LEARNING BY SIMULATING IN VOCATIONAL EDUCATION

Pre-study

ABSTRACT

The aim of this pre-study is to explore the concept of simulation and how simulation-based learning can strengthen the development of the students´ skills and how it can be used in the ensemble of various pedagogical methods in vocational education. It can be said that vocational education is one of the environments that has been most disrupted and changed due to the extraordinary circumstances during the Covid19-pandemic. To the vocational education provider Adult Education Taitaja this challenge was the catalyst for change and strongly boosted the use of digital learning and VR-technology.

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1 A digital leap boosted by the pandemic

In both vocational and higher education, the goal of education is to prepare students for their future professions and working life. Therefore, their professional competencies should involve a range of complex skills. To be able to make professional decisions and implement solutions students should in addition to domain-specific knowledge and skills learn important soft skills e.g., critical thinking, problem solving, communication and collaboration. Also, the ability to flexibly use various digital application is one of the essential working life skills and therefore students must during their studies be prepared for this.

Year 2020 will be remembered as the year of the pandemic and distance learning. It can be said that vocational education is one of the environments that has been most disrupted and changed due to the extraordinary circumstances. To the vocational education provider Adult Education Taitaja this challenge was the catalyst for change and strongly boosted the use of digital learning and VR-technology. Luckily, the development of distance learning and digital pedagogy had been a few years ago recognized to be one of the strategic focuses and development objectives of Taitaja and therefore, the process was already going on when the pandemic hit the Finnish society.

Teachers are at the core of the change process and changing the mindset of teachers starts with the institution's management and how the management technically and pedagogically facilitates and supports teachers. Additionally, it must be made clear that everyone is expected to use the digital learning environment, and no one can choose not to participate in the 'digital leap'.

During the process of teaching totally based on distance learning, the teachers learned that by thinking out of the box, they could at least to some extent teach almost any course remotely, even those that usually requires students to practice in professional learning environment e.g., a workshop, building site or kitchen.

The biggest challenges were:

- The technical problems: Students in some cases were not able to get online. Passwords were lost or forgotten. Some of the students did not have sufficient digital equipment for distance learning. To tackle this Taitaja provided students with the necessary tools - laptop, iPad, headset, and the applications. Also, continuous technical support for students was offered. Additionally, the students needed instructions and guidance on the etiquette of digital learning e.g., how to use the camera during teams/Zoom lessons, how to use the microphone and mute function and how to pay respect to the fellow students.
- Some of the teachers were hesitant to start using the digital learning environment. It is obvious that if the teacher feels insecure or uncomfortable, this will trickle down to the students. Therefore, continuous technical and pedagogical support for the teachers was offered by two “support teachers”.
- The digital learning environment must not be used only to deliver Word or PDF documents. It must offer multi-faced activities for the students. To support this the “support teachers” also give ideas and instructions on how to use the various functions in the digital learning environment and how to design motivating activities. Also, best practices were shared through the intranet of Taitaja.
- Zoom or Teams must not be used as a channel for the teacher´s “monologue” but as an interactive platform for discussions. Breakout rooms should be used to facilitate group work and project learning. At Taitaja also the students are regarded as co-builders of knowledge by sharing their experience and presenting their own learning outcomes.

The next significant digital leap will be how to use simulation-based learning more efficiently and more diversely and to evaluate it´s usability and the learning outcomes. In this pre-study simulations are reviewed in the context of vocational education and working life and the focus is pedagogical rather than technical. The aim of the pre-study is to explore how simulation-based learning can strengthen the development of the students´ skills and how it can be used in the ensemble of various pedagogical methods.

2 Definition of simulation

In brief, simulations mean an imitation of reality and simulation techniques vary from simple acting to life-size and technologically complex simulators e.g., in aviation, healthcare and logistics. Gaba (2004, 5) classifies simulations in three categories based on the technology required:

- In actual physical reality using a mannequin: ‘‘mannequin-based simulation’’ e.g., in first aid training manikins and rescue manikins in hot works training.
- On a computer screen: a ‘‘screen-based simulation’’ e.g., virtual patients, virtual worlds, screen-based haptic trainers, and resource management simulators.
- Using virtual reality: a VR-simulation by which parts or all of the object and environment are presented to the user through two or three dimensional visual and audio representations. A VR-simulation can be made with or without touch (haptics) to create a more immersive experience.

Sokolowski (2011) has divided simulations into live, virtual, and constructive forms. In live simulations real people use real equipment, but outside the context of a real event. A virtual simulation consists of real people using simulated equipment. Constructive simulation involves simulated people working with a simulated system. According to Sokolowski these three simulation forms can also be combined to produce a simulation environment.

Simulation is a technique, not a technology, to replace or amplify real, often immersive experiences with guided experiences, that evoke or replicate substantial aspects of the real world in a fully interactive way. Immersive means that participants are being immersed in a task or setting as they would if it were the real world e.g., on a workplace. Experience shows that participants in immersive simulations easily speak and act much as they do in their real jobs. (Gaba 2004, 1.) According to Keskitalo, Kangas and Ruokamo (2018, 2316) simulation is closely connected to play and playful activities.

3 Simulation-based learning experience, SBLE

In educational context simulation is a technique to replace real experiences with guided experiences in a safe learning environment. By simulating, learners can take defined roles and act in a hands-on and heads-on way in a professional context. Simulation-based learning allows the working life reality to be brought into the educational institutions. (Chernikova, Heitzmann, Stadler, Holzberger, Seidel, & Fischer 2020, 6.) This is particularly beneficial for students who are not yet familiar with the professional operating environments. By simulation-based learning they can get an immersive experience of e.g., the hazards of a building site or production plant that are otherwise closed from the entrance of outsiders. This immersive experience will make the students better prepared for e.g., on-the-job training periods and help them understand the operational processes.

Simulation is a method for pursuing practical thinking and operational competence especially in vocational fields in which safety plays an important role. It can also be utilized as a pedagogic method in various professional fields to achieve efficiently the work-related core competence already during the education. (Poikela 2012, 11.) Playfulness appears in simulation-based learning mainly by emphasising trust and encouraging collaboration, as well as academic curiosity and a playful attitude (Keskitalo et. al. 2018, 2321).

Several research results indicate that if the simulation requires the coordinated use of different mental modes and abilities e.g., motor, and sensory skills together with reasoning, the learning outcomes are larger than in simulations that require the involvement of fewer skills. It is also very interesting to note that even simulations with low authenticity have large benefits, exceeding those of many other forms of instruction. This is encouraging since high-authenticity simulations are often very expensive and time-consuming to build. At least for learners with some experience of the real situation, a reduced low-authenticity version might work equally well as a high authenticity simulation. (Chernikova et al. 2020, 25.)

New technologies and ICT applications have made it possible for teachers to quite easily design their own simulation-based learning experiences based on VR- and AR-reality. According to the experience gained at Adult Education Taitaja, this is a cost-effective way to design new learning experiences. For teachers, the software is easy and flexible to use

and design strongly working life-oriented learning experiences. In the students´ perspective especially the screen-based VR-simulations seem to be particularly user friendly because they can be used with various device e.g., computer, iPad and smart phone and it possible for the student to practice independently of time and place. This aspect also strongly supports the individualized learning paths and enables lifelong learning which are characteristic to the Finnish vocational education.

4 Problem based learning (PBL) as a foundation on simulation pedagogy

Pedagogically, simulation-based learning resembles case-based or problem-based learning, where the learning is organised around a specific case (Keskitalo et al. 2018, 2316) and according to Chernikova et al. (2020, 28) a well-designed simulation-based learning experience should include elements of problem-based learning. In today´s working life most of the professions include solving diverse problems caused by unexpected factors. Therefore, in education, it is important to instead of just distributing knowledge to develop the students´ ability to analyze, diagnose, understand the cause and effect, make conclusions, collaborate, and evaluate various phenomenon. According to Poikela and Poikela (2012, 10), in comparison to conventional pedagogy, PBL has four fundamental differences:

1. Instead of learning contents, learning is organized around problems based on real working life.
2. Learning is based on guided knowledge processing in tutorials and independent knowledge retrieval that is carried out individually or in small groups between the tutorial sessions.
3. Continuous reflection, feedback and mutual assessment are a permanent aspect of learning. Guidance and process evaluation is very significant in the production of learning and competence and transparency is expected of product assessment criteria.
4. Education that is based on the logic of problem-solving requires support from an integrated curriculum that is based on a multisectoral and multidisciplinary approach.

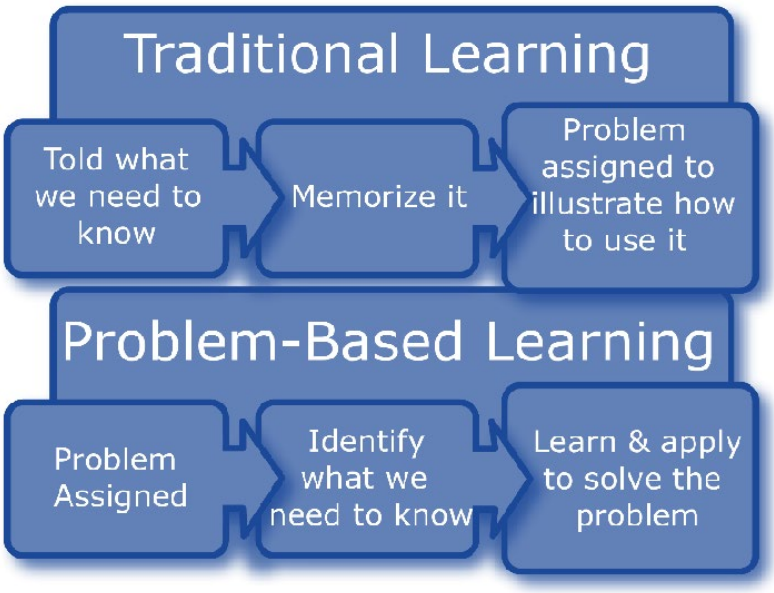

Figure 1. Comparison between traditional learning and problem-based learning (Rossiter, Kinahan & Henderson 2020)

5 Simulation-based learning in the whole of the pedagogical approach and curricula design

Simulation-based learning can start early in study programmes because it works well for both beginners and advanced learners. The effect of simulation is greatly enhanced by the recent technologies. According to resent research, higher levels of authenticity are related to greater effects while learning in both familiar and unfamiliar contexts. It is worth noting, that higher levels of authenticity do not necessarily involve the use of recent technologies but rather more precise design of a simulation-based learning environment. (Chernikova et al. 2020, 28 - 29.) From the students' point of view, simulation-based learning brings variation to studies, complements theory, and promotes peer learning (Niemi, Kräkin & Saarinen 2019, 2810). The wider use of simulation to support learning and the development of the basics of simulation-based learning and teaching show that the gap between work and education is becoming narrower. The challenges of simulation-based pedagogy are related to the development of future professionals, to the renewal of the communicative, social, and technical practices of work and the work organization and to the solutions that make use of both the society and working life. (Poikela 2012, 28.) Because the key aim of simulation-based learning is working life authenticity and teachers are the designers of the learning experiences, it is important that teachers have close

connections with the industry and the industry participates in the process. Actually, in simulation-based learning the teacher is no longer at the center of the learning process but becomes a facilitator and supporter of the students´ actions.

Facilitators should overcome their own fears related to teaching in the simulation environment. (Keskitalo 2015, 54). Hence it is important that the facilitators have access to user-friendly digital tools to create simulation-based learning experiences and the necessary technical support during the design and implementation. Based on her research findings Keskitalo (2015, 73 – 74) summarizes the main points to be considered in both design and implementation of simulation-based learning:

- Teaching approaches may vary, but in SBLEs the most essential thing is the facilitation of students' learning.
- Simulation based learning requires well-prepared and knowledgeable facilitators.
- Learning is a multifaceted phenomenon but is seen here mostly as an active and student-centered process.
- Educational institutions and teachers should be attentive to differing views about teaching and learning.
- Students, especially adult learners, have high expectations of activities involving simulation-based learning.
- Small groups are more suitable for simulation-based learning than large ones.
- Learning within simulations can be considered inherently meaningful.
- Students' individuality and expectations of learning through simulations need to be addressed.
- Setting general learning objectives as well as individual learning goals is important.
- Evaluating and reflecting on the learning objectives of the course, as well as on the students' individual learning goals, are a crucial part of the learning process.

All innovators and developers of learning must move a step forward from what has been done before. All tools that support learning need to involve inquiry, especially those based on information and communication technology. (Poikela, Ruokamo & Teräs 2015, 381.) In areas such as engineering, science, technology, mathematics, and management, new generations of employees will require to daily deal with increasingly complex systems that are characterized by their large scale and the number of interactions among their

components, as well as their levels of uncertainty and dynamism. Hence, it becomes necessary to train students accordingly and provide them with the analytical skills that they will need when designing, implementing, and using these systems. Simulation education software, tools, and games constitute an excellent methodological option to support the teachers/facilitators during the training process since simulation facilitates the utilization of realistic models that students can use during their learning activities. Among the numerous benefits provided by digital simulation-based learning experiences, their easy integration within blended and online courses is a fact that promotes their expansion and popularity among educational institutions at all levels. (Campos, Nogal, Caliz & Angel 2020.)

Simulation-based learning has large positive overall effects on the advancement of a broad range of complex skills and across a broad range of different domains in higher education. The size of the effect of simulations on learning exceeds the expectedly large influence of the learners' prior knowledge. The effect size is still very large when simulation-based learning is compared with different kinds of instruction instead of "real" control groups, including waiting controls. One of the strengths of simulation-based learning is that it can give the learners timely feedback in the context of complex authentic activities. Simulated problems may be tailored to the needs of learners as an approximation of practice and are thus probably often more effective than real practice. For example, communication skills are frequently facilitated through role plays, whereas technical performance is frequently addressed by using a simulator or virtual reality. Therefore, we would like to emphasize that the simulation type should not be viewed independently of target skills and instructional support quality. The type of simulation depends a lot on the learning context but providing different types of simulations can be beneficial across domains. (Chernikova et. al. 2020, 522.)

6 Discussion

The pandemic in 2020 – 2021 forced the teachers in vocational education to experiment new dimensions of digital learning. At Taitaja the pedagogical innovations were boosted by the pandemic. It forced the teachers and students to do things differently. Although the situation was stressful, it also gave a sense of achievement when the teachers were able to reach the “next level” in distance learning and create new ways to teach. Good learning seems to be a combination of meaningful use of diverse learning environments and learning methods. As a result, and conclusion of the various pedagogical experiments in various fields of education, it can be stated that in vocational education a balanced combination of innovatively constructed distance learning, online and traditional contact teaching, simulations, and practical hands-on exercises in the actual vocational environments (at school or on-the-job learning) is probably the best way to teach and learn.

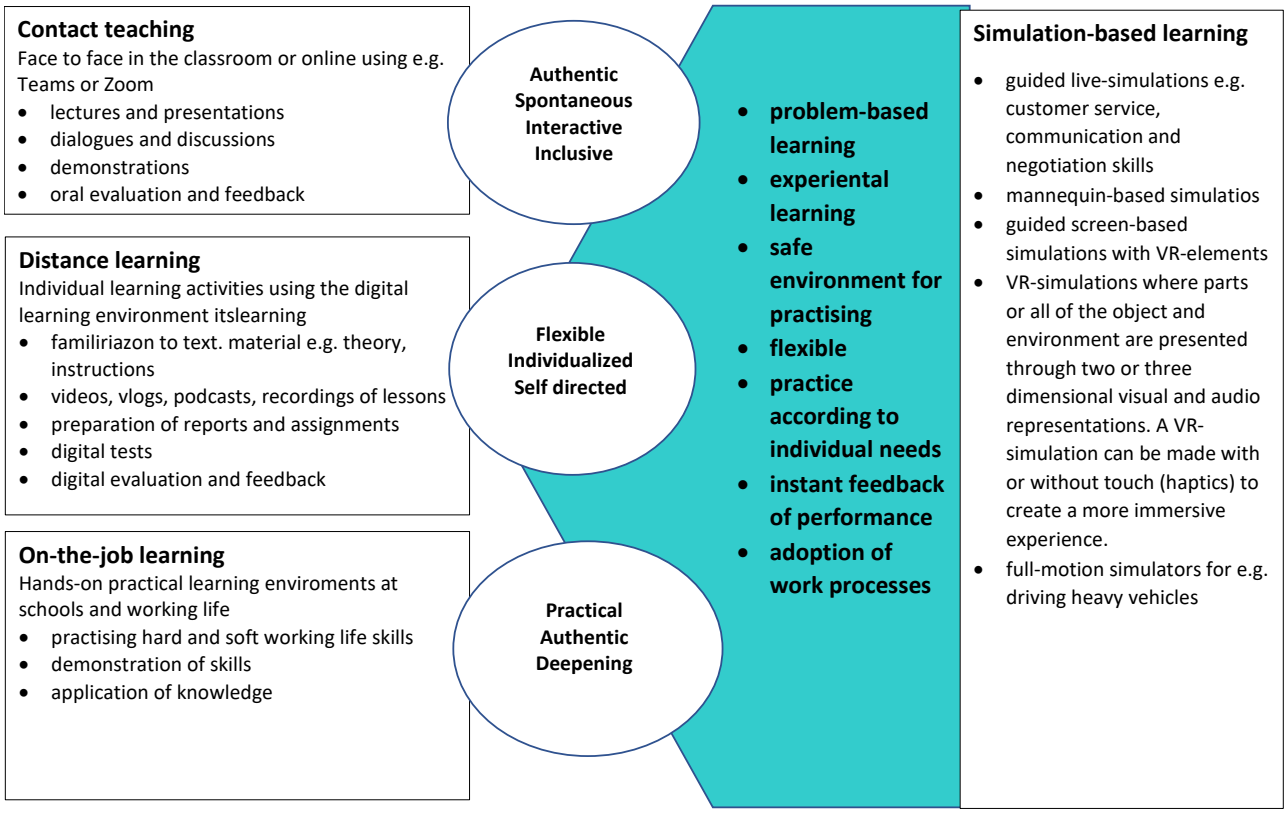

Figure 2 Better learning with diverse learning environments and methods

Simulation-based learning and VR-technology form an effective pedagogical tool in the entirety, especially in vocational education. It´s significance will increase in the coming years. The most approachable and interesting form of simulation-based learning and teaching are the VR- and screen-based learning experiences that can be flexibly designed by teachers. Simulation-based learning offers the possibility to develop practical and theoretical skills simultaneously for comprehensive action and the “knowing” of professionals. It allows students to train and experiment in a safe and controlled environment, avoiding the possibility of damage to themselves and expensive equipment. Simulations make it possible for the students to learn regardless of time or place and facilitates individually targeted activities. By using simulations students can easier understand the performance and relationship between different parts of the system or work process. It can be used to assess performance and competency of individuals and teams.

Simulation-based learning in various digital learning environments also offers and interesting possibility for international co-operation between educational institutions, teachers, and students. It can form a foundation for digital cross border learning centers as a part of international curricula design and sharing best practices between partnering countries. The cross boarder learning centers also offer an interesting platform for the industry to participate in international co-operation. According to Campos et al. (2020) simulation-based labs can be used by students located in different countries, universities, and degrees. In addition to specific professional skills this will according to Campos et al. facilitate the development of interdisciplinary skills, teamwork abilities, and multi-cultural learning processes.

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