The ROI of Simulation-Based Training vs Live Training of Incident Commanders

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Abstract — This paper discusses how computer simulation training (CST) can complete live simulation training (LST) via an experimental study. The examples come from a class of incident commanders (ICs) from rescue services allowed to train a similar scenario in LST and CST. The results show benefits but also current limitations of the CST based on evaluations from learners and instructors. Many general benefits, showed by earlier research about CST argues for allowing higher experiences, to train unwanted or otherwise impossible situations, a more robust training possibility, and lower costs, were acknowledged by this study. Moreover, the learners' attitude were surprisingly positive to virtual training. Currently, the main limitation of introducing CST is the worry that CST will replace LST training, and lack of knowledge and experience on how to complement other training forms with CST training. In relation to design influence, the photorealism of the objects and interactions is not necessarily the most important factor contributing to high experiences, in contrary to the belief of many hesitating users.

1 Introduction

Incident commanders (ICs) usually learn in classrooms, on the training fields (via live simulation training, LST) and gain experiences through real life works in the field. LST is the traditional method, especially for beginners to obtain experience-based training. During the last decade, for achieving high experiences, several organizations responsible for firefighter education reported unique benefits of computer simulation training (CST). Examples are: training unwanted or otherwise impossible situations, a more robust training possibility, increased amount of training or lower costs. However, there are organizations hesitating to adopt CST, even if they have access to it (Hammar Wijkmark and Heldal 2015). In order to examine the benefits and limitations of CSTs in comparison with LSTs for ICs, an experimental study was designed.

This study aimed to answer the following three research questions:

1) Can CST replace LST?
2) What are the main values of CST, for learners and instructors?
3) How the design of a CST scenario may support or disturb training? Here we focused on the photorealism of scenarios, objects, and people.

These questions are interesting, since there are several obvious similarities and differences between CST and LST. Similarities can relate to the similar learning goals, and performance of certain tasks. Differences are more, due to the different experiences in live or virtual, the nature of the different settings, elements of representations (e.g. humidity, smoke, heat, weight), activities performed during the tasks (e.g. acting in a field or with a game pad or joystick), but also the possible outcomes may vary. While LST requires physical training fields with real objects, CST requires computers, licenses.

Both training methods are resource demanding, but in different ways. While both require dedicated instructors and careful plans; the plans to carry out and examine in LSTs need different competencies and support than similar training and examination in CSTs (Lamb, Boosman et al. 2015). One and the same organization needs different rules for implementing educations with LST or applying CSTs (Fomin, Heldal et al. 2018). Many organizations responsible for planning educational activities have developed great methods and tools to include LST in their educational activities, but questioned if LST is enough to train for several new challenges and risks in today's society (Heldal and Hammar 2017).

This paper presents an experimental study examining a class of ICs performing basic tasks to train the role of an IC, here to manage activities around a house fire. According to our knowledge, this is the first systematic approach of comparing LST and CST. By using observations, questionnaires and interviews with learners and their instructors, the results illustrates a few example on ROI of the two different simulation-based training methods.

2 Experimental study design

Observations and interviews were planned to collect data from two classes of IC students and their teachers. The classes were at the same level, in the beginning of the IC education. The first class trained only with LST and the second class with LST and CST. The first part examined LST to inform the design of a CST with corresponding learning goals.

The studies took place at the training field at the Swedish Civil Contingencies Agency (MSB) in Sandö, three days in September 2017 and a week in October 2017. The training objectives for this part of the IC education was focused on the IC role and managing the initial stages of an incident, from receiving the call, arriving on scene, risk assessment, report and set orders etc. The LST was planned to allow a learner to act as an IC, first on scene, with a team of three-four more experienced firefighter students. After each LST an after action review (AR) was performed. From this class six different students and their

ARs were observed and questions important to this study were added after the end of each AR.

After the first occasion a virtual environment supporting the same type of learning goals in CST was designed. This environment included more actors (avatars with several roles and expressions) involved in the case, e.g. victims, bystanders, and journalists. The basic narrative for the incident, was the same. From this class eleven different students and their AR were observed, and the learners and their six instructors were interviewed. These instructors were not instructors in the CST, but they were observers during the study. They had not planned or conducted CSTs before. The length of the LST and CST varied between 20-40 minutes, and each interview lasted 10-15 minutes per student after each training situation, and an additional 10 minute at the end. The interviews with the instructors lasted approximately one hour. This abstract reports a summative comparison of the results of CST and LST training.

3 ROI of virtual training

The IC learners on basic level in Sweden have, 2-5 LST planned in their education. Our first step was to investigate what an LST/person costs, and if the 2-5 training occasions can be enough for preparedness? Similarly we investigated the CST/person costs based on data from this study.

Considering all the important elements that has to be trained, for this LST, the cost of LST/person was 2922 SEK (approx. 300 Euro), based on a list from managers responsible for trainings. The list included price for objects, time for exercise, instructors time, property usage, people involved, objects for ensuring realism, and cleaning up after the fire etc. The corresponding CST/person cost was calculated to be 1563 SEK (approx. 165 Euro), including computer and additional technologies, needed technical support, time to construct the scenario, instructors' time, costs for licenses etc.

To answer the question "*Can CST replace LST training?*" both learners and instructors answered "*no*". However, all 11 students and six instructors acknowledged the added value of CST training, and wished to use CST training for their everyday preparedness. Three learners, not willing to participate in the study from the beginning, but tried out CST during their free-time at an open session during the evening, wished to participate later. However, we not include this data in the current result.

Thus, if CST do not replace LST what should motivate for the extra investments? And: What exactly would be needed for better training? Most of learners enjoyed CST for the possibility to train in more various incidents, with several occasions. Having journalists, pedestrians involved in the case, and not only one or two persons, as in LST was considered to contribute to more realism of the scenario. According to the learners the CST would be especially beneficial to use in the fire stations, allowing a better understanding of the role and responsibility of the ICs, not only from the ICs, but also from their fellow firefighters. Another motivation to use CSTs is that the cost (CST/training) would decrease the more training sessions is used for and the flexibility and variation of scenarios is high. By having more scenarios better shaped for e.g. training firefighting, command and strategy levels in varying incidents can result in less cost per training for CST, but would not change the cost per training for LST. For certain situations planning a LST is not even possible.

To answer the question "*What is the main value of CST, for learners and for instructors?*" most of the interviews (with ICs and instructors) acknowledged the possibility to train in scenarios similar to real incidents, both for CST and LST. For CST this means often recurring incidents that are trained in LST, but opening up the possibilities to train in incident that are not possible in LST.

For certain situations, speaking with human-like avatars or having photorealistic vehicles, lifelike simulations were considered important. The realism of a scenario were not experienced the same as the photorealism of environments and objects, according to the interviews. Even if many of the current limitations regards the not proper representations in CST, these were not hindered high presence, i.e. experiencing training as training at a real place with real objects. Accurate representations of environments, facial expressions and proper details does not necessary contributes to a better problem understanding, according to interviews both with the learners and their instructors. However, important signs that contribute to the understanding the situation, i.e. spread or direction of smoke, people around the fire, were considered more important than the photorealism of the buildings, flames or avatars. According to the comment of one learner, a virtual simulation should provide basic training in a scenario, and prepare for comparable scenarios, not exactly similar ones. Since ICs need to learn to generalize a training session to many other similar incidents, the realism of a CST should be focused more on the realism of the important signs leading forward the activities in the narrative, and not the details of the narrative. Therefore, a part of the answer to the question "*How design related issues of CST may support or disturb training*?" is that photorealism is not the most important feature. Supporting situation awareness in a scenario is not necessarily having exact match of buildings, people and objects, issues always coming up when new people see virtual simulations for the first time.

3 Conclusions

To prepare for the surprising, uncommon or unfamiliar situations, the next step needs to come from using CST. For this the better involvement of the instructors in the scenario design, and the exploration of how CST can complete current training would be beneficial.

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