Improvement of the Learning Environment at an International Multicultural Company through the Assessment of Relevant Methodology and Technology Goals

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Abstract. "Open Teaching & Learning" in a University/academic environment becomes increasingly more important and needs to be designed in the most efficient and effective way to ensure a balanced return-on-investment. This issue is of particular importance when it comes to complex learning areas.

In this context, the paper addresses opportunities applying new learning technologies within a multi-disciplinary and multi-cultural environment to improve the efficiency and effectiveness of training.

This paper presents an in-depth analysis of state-of-the-art learning methodologies (knowledge transfer process) to ensure a higher learning engagement of all employees, taking into consideration function, age, culture and technological abilities.

The results arising from this paper will identify the pedagogic and business impact of an individualized application of a knowledge transfer strategy.

After a review of literature on the subject, the paper concludes with a proposal of the optimal knowledge transfer strategy. This strategy is to be integrated into the existing pedagogic provisions of a multi-disciplinary / multi-cultural R&D (learning) environment of a global PTS company. The strategy can also be used in an academic environment to aid problem solving and engineering knowledge transfer.

1 INTRODUCTION

Learning is a lifetime task. Especially today, facing the challenge that worldwide knowledge doubles every 7 years, the knowledge development of a workforce is of enormous importance for companies and organizations.

Mega Trends influence social life through technologies (e.g. Digitalization) and irrevocable tendencies (e.g. Urbanization). Knowledge, and therewith intelligence, is ubiquitous via mobile access to the world-wide web. All this affects the way people live and learn.

To ensure the best return-on-investment when investing into the personal development of staff, enterprises apply modern training methods to train their employees that are frequently spread all over the world. In the past, most training was delivered in a classroom. However, an increasing number of mixed training versions are offered. To ensure efficient & effective training, a number of factors must be seriously considered.

2 LEARNING

Even though more technology for learning is becoming available, the main principles remain the same regardless of what people or environment is involved. People still respond to the principles of adult education: *Learners need to be engaged. Learners need to be able to apply their learning. Learners are essentially motivated.*

It is important that the teaching material directly relates to each learner of the entire group, regardless of whether the learning is self-paced or through group events. A learning experience that is directly related to the learning goal of a learner ensures that the learner finds it easier to remember and recall in the future. [1]

With reference to the development of a learning program, it is essential that each learner is motivated and engaged with a personal benefit. It is important that each learner is able to make his/her own effect.

The fundamental needs of adult learning are summarized by the *Principles of Andagogy* [2].

- *Adults must want to learn*
- *Adults will only learn what they think they need to learn*
- *Adults learn by doing*
- *Adult learning is focused on solving problems*
- *The experience an adult has can affect there learning*
- *Adults learn best in an informal situation*
- *Adults expect to be considered as an equal partner in the process*

It has to be considered that this theory is described as a general approach and therefore can vary depending on the individual learner and the individual's background [3].

Generally, learning can be categorized into four types:

- *Auditory Learning,*
- *Visual Learning,*
- *Haptic Learning and*
- *Intellectual Learning,*

Auditory, visual, and haptic learning are somewhat related. They all focus on perceptions and inputs that come through the same type of nerve cord. Intellectual learning is different in its receptive channel.

Bloom's Taxonomy splits types of learning into the following levels:

- *Remembering (Recall or recognition of an expression.)*
- *Comprehension (Understanding of facts. Ability to organize them and bring into relation.)*
- *Application (Deeper understanding. Use/apply information for related problem solving.)*
- *Analyzing (Break-up information into smaller chunks, organize them and relate them together.)*
- *Synthesizing (Ability to structure patterns from given/known information. Develop ideas and critical doubts about the subject.)*
- *Evaluating (Ability to take in external information and relate your knowledge to them to make decisions.*

These levels work in a hierarchical order with *Evaluation* as the highest level of understanding, and *Remembering* as the lowest level. This categorization is important for the development of learning goals. They help to write the training outline and apply the learning results evaluation method to the group of learners [4].

3 TRAINING CONTENT

Based on the fact that learning can be described as a transformation process, the following model shows the important interactions within the learning process [5]:

Figure 1 - Transformation Model

Cognitive learning is the intended, or sometimes unintended, process to gain knowledge (perception, imagination, thinking, judging, language), and it starts on the day a human being is born. Over the course of time, every person develops specific skills and cognitive structures (knowledge structure) which are built through cognitive processes.

In a professional work environment, it is essential to prepare the workforce for the specific tasks that have to be fulfilled by a project. The learning portfolio of companies and organizations typically consists of - but is not limited to - the following topics [6, 7]:

- *Language skills (especially important in multi-national & global enterprises)*
- *Craftsmanly topics (skilled occupation, manual competence)*
- *Skills in all regards of Information Technology (e.g. application know-how of a specific software, general skills to be able to operate with computing devices or IT data security)*
- *So-called excellence factors like exponential thinking, self-learn/self-reflection competence, customer orientation, data smart, capability to adopt change, responsibility, information scouting & investigation, problem solving, process analysis, design thinking, agile, and user experience*
- *Soft skills (e.g. conflict management, motivation)*
- *Communication and presentation skills*
- *General management skills (e.g. instance business models, economics, and project management)*

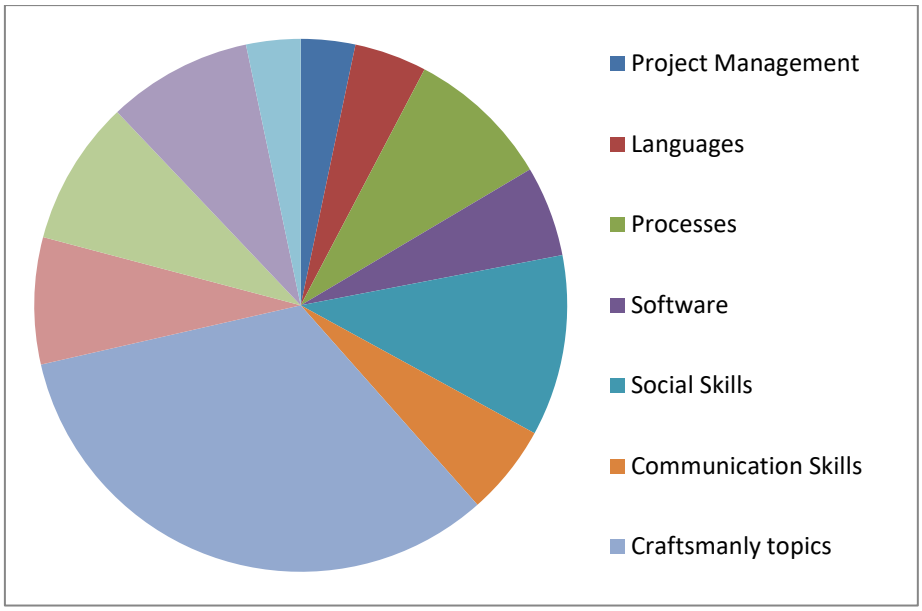

Figure 2 – Training share (analysis of training portfolio of thyssenkrupp Elevator)

Therein the value stream (in a company or workplace) and the individual learning process have to be synchronized to ensure effectiveness.

4 INSTRUCTOR-LED-TRAINING VS. ALTERNATIVES

Instructor-led-training or ILT is the classic and most common practice of training between an instructor (or teacher or facilitator) and a learner. This learning process can happen in a group or individually. The instructor is referred to as knowledgeable and experienced in the specific learning topic. Ideally, the instructor has certain skills and the ability to deliver the content or material to the learners and to apply different methods to occupy learners and to include different learning styles.

The training is typically delivered in a lecture (a classroom format) format, but can also be delivered in alternative formats such as interactive workshops (demonstrations which offers learners the chance to practice) or through virtual tools such as real-time video conferences. Mobile training trucks/busses offer mobile physical classrooms and allow the equipment to be moved to where it is needed.

This ILT represents, in general, 2/3 of corporate training and development programs [8], while more and more alternatives to ILT appear on the horizon of teaching & learning. This shift is enabled by evolving technology, ubiquity knowledge (Mega Trend), increasing number of mobile devices, growing share of digital natives, and the fast increase of computational power.

As of today, the most common alternative forms of training are as listed and defined in the following table:

Alternative learning format	Definition
Uncontrolled on-site training	On-the-job training where the learner gains informal knowledge from co-workers.
eLearning [9]	No clear definition existing. However, eLearning refers to learning experiences that use technology such as videos or web-based training (specific user interfaces).
Videocasts	Basically classroom training that was recorded on video

	and can be viewed by a learner anytime, anywhere.
Massive Open Online Course (MOOC)	Free online seminars on university level that have a huge number of participants.
Physical simulator training	Environment that copies a real-life situation (e.g.: elevator shafts in steel frames that allow group training).
Augmented reality / Virtual reality / Mixed reality training	Immersion of learners into a simulated facility giving them an experience similar to real life. Benefits: The trainee can be placed in simulated environments that would be potentially dangerous to simulate in real life. No need for a simulation facility to undergo the training. Multiple people can be trained at the same time. Different trainees can interact with one another as well as the instructor. Transport a learner to a different location.
Micro Learning	Smaller chunks of training content, generally available 24/7 via mobile applications to allow access anywhere & anytime.
Blended learning [9]	Mixed learning formats (e.g.: literature + video tape of a classroom lecture + web-based knowledge control).

Table 1 – Types of learning formats

Amongst these examples, self-directed training, which is a specific form of training, allows learners to assume responsibility of their own training (e.g. selecting content, defining right timing, and choosing the suitable delivery form).

An open learning environment (OLE) is a customer-centered system that applies design principles and considers learning activities that "support the individual's efforts to understand what he or she determines to be important" [10]. OLEs put emphasis on the self-directed learning of a learner, but also provide guidance and support to the learner when needed. This allows learners to be effectively involved into complex problem solving.

Organized, or formal, learning strategies such as workshops, certification courses, or long hour training sessions, will have different impacts on learners as opposed to those of informal learning strategies which can include mentoring, tutoring and self-directed learning. Both of these methods are valid learning environments but one or the other can be more useful depending on each situation.

Individual learning also has a main benefit derived from the core concept of being done individually as it will take less time to set-up lessons.

5 TECHNOLOGY IN LEARNING

These learning environments can be implemented online to allow for distance learning. Individual learning especially benefits from this, as there are multiple Learning Management Systems (LMS) available that can have entire training courses implemented online for individuals. Collaborative learning can also be done online. However, this tends to be more difficult as individuals have different time availabilities. Technology can help to solve these challenges.

A huge variety of technologies are available that support the learning, and therewith the learner's transformation process. Successful technologies in learning consider the principles of learning as described in section 2 LEARNING and are briefly introduced in section 4 INSTRUCTOR-LED-TRAINING VS. ALTERNATIVES. The latest Learning Management Systems (LMS) combine all facets of training & learning. Amongst the function to manage training events and track learners' progress, these systems offer a comprehensive collection of all kinds of different training types, such as

- *Mobile applications for mobile phones, computers and tablets*
- *eLearning*
- *Video*
- *Micro learning (smaller chunks at a time)*
- *Gamification*
- *Coaching functionality*
- *Tailored functional (e.g. engineering) training*
- *Implemented Virtual/Augmented/Mixed Reality training*
- *Artificial intelligence (this technology enables the system to form user-specific learning material, e.g. individual questions)*

Therein, the LMSs consider the need for personalized individual learning, social learning (learning with others). They make distance and OLEs available for enterprises and accessible for each learner any time and everywhere. This is especially important as the younger generation of learners (so-called Digital Natives) is very dependent on technology and will more likely participate in the learning journey if it can be used easily with their personal devices.

6 FACTORS OF SUCCESSFUL OPEN LEARNING ENVIRONMENTS

Without a doubt, it all starts with good pedagogy. However, there are few other factors that influence the success of learning [11]:

- *Engaged students (who are motivated, curious and ask good questions)*
- *Multiple different methods of teaching should be used individual, collaborative, lecture, group to group, etc.*
- *A constant opportunity to practice what's been learned.*
- *Fun*
- *Everyone's different work style has to be accounted for. There are online assessments such as Kolbe and other sources that can be used to get an idea of different peoples working styles so that they can be matched with a suitable training program.*
- *Expectations of the employee have to be made clear initially. This also goes for the person in charge of training, the trainee's expectations of them should be known.*
- *Progress check-ins need to be regularly made to an agreed schedule.*
- *The trainer needs to consistently ask questions.*
- *The key to effective training is communication, knowing the trainee's thoughts throughout the training process will help to adjust the training plan so that the trainee is involved and is learning quickly.*

Because of increasing diversity in workplace it is necessary to put trainees in situations that they would be unaccustomed to in their own culture. This can help to ease an employee when introduced to these situations in the workplace.

7 BENEFITS OF DIGITAL TRAINING FOR THE COMPANY AND LEARNER

Based on latest pedagogic research results, modern learning environments are open (observe and learn from others) and offer flexible access to learning resources. The benefits of modern learning environments include, but are not limited to [12, 13]:

- *Flexibility (The learner can choose time and place of study.)*
- *Efficacy (Easy access to information.)*
- *Social contact (Support relations between learners.)*
- *Cost effective (No need for travel. No need to provide buildings and physical environments.)*
- *Consideration of learning style and individual differences between learners*
- *Self-paced (Each learned studies at own pace. That increases the learners' satisfaction and motivation.)*

8 PRACTICAL EXAMPLES (OF PTS INDUSTRY)

8.1 TSG T6001-2007 "Examination Requirements for Safety Administrator and Operators of Elevators"

In 2007, the Chinese government published a requirement document TSG T6001-2007 "Examination Requirements for Safety Administrator and Operators of Elevator" to compile all necessary know-how to inspect and operate an elevator in a safe manner. Based on this and the listed requirements, an interactive learning model has been developed by the company Zhejiang Provincial Special Equipment Inspection and Research Institute, Hangzhou, PRC. The system modules follow the general structure of an elevator, its main parts, a standard installation method, and the system operation principle.

The learning tool combines different learning methodologies, from text reading to multimedia, and considers two basic roles: Operator/Worker and Safety Manager/Inspector [14].

Function module		Function description	Expression form
Safety management personnel	Theory	introduce the relevant knowledge of the elevator by graphics, animation, video	Graphics, animation, video
		Consult the statute	PDF document
	Skill operation	Review of the security management knowledge document	WORD、PDF document
		Check the actual operation	Video, animation
Driver	Theory knowledge	introduce the system and components of elevator with graphics and 3D simulation	Graphics, simulation
	Skill operation	Introduction operation with video, graphics, animation Using simulation operation process	Video, animation, Graphics, simulation
Installation and maintenance personnel	Theory knowledge	describe the basic knowledge with graphics	Graphics
		explain professional knowledge with animation	animation
		Consult the statute	PDF document
	Skill operation	Provide engineering drawings and circuit diagrams	Two dimensional drawing
		Introduction operation with video, graphics, animation Using simulation operation process	Video, animation, Graphics, simulation

Figure 3 – Learning methodology vs. system function [14]

8.2 3D Virtual Reality Elevator

A Singapore-based company[1] developed and distributes an advanced browser-based interactive 3D virtual software platform for public education and other purposes.
Platform product features are:

- *3D Online Product Display*
- *3D Instructional Product Installation and Disassembly*
- *overall Product Training*

The intended user group includes vendors, agents, internal staff, end users, operators, and other trainees. The system allows users to remotely view elevator product demos to provide a specific experience for them, since the main application of the VR training tool is to learn the operations and maintenance functionality of the elevator system. Aside from elevators, the platform is used for showcases and training demos for different industries, such as Automotive, IT, Architecture, Electronics, and Logistics [15].

Figure 4 – Screenshot of user interface for architects [15]

8.3 Immersive Reality and Service & Maintenance Application

The learning organization of a German-based elevator manufacturer[2] uses many different kinds of learning methodologies to teach & develop internal staff. Amongst others, eLearning, video lectures and games to learn about safety at work in a fun mode are implemented.
Under the umbrella of the strategic partnership with a California-based software company, the application of a mixed reality glasses demonstrates the benefit of modern electronic devices for the success of training & learning [16].

Their VR Research application is a headset solution that transports the user into an immersive reality world (for research application: CAD only elevator & escalator systems to demonstrate new

[1] Phoenix OneSoft Ltd.
[2] thyssenkrupp Elevator AG

designs and functionalities). That VR headset[3] tracks the movement of the user's head in real time (Steam VR Tracking) and offers a high resolution display with a field of view of 110°. The intuitive command navigation and haptic feedback completes the immersive feeling.

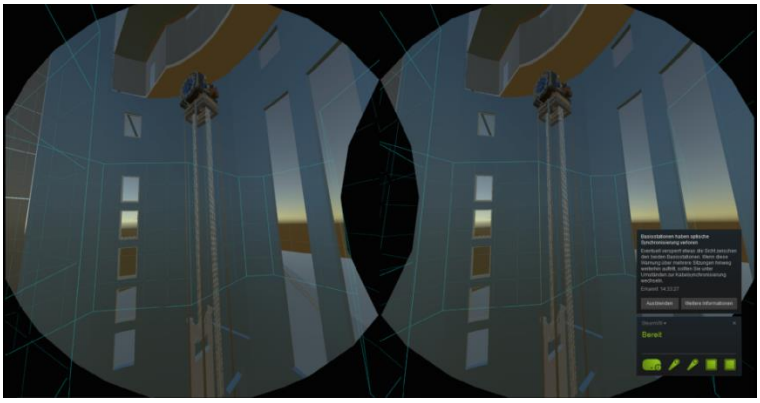

Figure 5 – Virtual Reality glasses screenshot of elevator system

Figure 6 – Mixed Reality application for maintenance training (illustration)

9 CONCLUSION

The foundation for any good training, whether it is delivered in a classroom or via an eLearning tool, is a solid pedagogic model that relates content & learner.

Modern learning environments are learner-centric and offer the opportunity for the learner to engage with other learners and a supporting function (e.g. teacher or mentor). The learner-centricity considers the different aspects of learning style, knowledge status, available time and learning pace.

Without a doubt, the efficacy of OLEs is enormous, and digital learning technologies provide huge opportunities to organizations to create digital learning assets and can be categorized based on the training format. These can be all sorts of eLearning modules such as videos, podcasts, webinars or PDF literature. Blended or mixed formats show the best learning effect.

[3] HTC Vive

Within the coming years, technology innovations and the huge demand for a wide variety of learning methods are going to make customized and user-centralized training a necessity.

The future will prove the destiny of OLEs and Micro Learning applications. New advancements in technology may even create new types of Micro Learning.

As a consequence, training should no longer be seen as a single isolated event, but more as an ongoing activity which provides learning and development opportunities for employees to their demand. Supported by the right piece of technology, training is even more efficient and therefore repays investment into time and money.

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BIOGRAPHICAL DETAILS

Thomas Ehrl, thyssenkrupp Elevator Innovation GmbH, Germany

Married since 1999, one son of 15 years

Mechanical Design Engineer (degree in 1994), Part-time PhD student with the School of Science and Technology of The University of Northampton. Professional career started in 1994.

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Interests:

Travelling, sports, soccer, music, vintage English motor cycles.