shipping and the military. This article reports on observations of maritime pilots' training in full-mission ship simulators and discusses the pros and cons of simulating work activity for learning purposes. Interaction analysis is used to examine videos of actual training (Jordan & Henderson, 1995), allowing the investigation of both the technical and social requirements of successful training.

A simulator can be defined as a 'device that duplicates the essential features of a task situation and provides for direct human operation' (Vincenzi, Wise, Mouloua, & Hancock, 2008, p. 426). The degree to which a simulator matches the characteristics of a real setting is often referred to as the level of simulator fidelity, and the effect of fidelity on learning and instruction has been much debated in the research literature (Dahai, Nikolas, & Dennis, 2008; Krange, Moen, & Ludvigsen, 2012; Rystedt & Sjöblom, 2012). Across various theories of learning, instructional designs have been developed to enhance systematic encounters between situated actions and reflection on action (Kolb, 1984; Schön, 1983; Tuomi-Gröhn & Engeström, 2003). The support for 'authentic' and situated

* Department of Education and School Development, Vestfold and Buskerud University College, P.O. Box 2243, N-3103 Toensberg, Norway.
E-mail address: manh@hbv.no.

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experiences is considered a major advantage of using simulations for training (Baker, Jensen, & Kolb, 1997; Dahai, Nikolas, Elizabeth, & Dennis, 2008; Rystedt, 2002; Salas, Bowers, & Rhodenizer, 1998). However, few studies have investigated the situated practices of simulator training on an interactional level. The present study aims to add to the current body of research by providing an empirical account of the role of simulator fidelity in facilitating 'real' experiences for professionals using ship simulators.

Maritime pilots guide merchant ships through unsafe waterways where local knowledge is crucial for safe navigation. Their ability to lead ships safely in and out of ports solely by orienting visually to elements in their surroundings, such as islands, buoys and landmarks, is characteristic of their profession. Pilots' professional conception of tasks and situations — their professional vision — is shown as vital to how they perceive and perform in a simulated environment. In a study of archaeologists' and lawyers' ways of distinctively seeing and understanding events specific to their professions, Goodwin (1994) defined professional vision as "socially organised ways of seeing and understanding events that are answerable to the distinctive interests of a particular social group" (p. 606). In this case, the ways in which maritime pilots are trained to favour visual lookout in manoeuvring ships can be considered a form of professional vision. By closely examining how the pilots perform tasks, respond to training scenarios and activate their professional experiences, the following analysis seeks to shed light on whether the simulator constitutes a reliable learning environment in which maritime pilots can practise cruise ship manoeuvring. To my knowledge, such issues have not been scrutinised in prior studies of ship simulators. To address this gap, the following research questions are posed:

> How are work tasks re-created and trained for in ship simulator training sessions for maritime pilots?

> How is simulator fidelity related to training objectives and to the participants' professional performance of work tasks?

To answer these research questions, the following analysis investigates instances in which the simulators successfully facilitate a work-like training environment, including encounters with glitches and problems in this socio-technical environment. 'Socio-technical' is used as a descriptive term that encompasses work systems that rely on the joint efforts of human and technological interlocutors. By analysing problems in the simulator training, the analysis will show how small disturbances in the simulator software affect instructional scaffolds and, consequently, participants' learning. The study analyses video recordings of cooperative training activities from a sociocultural learning perspective.

The next section presents a review of the background and prior research on the use of simulators for professional training. The analytical framework will then be outlined before the empirical setting and research design are described. The Results section includes the interaction analysis (Jordan & Henderson, 1995) of five extracts from a training session. The Discussion section considers some possibilities for meeting the opportunities and challenges described in the Empirical setting and research design section.

2. Simulators as a resource for re-creating the socio-technical environment of a ship's bridge

Training within the maritime domain is often focused on meeting training objectives explicated within the cross-disciplinary field of human factors, which is concerned with human performance in technology-saturated environments as well as the ergonomic design of such environments (Vicente, 2003). Several studies have identified human factors that are commonly associated with ship accidents, such as fatigue, lack of situational awareness, lack of teamwork and poor decision-making (Hetherington, Flin, & Mearns, 2006). However, even if the role of human factors in accidents is known, it is not obvious how training to overcome these factors can be effectively accomplished.

Simulators are commonly used for learning technical skill, coordination and teamwork in a safe environment. Existing research shows that simulator training can provide relevant content and scenarios as well as instructional features and opportunities for measuring individual and team performance in several professional domains, such as health, aviation and shipping (Okuda et al., 2009; Salas, Tannenbaum, Kraiger, & Smith-Jentsch, 2012; Salas, Wilson, Burke, & Wightman, 2006; Vincenzi et al., 2008). Within this cross-disciplinary field of simulator training, prior studies have examined crew resource management (Salas et al., 2006), skill acquisition (Ross, 2012; Silvennoinen, Helfenstein, Ruoranen, & Saariluoma, 2012) and the relationship between simulator fidelity and photorealism on one hand and learning on the other (Beaubien & Baker, 2004; Dahlstrom, Dekker, van Winsen, & Nyce, 2009; Vincenzi et al., 2008).

In the field of simulator training, there seems to have been an underlying belief that mere exposure to the physical work environment contributes to the development of competence (Dahlstrom et al., 2009; Salas et al., 1998). Fidelity is often labelled simply as high or low, and such general levels are frequently associated with learning efficiency. The Alessi hypothesis is often cited, which claims that maximum effectiveness in learning can be achieved by training novices in low-fidelity simulators before moving on to more complex tasks in high-fidelity simulators (Alessi, 1988; Dahai et al., 2008). Such claims may provide some useful general principles and guidelines for practitioners, but they do not specifically connect fidelity with training objectives. Unlike these previous studies, the present study focuses on the requirements for fidelity on an interactional level.

Interactional studies of professionals' work enable the researcher to detail aspects of dialogue, gestures and gaze and analyse how types of professional work involve partaking in socio-technical settings. For example, Goodwin (1995) showed how differently positioned actors use spaces and representational technologies to create a common course of action an oceanographic research vessel. Another example of a detailed analysis of such a work system is Heath and Luff (1996), who explicated the collaborative and socio-technical coordination of the line control rooms of the London Underground. Heath and Luff pointed to actors' ability to participate in the coordinating and communicative patterns at work as crucial to success. In a similar line of reasoning, Suchman (1997) portrayed