EXPERIENCES WITH INNOVATIVE TOOLS AND SERVICES FOR VOCATIONAL EDUCATION AND TRAINING IN QUALITY ASSURANCE

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Abstract

The article report work related to designing, developing and introducing product- and process oriented training methods within the quality assurance sector in Norway, Hungary and Romania, as well as the plastic welding sector in Hungary, Slovakia and Slovenia, is reported. The article discusses use of on web-based student response services in vocational education and training related to industrial production processes.

Keywords: Activity Based Training, Student Response Systems, mobile learning, quality assurance training, welding

1 INTRODUCTION

As a teacher, when disseminating knowledge to large groups, feedback from the students is important. To get this feedback from large groups in an effective way is not so easy since a lot of students don’t like the idea of speaking in large groups and hence tends to become silent and non communicative. Student response systems have been introduced and been demonstrated [1,2] as an effective tool to obtain communication between a teacher and a large group of students. Our SRS system [3] has been designed as a tool for the teacher to get response from students using their own cell phone, iPod or Laptop, without commercial clickers and software. Students can participate using any device capable of reading a web page as a response device. Since the tool is supposed to be used during a teaching session, it has to be simple, easy and fast. Any technical problem, or difficulties that the teacher has in the classroom, will cause a set of secondary problems and disturb the communication. We have done a lot of work in designing the software such that it is entering the arena in a natural way without disturbing the teaching, and rather enhance communication. The tool should not disturb the way that the teacher is usually working and be in conflict with the regular teaching.

This paper aims at disseminating and raising the awareness of using SRS in new product and process oriented learning and training environment [4]. It offers flexible and sound pedagogical delivery of level specific manufacturing industry Quality Assurance (QA) production process training to VET schools and SME organizations in Romania, Hungary, Sweden and Norway [5].

Response system technologies are going to be used in education of plastic welders in Hungary, Slovakia and Slovenia [5], in order to address an important general issue within the processes of lifelong learning and upgrading of skills: How to efficiently transfer advanced production process knowledge to students who are looking for a profession which to a large extent has required practical training with a minimum of theoretical education and where the students have limited knowledge of mathematics? This is of particular importance in the plastic welding industry where failures related to incorrect operating procedures result in complex repairs and increasing life cycle costs. In this sector the new pedagogical method mixes

- Cases from industrial manufacturing
- Problem based learning methods where theory and practice are closely interconnected
- New video solutions on modern, widely accessible and easy to use digital blackboards.

This approach is completely new in training in the plastic welding sector in Slovenia, Slovakia and Norway, and implements modern learning tools into the training processes.

Thus, use of SRS provides new methods for delivering in-company skills upgrading processes that reduce the costs related to competence and knowledge transfer, and enhances production competence and know-how transfer to VET schools. This includes:
• Education of QA VET instructors as Product Oriented learning environment advisers, as well to instructors that educate plastic welders
• Disseminate an innovative transfer system for in-company QA training of personnel, delivered on a just-in-time basis without distance limitations by utilizing video and brand new mobile learning technologies that utilize Student Response Technologies

2 INTRODUCTION TO THE RESPONSE SYSTEM

When the system was designed it was with the idea of having a complete digital classroom. Teacher can have a minimal solution of a computer with a projector, wireless network in the room and students with a device capable of reading and submitting data through a web form. The SRS-Control Interface was designed for use on digital blackboards, where the operation is easy and possible to use without leaving the blackboard. Any unnecessary steps away from the blackboard, to a computer mouse or keyboard, are disturbing and not optimal when teaching is in focus.

The control interface is designed such that when the teacher has logged in, the system is called used and hidden with a finger touch from the teacher. Teachers are like anyone else, have their favorite authoring tools and work with different subjects. For some subjects it's natural to teach with PowerPoint as a tool, some prefer writing on a blackboard or digital blackboard, some use pdf documents created with any tool. To design a response system that meet these requirements means that the system needs to be independent of what the teacher/presenter use as a presenting tool. If the software should interact with the presenting tool, it would typically limit the teacher to use PowerPoint. This will however limit those that teach subjects that don't fit naturally, like technical and mathematical subjects where equations appear often. This is the reason that SRS-CI was designed to work independently of the tool used to present the subject. It will work with PowerPoint, Prezi, Latex, PDF or any presentation tool.

To keep the control software independent of the presentation tool is also useful if the teacher gets an idea and spontaneously creates a question where he/she wants some response. He or she can write the question on the blackboard and use SRS to get feedback at that instant. The question does not have to be prepared before the presentation.

To get a response, a presenter normally asks a question, either to check that students are following, to check if they know the subject, or if they like the subject. The question can be of technical nature with graphs and equations, figures or a movie, sound file and so on. By also leaving the response system independent on what kind of question you ask to some extent, the possible types of questions is less limited by the tool and you can leave it to the teachers imagination and fantasy, how to use the system and what kinds of questions to ask. If the system were to contain the questions, this would typically limit the teacher to use PowerPoint. Going beyond and add equations and figures, would generate a lot of additional work and end up with a project spending time on creating a question editing tool that does not make sense. We designed the system in such a way that any presenting tool can be used to present the question. The weak point here is that the questions and the responses are not linked. Dependent on purpose, this might be a weak point with the design.

The system in general is requiring a classroom with a wireless network. Students need voting devices. This can be any device capable of reading a web page. Students has mobile phones, iPods, iPads and laptops with them, and in the future web is a common platform to reach an interactive arena with students through many devices. It has been a key issue not to develop an application specified for Android, Apple or any other cell phone, because you limit access to many who does not have access to the right application for their device. By keeping the student interface at a pure HTML format, opens up for students to use existing tools when responding. Web gives access to the system without investing in voting devices, and opens up new possibilities for creativity in using the system.

A major advantage of having a system developed by support from the European Commission is for research purposes. With our software we can store and do research on the data material, when students do the voting, what order the responses arrive and so on. Each response is tagged and logged and can be retrieved if needed. As a part of this research activity, we have added a forwarding system in the SRS solution, as a tool to use web forms for evaluation and questionnaire. When we
have tested something and want asynchronous feedback, we can immediately forward the students to a webpage where we have a Google Form or a Quest Back form, where the students give their opinion or answers. It is a quick way of performing evaluation of the system that we have used extensively.

The wireless network needs access to the SRS server and the teacher controller needs access to the same server. So in general you need

- A room with easy access to WiFi network.
- Each responder or group of responders needs a voting device.
- Teacher needs a computer with control software and a projector presenting and communicating the questions to the responders.

3 THE NEW LEARNING METHODS

The DO-IT project raises awareness and makes use of Activity Based Training (ABT) in combination with use of response system technologies, within the field of quality assurance. This includes using new methods for delivering in-company processes that aim at upgrading skills, which again lead to reduced costs related to the transfer of competence and knowledge. It also enhances the transfer of competence to Vocational Education and Training schools and includes the use of an innovative transfer system for quality assurance training of personnel. This system is delivered on a just-in-time basis without any distance limitations by utilizing video transmissions and brand new mobile and interactive student response systems on iPod Touch and iPhone.

The new learning methods mix and merge the following components into one competence transfer model:

- Specification of a product that is delivered to the students as an order
- A pedagogical tool that utilizes ABT to produce a product by following the industrial production flow of an object in such a way that theoretical training is directly connected to practice.
- Onsite training.
- Self paced on-line education, and high quality instructional video of learning material to institutes, SME and VET schools. The training method promotes the use of modern learning tools in quality assurance and quality management training.

At the end of a course, the students have produced a product based up on specifications provided through an order. During the course they will need to learn more theory based up on the specifications in the order, and the practical problem solving process where they must decide in which sequence they are going to produce the components and afterwards assemble them. Quality assurance is integrated into the education model, since the students must check the ingoing and outgoing quality of their products during the production process. Video is used as a facilitator for initiating discussions based up on cases that are illustrated by use of cases that illustrate HOW to DO, as well as HOW NOT to DO. The DO-IT project are extending the results from the Mecca project, which applied ABT only on the production process, by also utilizing ABT in the quality assurance process training.

4 EXPERIENCES OBTAINED WHEN USING SRS IN INSTRUCTOR TRAINING

Today classes are quite large, often with more than 60 students per class. Due to time constraints, it’s often not possible for the lecturer to interact directly with the students during the lecture. Furthermore, many students find it difficult or embarrassing to ask questions in class; which reduces the level of student-teacher interaction even further. Because of the lack of feedback during class, it’s difficult for the lecturer to assess how many of the students actually follow and understand what’s being taught. Conversely, from the students’ perspective, their understanding of the material is rarely put to the test during class – such tests usually take the form of written assignments and exercises, which are corrected and returned weeks later. In other words, neither the teacher nor the students have a good “real-time” indicator of learning effect.

Again, because of time constraints, the students are rarely given time to discuss and interact with each other during class. If a student finds it hard to understand what’s being taught in class, it is therefore difficult to gauge whether he or she is the only one who doesn’t follow the proceedings. A normal class lasts 45-60 minutes. Cognitive research indicates that attention wanes dramatically after
about 20 minutes, which would indicate that unless the students are allowed some pause for thought, a significant portion of the curriculum is lost on the students during class.

The main objective of the SRS is to address these issues; in particular:

- Break the monotony of a lecture and allow the students to actively take part in the lecture
- Increase teacher-student interaction
- Give both teacher and students “real-time” feedback on learning effect

The SRS consists of two main components: the handheld units, which the students use to submit a response during a voting session; and a server. The server has three main tasks:

- Set up the handheld units prior to the vote by uploading the voting interface to each unit (i.e. buttons “A”, “B”, “C” etc. corresponding to the selected vote type)
- Collect the response from each handheld unit
- Processes the data to create graphical representations of how the students voted

The handheld units use a wireless Internet connection to communicate with the server.

The SRS can be used within a multitude of methodical and educational approaches. Two approaches are of particular interest, both of which have been tested by us:

- Letting the students discuss 2-3 minutes between themselves in groups before doing a voting session
- Peer instruction: each student first has to think individually through the quiz question before casting a vote. Once the vote is cast (and the results of the vote is shown to the students), a group discussion ensues, during which each student has to argue his or her position to the rest of the group. After the group discussion another vote is held, and the results between the two voting sessions can be compared

A typical SRS session runs as follows:

- Handheld units are distributed to the students (preferably before the class starts)
- The students are presented with a multiple-choice quiz question, where only one alternative correct
- The students are given time to discuss between themselves (in the peer instruction paradigm, they are given time to think through the question individually first)
- From a web interface, the teacher starts the voting session (a timer/countdown mechanism can be used, if desired)
- Each student casts a vote as to what the correct answer is, using the handheld unit
- The vote closes and the results are shown to the students in the form of an histogram
- The instructor will comment the various alternatives and highlight the correct one – explaining thoroughly why it’s the correct one; and why the other ones are incorrect
- The lecture proceeds as normal

During an instructor training course in Miskolc in April 2011, 6 teachers, 2 researchers, one technician, one decision maker, and 4 others participated (7 men and 7 women). The average age was 38.3 years. 14% rated the first impression of the SRS as excellent, while 86% rated it as very good. 71% believed that the SRS was very easy to use, while 21% believed it was easy to use. After the course, 93% believed that the SRS can be a positive contribution to an ordinary teaching session. On the other hand, 78% pointed out that economical factors would be the main limiting factor for adopting the system in VET in Hungary. 85% of the people attending that course believed that they may use the system after a one day instructor training course in a class. It was also pointed out by the instructor training class, that the SRS should be developed further to handle tests, assignments and examinations.

Multiple-choice questions in combination with use of student response systems may be used to stimulate in-class discussions [7-8] where for instance students may learn from each other. A typical example is peer-instruction based learning processes where the student starts by figuring out a solution them self, and then vote on the alternative they have selected. Afterwards they participate in a discussion where they argue for what they believe is the correct alternative. At the end they vote once more, and the results are shown on the blackboard.

Use of response systems help teachers and instructors to
• Activate the students in order to avoid passive listening
• Improve learning of course content by promoting engagement during a lecture
• Promote a training environment where students collaborate and learn form each other by initiating discussions
• Motivate and encourage every student to participate in class learning activities
• Create a learning and raining space where all students may participate anonymously, whereby those students that don't raise their hands my express their opinions and thoughts
• Check up if students understand what the teacher is teaching during class
• Use teaching methods which adapts and reflect to what students absorb during the lecture
• Improve the storytelling by introducing a small gaming element where each student wait with expectations in order to observe how their classmates answered

5 RESULTS AND DISCUSSION

The new mobile learning environment and the product oriented training model close the traditional gap between VET training and the industrial production process workflow. The methods are generic, whereby they are applicable to European wide manufacturing industry sectors (fabrication industries, VET schools and SME’s). They facilitate an innovative solution for cost- and time effective transfer of industrial production process know-how and technology knowledge to SME at a just-in-time basis. Using mobile devices or laptop computers, both in the classroom or at distance, trainers can start discussions or introduce evaluation moments to the group of trainees, and get their participation and feedback instantly. The SRS provides new pedagogical methods [9-11] that enhance interactive teaching models by enhancing communication and instructional feedback loops. Collected data is immediately available to the trainer, both in a qualitative and quantitative way, allowing the trainer to understand if the learning outcomes of the trainees are in line with the overall training objectives. SRS mainly supports multiple-choice questions, but teachers can sample extensive data regarding their students’ knowledge that is otherwise hard to obtain.

The new mobile learning environment, and the product- and process-oriented training model contribute to close the traditional gap between VET training and the industrial production process workflow. The methods are generic, whereby they are applicable to European wide manufacturing industry sectors (fabrication industries, VET schools and SME’s). They facilitate an innovative solution for cost- and time effective transfer of industrial production process know-how and technology knowledge to SME at a just-in-time basis.

Based on the feedback we’ve received, it’s critically important for the students that the teacher

• Thoroughly explains what the correct alternative was, and why
• Puts a lot of effort into stimulating the discussion between the students – in some classes, the discussion can be a bit heavy-going unless the teacher aids the process along. This problem is exacerbated if the students don’t know each other very well

Based on this information, it’s possible for trainers to make decisions on the fly during the course of the sessions and introduce adjustments to their initial training session plan, aiming the trainee’s full achievement of the learning objectives/competences. Experience on testing this system has shown that this methodology:

• Increases the level of participation of the trainees (close to 100%);
• Significant higher engagement, it become fun to attend courses;
• Results in higher levels of motivation, both for trainees and trainers.
• Reduces the use of “paper” training materials in organizations thus contributing to more “environment friendly organizations”;
• It’s “user-friendly” making it very easy and fast to publish and operate evaluation questionnaires within seconds, and to collect “treated data” immediately;
• Increases flexibility: it’s possible to use it to start discussions and as support tool for group discussion or for evaluation purposes (of on going training evaluation, trainers evaluation, impact of training evaluation, trainees learning outcomes, etc)

The training methods specify training tasks, while the technologies used have to be adapted to the production processes inside the company. In this way the technology and production process available inside the company, become the standard of the training provided to a class. The starting
approach is an order from a company that supports and produces a value for the training in form of defining a final, completed product. It starts with placing an order inside the school or class, and ends with the receipt of the agreed product by the customer. The training process can be subdivided into a number of work orders that describe the individual production tasks and activities in detail. It must include a description of the sequences and individual work steps, thus describing how work tasks should be carried out. The learning tasks will have a sequential structure, such that the students can acquire the relevant and required knowledge through their own studies and work. Each learning step provide the preconditions for the next either it is theory or practice. The system with work orders always prescribes the sequence in which the tasks and exercises are going to be dealt with.

The Activity Based Training in combination with use of SRS, are going to be implemented and evaluated in a number of courses in Norway, Romania, Slovakia, Slovenia and Hungary during the period 2010 to 2011. By implementing a strategy for inclusion of practical experience of quality assurance and quality control, it is expected that it is going to stimulate the students, and give them a new practical dimension in their educational framework by use of cases that utilizes problem-based training. This includes mastering specific technologies and manufacturing methods, as well as industrial work processes that are part of the production environment.

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