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Innovative Training Solutions for Quality Managers

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Abstract

This paper presents the design of a pedagogical methodology for training of quality managers by employment of Activity Based Training (ABT) and Student Response System (SRS). The recent developments and results obtained during pilot testing of the new pedagogical models and services are presented. It is demonstrated the professional training by means of ABT learning environment, employing a generalised quality assurance process in an organization. It makes training experiential allowing for periods of reflection. Trainees' outcomes are evaluated with SRS that are an integrated component of the course. The research results and practical issues deduced from the implementation phase demonstrate the quality of feedback from trainees, the effectiveness of the different discussion methods, some logistical considerations, timed versus non-timed voting sessions, the instructor's role in explaining the alternatives of a quiz and the main problems that may become drawbacks of the evaluation system.

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Keywords: activity based training; student response system; mobile device; vocational education and training; quality managers

1. Introduction

It is expected that instructors in vocational education training (VET) courses to provide more than lecturing, by structuring the components of the curriculum into a system, thus establishing a suitable learning environment where evaluation activities are integrated in order to encourage the study paths.

The learning results are obtained through stimulating, enjoyable and engaging good lectures, which utilize interactive learning methods that enhance learning. One way of obtaining such an approach is by providing examples of the production flow by means of Activity Based Training (ABT) and evaluation methods by means of

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Student Response System (SRS) that are integrated components of a course.

The project entitled "Transfer of innovative training solutions for VET of quality professionals" (acronym TIT-us) [20] financed by European Commission and promoted by the Chamber of Commerce and Industry of Mures County Romania (CCIM) disseminates new methods for delivering in-company skills upgrading processes that significantly reduces the costs related to competence and knowledge transfer and enhances production competence and know-how transfer to VET schools by educating instructors as ABT learning environment advisers and evaluators of learning outcomes by means of mobile devices and SRS software [13].

2. Activity based training

Activity Based Training has in theory a lot in common with *Learning by doing* [8], which improves capability of people in execution of tasks by repeating the same type of action very regularly and *Problem based learning* [9], which enables trainees to apply their knowledge to solve matters that are directly related to their jobs, but when it comes to the practical implementation there are differences in the methodology.

The core idea behind ABT is that trainee should produce something related to their activity, which can be a physical product or a service [7]. The exemplified industrial process must be clearly defined so that each step in the process represents an added value to the process itself. The process consists of a number of defined production steps, each adding a value to the product. These steps can be described with a scope, purpose and a time schedule. The instructor may also add information in detail for these steps or, the trainees may have as a special task, to describe the process in detail.

To be able to actively participate in collaborative creation of knowledge objects, trainees are expected to take control of their learning, to go beyond individual efforts and to engage in productive collaboration with peers.

The idea of collaboration is central and a key element in ABT. Collaborative learning will stimulate the ability to cooperate in order to full-fill the activities that is a part of the production process. The collaboration efforts are in many cases, more important than the results.

The collaborative learning can be stimulated through the learning process by establishing a group of trainees that shall work together as a work group. Each class will then consist of two or more work groups. These work groups will work in parallel with the same activity through the production process.

At the end of each activity these work groups are going to exchange their results of activities at that stage. This means that for every activity in the production process the work groups are starting with a result from another work group, they will add a certain value to the final product during the activity and at the end they deliver their result to another work group. Through this result exchange they will experience the dependencies of other groups to perform their task in order to be able to full-fill their own task. This is a very important element of the ABT, because this is quite similar with the normal production in real life.

The result exchange is a way of letting the trainees be aware of their dependencies of other groups in order to full-fill their own tasks. It also will make them aware of that they have to deliver the correct quality as defined in the task. If the quality is not acceptable or the delivery time or scope of delivery is not correct, negative consequences will occur.

ABT may be used in any vocational training for physical products or services [17]. Since the idea is not targeting special products then it can be used with products that may be available through cooperation with local industrial companies or other sources. Through such cooperation additional practical knowledge and competence can be accessed during education and training. Activity based training is a concept suitable to apply also in quality management VET [12].

3. The ABT methodology for quality management in manufacturing

The Activity Based Training (ABT) methodology uses an alternative pedagogical approach to education and training of personnel in industry, ensuring that theoretical content is directly relevant for the subsequent practical tasks in the industrial verification and control process.

In the ABT employment for quality managers training the core idea is that during the training course the trainee shall follow the main steps of the real quality management issues from an enterprise. The base processes of the

enterprise can be anything that is related to industrial fabrication or services.

During the course the quality management training will be produced by going through a sequential process that consists of a number of steps that can be identified and be treated as standalone training elements.

It should be noticed that local industry needs can be used to define the object of the study, or local community needs for products or services could be utilized in the training process in order to be more meaningful for trainees.

In figure 1, we considered the idea of training with the ABT methodology by simulating quality management issues in an organization. The main steps of the ABT training are evaluated with the SRS methodology. The key structure of the quality management activities involves a sequential number of training activities organized in modules (1-9 in this example) consisting of theory and practice.

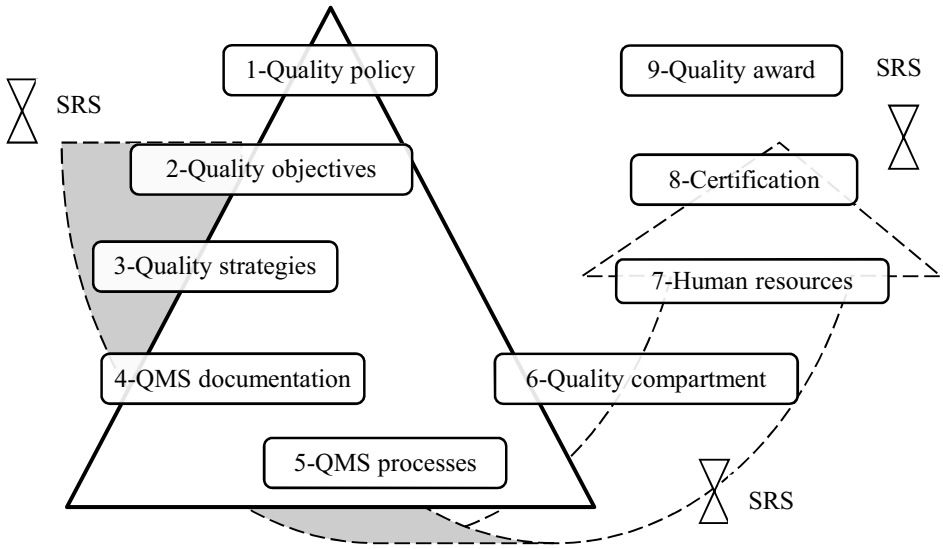

Fig. 1. The sequential structure of the Quality management training by means of ABT and SRS evaluation

The study modules for quality management in manufacturing are exemplified with ABT practical activities, which are explored by trainees during training and then are evaluated with SRS. The content of ABT activities and the number of questions used in each module evaluation are presented in Table 1.

Table 1. The ABT modules for quality managers training evaluated by means of SRS

Module no	Module title	Quality management process – ABT activities	Quality management process – ABT practical exemplifications	SRS evaluation
1	Quality policy	The way to elaborate the quality policy, and the quality plan for an enterprise	• Quality policy declaration • Quality plan for a work	8 questions
2	Quality objectives	The elaboration of quality objectives and ensure the adequate quality for the product	• Quality objective of the enterprise • Quality objective of individuals	5 questions
3	Quality strategies	The main types of strategies in quality	• Continuous improvement strategy • Methods and techniques of Kaizen strategy	11 questions
4	Quality management system documentation	Main steps of QM system implementation and structure of documentation	• Quality manual • Quality procedures • Work instructions	10 questions

5	Quality management system processes	Identification of processes in a company	• Process matrix • Process map	10 questions
6	Quality compartment organising	Global image of the quality compartment organising	• Organizing chart of the company • Organizing chart of the quality compartment	26 questions
7	Human resources – competence, awareness, training	Selection, training and awareness of the personnel	• Evaluation of personnel • Training • Job description	5 questions
8	Quality management system certification	Main steps of the QMS certification	• Documents for certification	10 questions
9	Quality awards	Main quality awards and methodology to select companies	• Criteria for quality awards • Steps in quality awards	22 questions

It should be noticed that this sequence is generic and not related to any specific product. The methods are generic, whereby they are applicable to wide industry sectors. As a consequence, it may be adapted for use in any VET training where an industrial production environment is used as a model for training activities.

4. SRS evaluation for quality management in manufacturing

Student Response Systems or SRS have been used for many years, typically in large classes to increase the level of trainee's engagement and learning. SRS technology generally includes a receiver, a collection of mobile devices and dedicated software. Through a wireless connection the clickers enable trainees to answer a number of questions, or quizzes, during a lecture. Because the trainees use their keypads instead of raising hands to submit answers, individual responses stay confidential from the rest of the trainees while result overviews are available on the classroom screen.

In literature SRS may have many different names, such as clickers, personal response systems, audience response systems, and classroom response systems. SRS are technology products designed to support communication and interactivity in classes [2]. Technology allows an instructor to present a question or problem to the class, and receive answers from the trainees through a response device. A summary of all answers is presented to the instructor and the trainees to see. In other words, SRS is a communication system that allows the instructor to collect and analyze large amount of data and on behalf of these investigate whether learning has taken place.

SRS has the ability to collect and display data instantly rather than waiting days to present the outcome as with a test, essay or project. The value of SRS comes from instructors analyzing information quickly and then devising real-time pedagogical solutions to maximize trainee learning [3, 6].

SRS has been found to be effective across grade levels and in a variety of subject areas [5]. Moreover, Realy et al., conclude in a research [15] that "the voting machines reduced the gap between male and female student performances on tests."

SRS have the potential to facilitate classroom processes such as: participation, collaboration, physical activity, cognitive involvement, self-evaluation [18, 19].

On the other hand if SRS is not used correctly, it can affect negatively the lectures [1]. Focusing only on the SRS technology instead of focusing on how students think and learn, it will not automatically improve the lectures [11].

4.1. Technical and methodological preparations

In the TIT-us project SRS have been used for evaluation of quality managers training by making technical and methodological preparations.

The technical preparations have been conducted weeks ahead of first-time use of the SRS to ensure a successful implementation, by:

- Checking that the classroom in which the SRS is to be used has sufficient wireless network coverage in terms of signal strength, the number of simultaneous connections, and bandwidth;
- Making sure the SRS interface is properly installed and tested on the instructor's computer;

- Making sure that the handheld mobile devices distributed to the trainees are fully charged and properly configured (e.g. set up for wireless network access, passwords etc.);
- Setting up bookmarks/home screen shortcuts on the mobile devices (this can be done either by technicians or by the trainees themselves).

The methodological preparations have consisted in:

- Have a one or more instructor colleagues check that the quiz questions are clear and unambiguous;
- When the class starts, hold a 15-minute introduction to the SRS, during which the purpose of the SRS is explained, and the trainees are made familiar with the interface on the devices used for casting votes.

4.2. Using the SRS in class

A timeline of a typical SRS session, consist in:

- Mobile devices are distributed to the trainees (preferably before the class starts), or trainees may use their own devices (mobile phones, laptops);
- The trainees are presented with a multiple-choice quiz question, where one or more alternatives are correct. The quiz questions can been displayed in several ways depending on the facilities available in the classroom: whiteboard/blackboard, flip over chart, overhead projector/ document camera, video projector;
- The trainees are given time to discuss between themselves (in the peer instruction paradigm, they are given time to think through the question individually first);
- From the SRS interface, the instructor starts the voting session (a timer/countdown mechanism can be used);
- Each trainee casts a vote as to what the correct answer is, using the handheld unit. The vote closes and the results are shown to the trainees in the form of a histogram;
- The instructor comments 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.

4.3. SRS methodology

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 in CCIM during the quality management course:

1. "Classical" approach: letting the trainees discuss 2-3 minutes between themselves in groups before doing a voting session;
2. Peer instruction: each trainee first has to think individually through the quiz question before casting a vote. Once the vote is cast (and the result of the vote is shown to the trainees), a group discussion ensues, during which each trainee 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.

To illustrate the difference between the two approaches, a side-by-side timeline is described in table 2.

Table 2. The differences between the classical approach and peer instruction in using SRS

"Classical" approach	Peer instruction
The quiz question is shown to the trainees	The quiz question is shown to the trainees
The trainees discuss between themselves for 3 minutes	The trainees think for themselves individually for 1 minute
A vote is held	A first vote is held without the instructor commenting on the results
The results are shown and commented by the instructor	The trainees discuss between themselves for 3 minutes
	A second vote is held
	The results are shown and commented by the instructor (who may or may not comment on the possible differences between the two voting results)
Total time used: 5-6 minutes	

The evaluation has shown that classroom technology can support active discussion learning. Based on observations so far, however, on a purely qualitative basis, it appears that the peer instruction approach (in which each trainee is given time to think through the question before the group discussion) engages the trainees to a greater extent than going directly into a group discussion before the vote is cast [4].

With the goal to increase the amount of interaction, classical approach and peer instruction have different strengths, the last one being superior to class-wide discussion. The smaller numbers in the peer groups makes it easier for all trainees to participate in discussion and trainees report that this method is more beneficial than class-wide discussion. From this viewpoint, a key strength of peer instruction is that trainees are encouraged to construct their understanding of core concepts in discussions with others.

Another observation is the combination of peer instruction followed by instructor explanation that improved average student performance substantially when compared with either alone [16].

5. Discussion

In this final section we highlight some research results and practical issues deduced from the implementation phase of ABT and SRS during the quality managers VET courses delivered by CCIM in the interval 2013-2014, which can be relevant to those who might wish to implement the interactive methods described in this paper.

The behaviours and skills required to solve a quality assurance problem are always multi-dimensional. Most of the VET programs for quality managers are linear in nature, being useless when a trainer interacts with the audience in one direction with a frightening array of slides useless. This mismatch between the real world and the training world makes it a certainty that industrial organisations are wasting their financial training resources and trainees learn nothing at all when subjected to this kind of training.

Training developed in a classical fashion, does not deliver the depth of learning required by trainees to actually change behaviour. In industrial companies, the objective of training is usually not the technical knowledge but to change behaviour. A good example comes from the aviation industry for pilots that are trained on simulators. There is no linear path in their training and are supposed to complex situations. Very often they fail but they learn in every situation by reflection. In this way their further knowledge is higher and they become much better prepared for different future complex situations.

Starting from these observations we have developed the content of the quality managers training programme in order to help trainees to learn from activity based examples that are making training experiential, allowing for periods of reflection. It employs the Kolb [10] four steps process of learning structured in: concrete experience, observation and reflection, formation of abstract concepts, testing in new situations. The developed ABT learning model for quality managers reflect similar patterns of activities in a circular series.

As a conclusion after delivery of training we observed that practical modules, combined with classroom training, have significantly improved the learning retention and application, the ABT is more fun; trainees learn more also from their mistakes when they are in a relaxed atmosphere.

As regards SRS the first issue is the added value provided by classroom communication technology, the unique contribution consisting in the quality of feedback that it enables.

A second issue concerns the effectiveness of the different discussion methods. This evaluation has shown that classroom technology can support active discussion learning. However, it has also shown that peer instruction is more beneficial than class-wide discussion. The peer discussion has to be followed by instructor explanation.

The third issue concerns some logistical considerations because the SRS is designed to be used in large classes, and the server/client infrastructure is very scalable. However, the simple task of handing out mobile devices for dozens of trainees can present a logistical challenge.

The most efficient way to distribute a large number of mobile devices is to have the trainees pick up a unit as they enter the classroom, and hand it back as they leave the class.

Alternatively, handheld units can be given on loan to the trainees at the start of a term, on the condition that the unit is handed back in at the end of the term. In this scenario, each trainee would be individually responsible for his or her unit – making sure it's charged; bringing it to classes and so on.

The fourth issue consists in exploration of the timed versus non-timed voting sessions. The SRS is designed to be

used in large classes, and maintaining order and discipline is a priority. After a group discussion, the instructor will want to start a voting session. But it can be challenging to restore order and attention in a class in which hundreds of trainees have been engaged in serious discussion. In particular, to make all the trainees, some still fiercely involved in the discussion, aware that a voting session is about to begin.

To aid the instructor in restoring order for the voting session, the SRS can be set to play back a "ticking clock" sound during the countdown.

Our experience shows that using such a sound is invaluable in shifting the trainees' attention away from the discussion, and over to the voting session in progress.

In our experience, a 20-second countdown is sufficient – any longer than that and the trainees quickly lose patience. When the vote starts, the trainees have already completed their discussions and made up their minds. Therefore, 20 seconds should be enough to let everybody press the button on their mobile device corresponding to the alternative they think is correct.

The fifth issue refers to the instructor's role that is critically important for the trainees to thoroughly explains what the correct alternative is, and why, but also to put a lot of effort into stimulating the discussion between the trainees. This problem is exacerbated if the trainees don't know each other very well.

After a 3 year employment of SRS, Nielsen et al. [14] shows that most criticism from trainees shifted towards the way SRS was used by different instructors, by dividing results into the sections: consistency when using SRS; differences in instructors' SRS experience level; time usage; commitment: a two-way street; preparation of the questions; and voting results as a false image of understanding.

On the other hand we have challenged with some problems that in some situation may become drawbacks of the evaluation system:

- Time spent to prepare relevant questions to the course is consuming resources. It depends also on the nature of the taught subject. The evaluation system is most suitable for descriptive sciences, and less for exact sciences. The instructor has to appreciate what kind of questions to ask: factual or conceptual questions. He has to read up on existing articles on multiple-choice questions. We appreciate that in general is preferable to have multiple-choice questions;
- For questions projecting the instructor needs technology support (lap-top, projector, smart board, etc.), so the classroom has to be adequate;
- If the trainees do not have own Smartphone the instructor has to distribute mobile devices (clickers like iPods) and there is a time spent to distribute/receive it;
- There are some browsers that don't run properly the application;
- Not all the instructors allow the use of mobile phone in classes, because it can be a distraction.

The trainees provide positive feedback with respect to increased engagement and motivation, many of them feeling that it becomes fun to attend the lectures. Our SRS trainee experience in general as a very positive element in their lectures and a valuable tool for both the instructor and trainees. In the 2013-2014 survey on 94 trainees, 91.5% of the trainees answered that they would want SRS to be used in their future education if they had the chance.

6. Conclusion

Chamber of Commerce and Industry of Mures County Romania (CCIM) Mures, is coordinator of the project "Transfer of innovative training solutions for VET of quality professionals" (acronym TIT-us), in partnership with vocational training institutions from Norway and Italy. The project is financed by the European Commission. TIT-us is aiming at disseminating and raising the awareness of a new integrated blended learning environment to VET schools and in-company training organizations in Romania, Italy and Norway.

Our approach consists in designing a very modern pedagogical methodology for training of quality managers. The new learning environments Activity based Training (ABT) and Student Response System (SRS) are used at CCIM for VET of quality managers. The training follows the main professional challenges of a quality manager from an industrial organisation.

We have demonstrated a professional training by means of Activity Based Training (ABT) learning environment, structured in 9 modules, employing a generalised quality assurance process in an organization that can be tailored to

any industrial application, which is relevant for the target group.

The findings are the generic training sequences employing the ABT learning environment that are not related to any specific product. Various technological processes, from very different industries can be employed for delivery of learning material, thus creating an attractive, flexible, engaging and motivating blended educational training environment.

The main steps of the ABT training are evaluated with the SRS methodology. The ABT and SRS have been designed such that it helps instructor to: break the monotony of a lecture and allow the trainees to actively take part in the lecture; Increase instructor-trainee interaction; Give both instructor and trainees "real-time" feedback on learning effect; Use modern and cheap and widely available mobile devices which trainees have access to through their mobile phones.

Pedagogical challenges related to the new roles of the instructor and the trainees in the educational process have been demonstrated, by linking of theoretical training with practice and increased trainee-instructor but also trainees' interaction.

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