Simulation-Based Learning

General

Simulation-based learning is a constructivist learning model that provides learners with an experience of working on an usually simplified **simulated world or system**. This approach, widely adopted in military and aviation "*to maximize training safety and minimize risk*"[1], is today used extensively, especially in the medical education.

What is simulation-based learning?

A simulation can be defined as a model of reality reflecting some or all of its properties. Robert Gagne identified the following properties of a simulation as crucial[2]:

- *A simulation represents a real situation in which operations are carried out.*
- *A simulation provides the user with certain controls over the problem or situation.*
- *A simulation omits certain distracting variables irrelevant or unimportant for the particular instructional goals.* Simulation = (Reality) - (Task irrelevant elements)

Simulation-based learning today mostly relies on usage of computers and advanced technologies to provide a near authentic experience for the user and enhance learning. As a learning tool, simulations mostly rely on some other learning theory and implement its principles.

Yet what is characteristic for simulation-based learning is the discovery that system representations are often to complex and difficult for a novice to facilitate his learning. Even though principles of human cognitive structure and methods of reducing cognitive load were taken into account while designing a simulation, it has been shown that learners are still frequently unable to successfully relate multiple representation elements to each other. This issue can be described in the context of prior knowledge as well.[3] Two successful ways of dealing with this issue have been proposed so far:

- **active integration** of representations[4] into complex system by the learner (for example link names of the elements to their symbol representations)[5], and
- **model progression**, or starting with a simple simulation models and then slowly increasing their complexity[6][7].

Simulation-based learning can also be guided or unguided, yet research has shown that instructional help in form of hypotheses to prove, offered interpretations, assignments to complete or structuring can be useful[8][9][10].

What is the practical meaning of simulation-based learning?

Simulation-based learning **examples** can today often be found in medical [11], physics[12], biology[13] education and other fields as well and the results were positive[14]. An example of this is "Harvey", a cardiology patient simulator. A recent study[15] has further showed the superiority of simulation-based learning to problem-based learning (also applied in medicine schools) in case of learning of critical

assessment and management skills.

Criticisms

Many previous studies in this area found that, at least for **novice learners**, simulation-based learning is hard and that they have problems in establishing goals and their results in learning through simulation[16)17)] or that they have **problems with verbalizing** results and gained knowledge[18)]. It seemed that richness of the information a student can extract from a simulation makes his **learning more difficult** unless it is first simplified and well structured.

Keywords and most important names

- **Simulation-based leaning**
- Ton de Jong

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