iQVet project D2.1.

Best practice pedagogical guidelines in monitoring the progress of teachers' and learners' attitudes, knowledge, and skills

1. Introduction

Nowadays, the need for innovative, work-based learning and teaching methodologies is rapidly increasing in the industry. To fulfill this need, the teachers in VET schools must be trained to develop a professional toolbox for new teaching methodologies. To follow the development of this toolbox, attitude, skill, and knowledge must be monitored frequently. With the best practice guideline, the teachers' attitudes, skills, and knowledge development and monitoring processes can be standardized at national and international levels. As the VET school teachers can share different pedagogical scenarios, the work-based and blended learning toolboxes will be improved to fulfill better, the industry's needs.

Recently, a digital transformation in education has been realized on several levels. However, this transformation is mainly based on using different tools and environments, not on the application of new interfaces and the possibilities behind them. With new educational approaches, the quality of education can be significantly improved, focusing more on developing critical thinking and problem-solving skills and not purely on theoretical knowledge.

In this report, the best practice guideline is set up to monitor the attitude, knowledge, and skill of the teachers and the student, to develop a work-based educational environment in VET.

2. Discussion on innovative educational and monitoring technologies

2.1 Selective examples of tools used for monitoring techniques

On the 10th of February, a full-day on-site training was held to define the tools used for evaluating and monitoring the teachers' and students' knowledge, skills, and attitude. The tutor was Balázs Varbai (MHtE). On the training and brainstorming event, three teachers attended in person and one teacher online (also from MHtE). Each of the teachers is going to train 3-3 students. To define the different monitoring techniques, the topic of 'Digitalization' was chosen as a pilot project. The 'Digitalization' course is an entry course for the International Welding Inspector IWI-C course; thus, the system of considerations was evaluated with this course as an example. The teachers were trained about the course material content previously. Keeping work-based learning as a tool for the innovative education of this course, the following monitoring techniques were used as a guide.

Monitoring the teachers' attitude, knowledge, and skill

Attitude

To monitor the teachers' attitude in teaching 'Digitalization' course, <u>semantic differential</u> type questions are a helpful tool. One example is shown below.

How comfortable are you with using a learning management system in education?
(please tick your answer)

1	2	3	4	5	6
○	○	○	○	○	○

I will definitely use LMS during education.   It is doubtful that I will use LMS during education.

Knowledge

To monitor the knowledge of the teachers' <u>essay type</u> questions are successfully used.

   Please describe in 5-10 sentences how you will use a learning management system to train the students in the topic of welding inspection, using this actual technical drawing.

> The main step is to use real technical drawing, it means the teacher uses a live industrial product drawing, asked from suitable industrial firm manufacturing pressure vessels or constructions could be welded.. Important to upload all technical, personal elements to the LMS, where can be evaluating the process steps, results. The LMS has to be improved by the evaluation of the course experiences. Very important: to organise a train the trainer course after each LMS using to disseminate, teach, agree, accept of the course experiences. Using of the LMS be an element of the harmonized process.

Skill

To monitor a teacher's skill in using digital tools, <u>actual demonstrations</u> can be used, which will be assessed by the tutor.

Let's demonstrate how to create a classroom with 10 students in the Zoom system and start a video presentation!

<u>Monitoring the students' attitude, knowledge, and skill</u>

Attitude

To monitor the students' attitudes in learning about 'Digitalization,' <u>semantic differential</u> questions can be used. After completing a questionnaire, the students can give feedback during an <u>interview</u> with the trainer.

How satisfied are you with learning in an online learning management system?
(please tick your answer)

1	2	3	4	5	6
○	○	○	○	○	○

I am delighted to learn a course online in an LMS.

It is very ineffective for me to learn in an online LMS. I much prefer learning in classrooms.

Knowledge

The students are more likely to answer <u>multiple-choice</u> questions, which can be effectively filled out online. An example of the 'Digitalization' course material is below.

Please answer what LMS is used for.

a) To help in the contracting stage of a pressure vessel inspection.

b) LMS is a novel type of non-destructive testing technique used for welding inspection.

c) LMS is the abbreviation for the learning management system, which is a framework for online education.

d) Learning using LMS requires a strong on-site presence in the classrooms.

Skill

To monitor the students' skills in 'Digitalization,' hands-on <u>demonstrations</u> will be used.

Connect to the Zoom platform and send an assignment to your teacher (for example, your answer to the multiple-choice questionnaire).

2.2 In-depth interviews as a monitoring tool

Among all of the listed methods used for monitoring, the interviews give the widest range of answers and give an overall overview of the development of teachers' skills, knowledge, and attitudes. In-depth interviews are qualitative tools used to explore the opinions of the participants. In-depth interviews offer a more complete and comprehensive picture of the participants' opinions. Thus, in-depth interviews should be used in focus groups, which include the teachers and the students of the welding inspector courses.

However, there are some limitations and risks in using this type of monitoring method. There is a risk that teachers tend to give more positive answers because they want the program to work. Thus, the right question should be designed and asked to allow minimal bias in the evaluation. The interviews consume more time than, e.g., a multiple-choice type of questionnaire; thus, the proper amount of interview time must be selected to make the participant able to explain their opinions. Interviewing techniques also need to be trained for the interviewers to make them able to lead the conversation to the right path. The results of these in-depth interviews can vary on a wide scale, thus the evaluation of the answers can also be more complicated. Overall, it is mandatory to be prepared for performing in-depth interviews.

To help plan an interview, the next steps can be followed:

1. Planning the interview
    a. Designate who will be included and who will lead the interview
    b. Identify what type of information will be taken out of the interview after the evaluation
    c. Prepare the interviewers to follow ethical guidelines
2. Set up the structure of the conversation
    a. Develop the backbone of the interview: What to say in the beginning and during the interview? What do to after the interview?
    b. Develop a general guideline, which can be followed by the interviewer. Ask for examples, tray to elaborate the new ideas given by the participants, ask for further explanations, etc.
3. Plan how the data will be collected and analyzed
    a. A review in data collecting techniques and proper practice in the usage of these instruments
    b. Summarize key elements right after the interview
    c. Conduct the interview to gather the data we aim for
    d. Transcribe the data
4. Disseminate the results
    a. Revise the analysis of the results
    b. Disseminate among participants and stakeholders

Examples for the presentation of an in-depth interview

The in-depth interviews are not a strictly regulated type of monitoring technique. Thus, the structure of them can be flexible. In the following a general guide is listed to help the interviewers planning, performing, and analyzing the conversation.

1. Introduction and the goal of the interview
    a. Names, how long the interview will last, what are the interviewer aware of, etc.
2. Methodology
    a. How the development of skill, knowledge, and attitudes are carried out
    b. How was the introduction of innovative educational tools were introduced
    c. What are the risks, weaknesses, limitations in the work-based education techniques
    d. Please tell examples, which we can elaborate
3. Results
    a. Highlighting the key point, with the agreement of the interviewee
    b. Agree on the following steps to further improve and help the development of the teachers
4. Appendices
    a. Additional information, which is not strictly connected to the main core of the interview

2.3 Examples of interview results in the welding inspector education

Questions for students	Not at all %)	Partly (%)	Totally (%)	Sum (%)
Were you satisfied with the knowledge you gained during the production control course, which was not only acquired through classroom training?	0,00	0,00	100,00	100
Were you satisfied with the teachers' preparation in the use of teaching methods and tools?	0,00	0,00	100,00	100
Were you satisfied with the amount of literature recommended by the teachers?	0,00	0,00	100,00	100
Are you satisfied with the teachers' willingness to cooperate in any teaching method?	0,00	0,00	100,00	100
Do you feel that the teachers were satisfied with the knowledge they acquired during the course?	16,67	0,00	83,33	100
Are you happy to recommend these teaching methods and tools to others?	0,00	33,33	66,67	100
Were you satisfied with the methods used in the prior knowledge assessment?	0,00	0,00	100,00	100
Were you satisfied with the above methods and tools used to learn hidden knowledge?	0,00	16,67	83,33	100

	Not at all %)	Partly (%)	Totally (%)	Sum (%)
Were you satisfied with the software used in the course?	0,00	0,00	100,00	100
Were you satisfied with the different e-learning methods?	0,00	0,00	100,00	100
Were you satisfied with the application of the work-based learning operated during the course?	0,00	0,00	100,00	100

Questions for teachers	Not at all %)	Partly (%)	Totally (%)	Sum (%)
How satisfied were you with the new teaching methods and tools during your training?	0,00	0,00	100,00	100,00
Were you satisfied with the use of the method of revealing hidden knowledge to students?	0,00	0,00	100,00	100,00
Do you think the students were satisfied with the knowledge they gained during the course?	0,00	0,00	100,00	100,00
Were you satisfied with the focus on production control training in the pilot course?	0,00	0,00	100,00	100,00
Were you satisfied with the e-learning training experience?	0,00	25,00	75,00	100,00
Were you satisfied with your knowledge before you were given this teaching assignment?	0,00	25,00	75,00	100,00
Were you satisfied with the level of preparedness of the students during the prior knowledge assessment?	0,00	25,00	75,00	100,00
Were you satisfied with the use of the LMS system software?	0,00	25,00	75,00	100,00
Were you satisfied with the literature recommendations provided to the students?	0,00	0,00	100,00	100,00
Were you satisfied with the students' compliance during the training and interviews?	0,00	0,00	100,00	100,00
Were you satisfied with the knowledge acquired by the students during their blended learning?	0,00	0,00	100,00	100,00

3. Conclusions

Innovative educational tools are useful in the education of many fields. In the education of welding inspectors work-based examples are used to improve the level of education, and to focus more on the problem-solving capabilities coming from real-life conditions. However, the development of the teachers and students skills, knowledge, and attitudes must be monitored before, during, and after the courses, to help the teachers and students in the implementation of new education tools.

For monitoring many techniques exist. Among them the most comprehensive is the using of in-depth interviews. From in-depth interviews many data can be collected, but also, the circumstances of these interviews are very flexible.

In this document, a basic guideline is highlighted to conduct interviews, and some examples are presented from the welding inspector course, organized by MHtE.

Appendix

List of monitoring techniques and methods used for the evaluation of skills, knowledge, and attitudes

Monitoring techniques of the attitude

The <u>students'</u> attitudes refer to their positive or negative feelings and predispositions to learn engineering-related topics. The <u>teachers'</u> attitudes toward the education of STEM-related topic significantly affects the efficiency of knowledge transfer. However, it is not easy to measure (quantify) somebody's attitude to learning or teaching.

The measurement of one's attitude poses distinct challenges compared to the measurement of learning or knowledge. One helpful tool to analyze attitudes is using surveys.

To get as much information as possible from these surveys, three types of assessment questions can be used:

1. Dichotomous: yes/no type
   a. I am inspired to meet my goals at school.
   b. I feel thoroughly involved during the online and personal classes.
   c. I am voluntarily willing to participate in optional homework to further improve the project results quality.
   d. I am inspired to improve my knowledge of welded pressure vessel inspection.
   e.
2. Semantic differential: e.g., from 1 to 6 (with no neutral or center point)
   a. My knowledge improvement during the course is:
   b. I find myself working on a project in teams:
   c. How satisfied are you with the course material?
   d. How comfortable are you with the learning management system?
   e.
3. Likert: e.g., from strongly disagree to strongly agree.
   a. I enjoy sharing my (silent) knowledge with others.
   b. I enjoy working in a team during project tasks.
   c. I consider myself knowledgeable on a variety of issues in pressure vessel inspection.
   d.

The questions need to address the individual, referring to "I would …" or "I agree to that…". The teacher and the tutor need to regularly monitor the attitudes through these surveys.

Monitoring techniques of the knowledge

The difference between knowledge and skill should be differentiated at the first level.

Knowledge is the facts, information, and skills acquired through experience and/or education, which can be a <u>theoretical or practical understanding</u> of a subject.

Skill is the ability to do something well, which also can be defined by the word "<u>expertise</u>".

Measuring knowledge on a STEM course is essential and unequivocal. The assessment of the <u>students'</u> knowledge can be based on theoretical questions and tests related to complex problem-solving tasks. The <u>teachers'</u> knowledge can be monitored along the same guidelines with the supervision of a tutor or a peer reviewer.

One effective tool for evaluation is using a **learning management system (LMS)**. In these online systems, generally the following types of questions can be used.

- Multiple Choice Question Type:
  - Allows the selection of a single or multiple responses from a pre-defined list.
- True/False Question Type:
  - A simple form of a multiple choice question with just the two choices 'True' and 'False'.
- Matching Question Type:
  - The answer to each of a number of sub-questions must be selected from a list of possibilities.
- Short Answer Question Type:
  - Allows a response of one or a few words that is graded by comparing against various model answers, which may contain wildcards.
- Numerical Question Type:
  - Allows a numerical response, possibly with units, that is graded by comparing against various model answers, possibly with tolerances.
- Essay Question Type:
  - Allows a response of a few sentences or paragraphs. This must then be graded manually.
- Calculated Question Type:
  - Calculated questions are like numerical questions, but with the numbers used in the question selected randomly from a set when the quiz is taken.
  - Calculated multichoice questions are like multichoice questions, but can include formula results from numeric values that are selected randomly from a set when the quiz is taken.
  - A simpler version of calculated questions, which are like numerical questions but with the numbers used selected randomly from a set when the quiz is taken.
- Drag and Drop Question Type:
  - Missing words in the question text are filled in using drag and drop.
  - Missing markers in the question text are filled in using drag and drop.
  - Images or text labels are dragged and dropped into drop zones on a background image.
- Embedded Answers (Cloze) Question Type:
  - Questions of this type are very flexible, but can only be created by entering text containing special codes that create embedded multiple-choice, short answers and numerical questions.

- Gapfill Question Type:
  - Offers dynamic options with a simpler question-builder interface than the Cloze question type. It can consist of a passage of text that has various answers embedded in it. These answers can be in a drag-and-drop, gapfill short answer, or drop-down format. There are several settings options for this question type, including distractors and hints.
- Select Missing Words Question Type:
  - Missing words in the question text are filled in using dropdown menus.

In **classrooms** the monitoring techniques can be different. In general, there are five monitoring techniques that can be used.

- Entrance and exit tickets
  - While arriving or leaving the classroom, the students must summarize the key features of a topic in a couple of sentences
- Reflection
  - An opportunity for the students to summarize what and from where they know about the topic at the current initial state
- Revision
  - The students can summarize how their knowledge is evolved during the course from class to class
- Accountable answers
  - Responding to a question, voting to different questions on the board (anonymously), monitoring the knowledge of the entire class
- Summarizing
  - A summary of the topic after the course lecture from the students

Monitoring techniques of the skills

The best way to monitor one's skills is through a comprehensive, complex, problem-solving task. This task can be solved in teams or individually. One excellent way for skill development is learning by doing.

In our case, the task would be developing the inspection plan of a real-life metal structure (e.g., pressure vessel), and the skills can be monitored through this complex task. There are basically five effective ways to monitor skills.

- Direct assessment
  - Monitoring the students' skills by a supervisor or an expert in the field
- Self-assessment
  - Monitoring one's own skills through surveys, periodically
- Anonymous peer assessment
  - Involving other students or coworkers as peer reviewers to assess the complex task solving skill
- Skill assessment through a learning management system
  - This type of assessment can be done for each student of employee after a training or course for a specific topic is completed
- AI-based tracking
  - Using augmented or virtual reality environments to assess a skill, e.g., for arc welding