

Future requirements for the use of virtual simulation at skills, command and strategic levels

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Abstract — Emergency response and management training is challenged by quick changes in society today. Education and training need to develop and adjust at the same pace to make sure the emergency professionals are well prepared. New types of complex incidents and unexpected events can be difficult and expensive to train in realistic live simulations. Virtual simulation offers benefits to complement traditional live simulation training. This paper investigates how virtual simulation can complement live simulation and contribute to the achievement of the necessary learning objectives for three levels of training in emergency response: the skills, the command, and the strategic level. By using Kolb's learning cycle [1] and illustrating problems and benefits in the main steps during training, we present some possibilities of applying virtual simulations to achieve the necessary experiences for learning.

1 Introduction

Live simulation is considered to be the most realistic method of training for firefighting (skills), incident command, and crises management (strategic) training to obtain experience-based training, and by this to be better prepared for real incidents [2]. Live simulation requires physical training fields, buildings and other objects, and realistic scenarios, that is resource (money and time) demanding. One of the main benefits of using virtual simulation for training is the possibility to create experiences in an effective way [3]. This paper investigates how experiences achieved by virtual simulation can complement live simulation.

To investigate the role of virtual simulation for training, this paper first presents the learning cycle defined by Kolb [3] for experiences achieved during the training. Second, it discusses the importance of realistic experiences for each necessary step in the learning cycle for both live and virtual simulation for skills, command and strategic level of emergency management.

2 Experience-based learning and training

Live simulation has been considered the most realistic form of training, aimed to provide a near to real experience within the emergency management area. In order to examine how learning occurs in live simulation, this paper uses the Kolb's learning cycle [3], which highlights the main steps of learning, as a constantly reoccurring process and allows discussing the experiences during a learning situation. This is discussed via experiences, possible engagement and reflections afterward. There are several theories explaining the learning cycle, but all agree on four main steps that a person needs to progress through to achieve learning:

- 1) *Concrete Experience*: the person needs to encounter a new situation or experience that is perceived believable.
- 2) *Reflective Observation*: the person reflects on the concrete experience in parts including aspects that are new or not understood.

- 3) *Abstract Conceptualization*: the person interprets the experience from a hypothesis of the meaning of the experience and can relate to similar situations.
- 4) *Active Experimentation*: the person is allowed to apply the hypothesis, the interpretation, on a new situation.

3 Real-like experiences in training

Now, we illustrate how Kolb's cycle is related to training using live simulation on a physical training field to obtain learning for 1) skills, 2) command and 3) strategic levels.

Firefighters use fire and smoke to train the use of breathing apparatus and real water to extinguish the fire. For incident command, live simulation, tabletop models, videos and photos with animated smoke and fire have been used to enhance the sense of a process or a scenario. For strategic levels, exercises often included maps and blueprints of buildings, etc. but often no video or visual input from the incident scene. This has been considered correct due to the exercise objective of the strategic level, which should not become operative.

Quick changes in society today implies changed and additional methods for training. Less real-life incidents and effective prevention can result in less real work experience. On the other hand, new needs appear, e.g. for handling new materials, new vehicle types, solar panels, antagonistic threats. Incidents are often more complex nowadays, i.e. a fire might not be just a fire, an explosive device could cause it. To be able to handle these situations, training needs to adapt in the same pace as they appear.

3.1 Realistic experiences in live training

To create realistic live simulation suitable environments, realistic buildings, vehicles, and actors etc. are needed. Considering the four stages of Kolb's cycle, the following can be seen as contributing to a learning cycle:

- 1) *Concrete Experience*. While vehicles, injured persons and the fire (sometimes) can be considered real-like, usually the fire behavior and spreading, surroundings and decisions are not real. Due to safety

and environmental regulations, the real fire is limited, i.e. only wood can burn in specific prepared places. The effects of decisions will not be realistic since the fire will go out anyhow and no buildings will burn. Often only cold smoke and no fire can be used. Cold smoke has different characteristics than warm. Therefore, many aspects of live simulation is relying on imagination, i.e. concrete experience cannot be accurate in these aspects.

- 2) *Reflective Observation*. The experiences relay in parts of the setting and feedback described by the instructor. The observation is as realistic as a student can interpret the feedback described by the instructor.
- 3) *Abstract Conceptualization*. The differences between what was real in the experience and the interpreted feedback need to be clear and has an effect on the student's hypothesis on how to act in a similar, real incident.
- 4) *Active Experimentation*. The possibilities to try out the hypothesis, are limited in live simulation due to limited resources.

According to this general discussion about the realism in experiences above, all four steps include unrealistic aspects, relying on verbal descriptions which implies the student's imagination.

For learning in skills, command and strategic management levels, realistic experiences are essential. In skills level, it is necessary that the fire is as realistic as possible, i.e. it is not enough that the fire is real, it also needs to behave realistically, and respond realistically to the extinguishing methods. For command level the scenario, the surrounding and the consequences of decisions need to be realistic, i.e. the student needs to have the concrete experience of the result of her or his decision. For the strategic level, the training needs a whole, a longer lasting scenario with a realistic narrative and resources. Videos and drone footage from a virtual incident scene would contribute to better train and understanding decisions and strategies since this is most likely to be available at an incident today.

3.2 Realistic experiences in virtual training

Virtual simulation can provide adequate experiences during training:

- 1) *Concrete Experience*. Vehicles, buildings, and persons are not real; however, the settings, narratives, and consequences of decisions are built based on real experiences. The fire and heat are not real, but a student needs to behave as it would be real. Consequences of actions need to be theoretically possible. A higher experience can be achieved via simulating things and happenings which are not possible for live training, e.g. by adding new dangerous materials, injuries people to the old scenario. By practicing the same basic scenario with variations, a better contextual understanding of situations can be achieved, since this changed situation may require new, adequate commands and decision making.

- 2) *Reflective Observation*. Observations entirely based on the student's experience, with or without input from instructors. Both realistic and abstract simulations may contribute to this. The role of instructors and the ability to design a supportive scenario for these observations are important here.
- 3) *Abstract Conceptualization*. The student can rely on a realistic scenario, even though the heat of the fire was absent. Augmenting reality (by adding abstract information, documents, meta information about situations) may contribute to a better understanding of the overall case.
- 4) *Active Experimentation*. It is possible to let the student try the hypothesis in the exact same or similar scenario in minutes, by restarting it. All actions can be recorded, to support an after action review or discussion.

4 Summary and future work

Both live simulation and virtual simulation are needed to achieve realistic experiences for emergency management students. In some respect, both have, differently realistic and not realistic aspects. In this paper, we have tried to show how virtual simulation complements live simulation for skills, command and strategic level training. It is essential that the virtual simulations are developed systematically with continuity through the different steps cycle, several times for all skills and command objectives, etc. to enable a learning spiral [5], where learning is transferred to and from similar and dissimilar contexts.

Our study implies the need of more experience on how to combining the use of virtual simulation on skills, incident command, and strategic levels, for rescue service as well as for the three agencies in multiagency exercises. However, more studies on methods on achieving continuity between the necessary educational levels, and supporting the implementation process, are needed. It is not as simple as buying new hardware and software, but needs to be prepared to integrate it into learning methods and goals.

References

- [1] Kolb, D. A. *Experiential learning: Experience as the source of learning and development*, Prentice-Hall, New Jersey. (1984)
- [2] Sandleben, O. *How Firefighters Learn on the Job*. *Fire Engineering*, Vol 155, No. 8, p 109.(2002)
- [3] C. Hammar Wijkmark, I. Heldal. *Kartläggning av State-of-the-art inom Simulering och Serious Games för Utbildning för Räddningstjänsten*, Report at Univ. of Skövde, School of Inf., Sweden. (2015).
- [4] Kolb, A.Y., Kolb, D., Passarelli, A., Sharma, G. *On Becoming an Experiential Educator. The Educator Role Profile*. *Simulation Gaming*, 45, (2), 204-234. (2014)