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Guiding Evaluation of Trainings in the Field of Energy Transition

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Abstract

The endeavor of transitioning to nearly-zero emission buildings presupposes upskilling the existing workforce in the construction and energy industry to meet new standards. For many professionals in this sector, this is accomplished via micro-trainings, aimed at updating their competences. However, evaluating the effectiveness and impact of training activities is often performed intuitively, by unexperienced evaluators.

The purpose of this study is to design guiding tools for evaluating training programs that can be adopted and implemented in a diversity of training programs in the construction and energy industries. The development of this program yields the following research question:

How to guide the evaluation of effectiveness of upskilling micro-trainings in energy efficiency with limited (human, financial, material) resources and expertise?

This question will be answered by determining what type and to what extent organizations in the aforementioned fields need support in implementing evaluations, as well as the influencing constraints, hindrances, and opportunities in the process. A conceptual model proposed by the University of Twente, based on Kirkpatrick's four levels of training evaluations, was further developed to encompass both objective and subjective measurements, implement the measurement of Learning Goals and provide guidance for designing and implementing evaluation programs. Pilot tests were conducted to inform design and test the feasibility and efficacy of the proposed model. As a result, three elements were designed to support the application of the model: an Evaluation Guide, a tool for determining clearly defined learning goals, and a standardized question pack containing validated survey instruments.

Keywords: upskilling, evaluation, effectiveness, assessment, micro-trainings

Supporting Upskill Evaluations in the Energy Transition Field

The BusLeague project (<https://busleague.eu/>) is a European initiative that aims at fostering a sustainable cycle of demand and supply for energy efficiency skills in the construction sector, through a series of synergetic initiatives, such as stimulating demand for specialized skills at market level, supporting legislative change and upskilling the active workforce to meet those needs. Upskilling interventions can take form in a variety of activities, methods, and techniques with specific learning objectives. In order to ensure that these learning processes translate into transfer into practice and the sustainability of such transfer, it is crucial that interventions be evaluated for their effectiveness and impact.

For many organizations, however, implementing evaluations can be a challenging enterprise, due to their lack of knowledge of and familiarity with such tools. As posed by Jim Kirkpatrick on an interview for the Training Journal¹, most organizations assess only the effectiveness of interventions directly after a training and not their delayed effect on performance in later practice contexts. He also highlights that there is a high focus on the satisfaction with trainings rather than their utility. Ultimately, deficient assessment of training programs compromises the efforts put into training and influences the outcomes of the learning experience (Durlak & DuPre, 2008).

In order to assess the effectiveness and impact of upskilling interventions in the context of the BusLeague project, a conceptual model built upon Kirkpatrick's (2006) model of training evaluation is proposed. This model, named Evaluation123, additionally builds upon educational research on workplace learning, respects scientific standards in study design as well as evaluation and includes validated survey instruments.

¹ <https://www.trainingjournal.com/articles/interview/means-and-end>

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However, the development of a conceptual model is insufficient to respond to the practical needs of organizations in evaluating the effectiveness of their training programs. Therefore, the aim of this project is to develop the necessary tools and guidance that will enable the organizations in the BusLeague project to autonomously design and implement efficient and cost-effective evaluation programs for their interventions using the Evaluation 123 model.

Theoretical Framework

Four-Level Evaluation Model

Kirkpatrick's (2006) four-level training evaluation is a well-known and established model for assessing the effectiveness of training programs. The model consists of measurements at four consecutive levels: *reaction*, *learning outcomes*, *behavioral change* and *impact or results*. At level 1 – *reaction* – the satisfaction of participants with the training received is measured. Kirkpatrick recognizes that these items may not necessarily be predictors of effectiveness but are known antecedents to it. Level 2 measures the *learning outcomes* in the form of objective knowledge or skill tests applied to evaluands, whose results may be used to infer the effectiveness of a training program. Level 3 measures the *behavioral change* resulting from the training, through the observation of long-lasting changes in attitudes and behaviors, representatives of transfer of learning. The fourth level measures the *impact* caused by an intervention in the operational and financial *results* of an organization, by means of analysis of productivity, quality increase or revenues.

Thus, the evaluation for the first three levels (satisfaction, learning and behavior) must be designed alongside and must be consonant with the training intervention, whereas level 4 (results) is typically measured using external and existing indicators.

Evaluation 123 model

The Evaluation 123 model proposed by this study is a simplification and adaptation of the Kirkpatrick model, focused on the three levels where evaluations must be designed and require support (1-satisfaction, 2-learning outcomes, 3-behavior). The model was enriched by validated instruments to measure the different dimensions at each level.

Learning Goals

Learning goals refer to the general aims or intended results of a training program and are the cornerstone of effective instructional designs (Fessler et al., 2021; Marzano, 2009). Whereas the terms goals and objectives are used interchangeably throughout literature, some authors make a distinction between the general aims of a program (goals) and the specific, measurable steps taken in order to achieve them (McNall, in Frey, 2018; Marzano, 2009), despite not distinguishing the terms, classifies them according to their characteristics (specificity), ranging from narrow-sense statements (objectives) and broad-sense goals. Moreover, the author deepens the classification by also discerning their level of difficulty and purpose. Learning goals that require evaluands to achieve a certain score are called performance goals, whereas those that learners are required to master a content are named mastery goals.

Defining clear learning goals is a key element for setting curricula, monitoring outcomes and self-regulation of learners (European Commission, 2011). However, the relevance of clearly defined learning goals are not limited to complying with instructional design principles only. For learners, they act as primer for acquiring knowledge and skills, enabling them to evaluate and modulate their learning strategies during the learning process (Pintrich, 2004).

There is also scientific evidence that the level of difficulty of a goal is influential. In a synthesis of over 800 meta-analyses on achievement, Hattie (2008) found that there seems to be a strong relationship between the level of difficulty presented by a goal and the subsequent performance, in which more challenging goals yield to higher levels of performance. Moreover, the relationship between goal commitment and outcomes is moderated by the level of goal difficulty, concluding that the adequate elaboration of sufficiently challenging goals is essential to attain effectiveness in learning processes.

Self-Evaluation and Self-Assessment

Self-evaluation can be defined as the individual's judgement or appraisal of their own work, usually against a known or defined set of criteria (Rolheiser & Ross, 2001), whereas self-assessment depicts the ongoing introspective practice of self-reflection that prompts individuals to their behaviors, modulating and regulating their experiences (Pisklakov, 2014). However, this terminology is not consensual throughout literature, and different authors attribute different definitions or nuances according to their focus of studies (see Dauenbeimer, 2202; Rohlheiser & Ross, 2001, Sedikides, 1993). Nevertheless, there seems to be a consensus in literature on the positive effects of both self-evaluations and self-assessments. Studies have found that self-evaluations potentially impact learners' performance, self-efficacy and intrinsic motivation (Rolheiser & Ross, 2001). Self-assessment has been found to increase certainty of self-knowledge (Sedikides & Strube, 1997), and of presenting itself as a learning opportunity (Pisklakov, 2014).

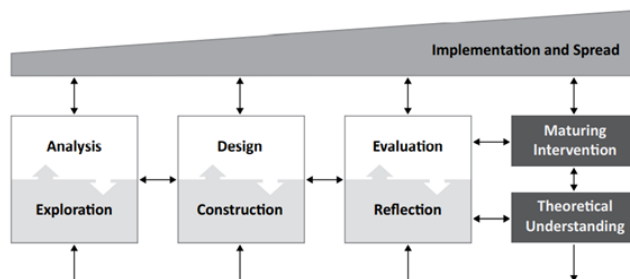
The reliability of self-evaluations has long been debated, with inconclusive results. In a meta-analysis on the validity of self-reported scores, Kuncel et al. (2005) revealed that the reliability of the scores increased at higher educational levels, implying that more advanced or

educated learners dispose of more tools to perform such assessments. The authors also point out that studies have shown that self-scored grades are frequently consistent predictors of actual grades, which implies that the validity of self-scores cannot be excluded.

Methodology

The purpose of this study was to find a practical and feasible solution for evaluating the effectiveness and impact of upskilling training programs in energy transition, in the context of the BusLeague project. To accomplish this and develop an assessment tool, this study adopted the Generic Model for Conducting Design Research in Education, as proposed by McKenney and Reeves (2018). This model posits three core phases (see figure 1) – analysis/exploration, design/construction, and evaluation/reflection – in an iterative, responsive, and flexible structure. It also integrates the research and design processes with theoretical scientific knowledge and practice.

Figure 1: Generic model for conducting design research in education



Note: Generic model for conducting design research in education. Reprinted from *Conducting educational design research* (p.98), by S. McKenney, T.C. Reeves, 2018, Routledge. Copyright of the authors.

Phase 1 – Analysis and Exploration

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As proposed by McKenney and Reeves (2018), in the analysis and exploration phase, expertise is sought by gaining theoretical knowledge from existing literature, consultation of involved stakeholders and contextual analysis. This provides a better understanding and framing of the problems, and identifies design requirements and limitations.

This study started with the analysis of the existing documentation of the BusLeague project to determine the scope, extent and needs of the partners involved in the project in terms of training and evaluation. Secondly, a literature search was performed to improve understanding of current challenges in the light of scientific knowledge and to gather insights on possible solutions. The analysis was enriched by an exploration of the problem in a real setting. Two volunteering partners were selected as pilots to test the Evaluation123 model. The aim of these pilots was to understand the application of assessments by commissioners of trainings and provide data on the constraints of evaluation processes, opportunities for improvement and feasibility of the proposed model. Interviews were conducted pre, during and post piloting in order to gather data and feedback from the involved stakeholders.

The results of this phase have indicated the main difficulties faced by organizations in designing and implementing evaluations for their training programs. To enumerate a few, the most prominent were:

- Difficulty in understanding utility/relevance of evaluation
- Lack of knowledge on designing assessment tools
- Lack of resources:
 - Material – instruments, tech tools, knowledge base
 - Human – personnel
 - Financial – cost of implementation

- Limited capability for analyzing survey results

Phase 2 – Design and Construction

In the second phase – design and construction - a conceptualized solution is developed under a theoretical perspective, and built upon constraints and requirements elicited by the stakeholders. The results from this phase identifies weaknesses or points of improvement on the design, ultimately refining ensuing iterations. This is an iterative and cyclical process, in which activities and outcomes of one phase provided feedback in a loop, informing and allowing constant adjustments in subsequent phases.

During this phase, the Learning Goals component was also added and tested in pilots, either as a complement to standard knowledge evaluations or as a standalone subjective measurement, when traditional assessments were not applicable. This comprised the improvement of the question packs from the previously selected instruments, clarifying the meaning and application of each pack within the model. A tool was developed to assist the definition and clarification of learning goals. This tool is aimed at helping evaluators to define clear measurement objectives for evaluations. Alongside, a reference manual was elaborated, in order to provide evaluators with step-by-step guidance on how to design and implement evaluations for their training programs. These tools were presented in a workshop, where participating partners were able to experience them in a fictive context and provide inputs and feedback on their improvement.

Learning Goals tool

The analysis phase of this study indicated that the definition of clear and straightforward learning goals still required improvement. Despite the use and determination of learning goals

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being established at the design stage of training interventions, they are usually very broad and overarching, precluding their use as precise evaluation instruments. One example of such general learning goals would be: *Trainees will be able to thermally insulate a room*. This Learning goal does not specify the conditions and circumstances (materials, time and skills required for the task), nor is clearly measurable because it comprises several activities and scenarios, such as insulating doors, windows, roof and walls.

Therefore, the process of defining and clarifying Learning Objectives from pre-established, overarching learning goals needed to be refined. In order to achieve that, a tool was developed to assist evaluators redefining and securing the precision of learning objectives. This tool uses the SMART (*specific, measurable, achievable, relevant and time-bound*) principles, as preconized by Doran (1981).




Learning goals are typically set using Bloom's taxonomy (Lasley, 2013). However, this taxonomy is limited to classifying cognitive processes, according to their level of complexity. In a review of Bloom's work, Krathwohl (2002) unfolded the taxonomy into a knowledge and a cognitive process dimensions. Whereas the cognitive process dimension retains the six main processes described by Bloom (*remember, understand, apply, analyze, evaluate and create*), the knowledge dimension adds four more layers: *factual, conceptual, procedural and metacognitive knowledges*.

In the context of the construction and energy industries, many of the competences exerted by practicing professionals are a result of both cognitive and psychomotor processes, allying knowledge and skills in performing certain tasks. On this wise, an adaptation of Krathwohl's revision seemed more applicable to determine learning goals for the upskilling trainings provided in the scope of the BusLeague project. The taxonomy was adapted and

reduced to three main categories: *Conceptual Knowledge*, *Procedural Skills* and *Analytical Thinking*. This aims at encompassing, respectively, the conceptual, procedural and metacognitive knowledges (see Figure 1).

Figure 1




Proposed taxonomy for learning objectives in the Evaluation123, adapted from Krathwohl (2002).

  		
	Abilities	Description of category
Conceptual Knowledge	<p>Recognize and retrieve relevant knowledge</p> <p>Constructing meaning from instructional messages</p>	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.
Procedural Skills	<p>Carry out or use a procedure in a given situation</p>	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.
Analytical Thinking	<p>Breaking down information into component parts and their relation</p> <p>Making judgements based on criteria and standards</p>	<p>Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support</p> <p>Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.</p>

In order to automatize processes and improve usability, the tool was developed into an online electronic spreadsheet (see Appendix A). The spreadsheet format allow users to separately identify the elements required for a clear learning goal and facilitates the selection of adequate action verbs, time clauses and participating agents. Given the transnational aspect of the involved stakeholders, an auto-translation feature was also added, to facilitate comprehension and increase precision in the determination of objectives (figure 2).

Figure 2

Sample field form of the Learning Goals Tool, in electronic format. Text in blue is an automatized result of the input given in the boxes.

	WHEN	WHO	SELECT 	Apply 	WHAT
1	After the training	Participants	will be able to	differentiate 	types of insulation materials.
<i>After the training, Participants will be able to differentiate types of insulation materials.</i>					
<i>Après la formation, les participants seront en mesure de différencier des types de matériel d'isolation.</i>					

Question Packs

The question packs (see Appendix B) are a selection of useful and validated instruments found in literature to evaluate the quality and effectiveness of training programs at level 1 - reaction - and are divided into three main categories: design principles, satisfaction & usefulness, and e-learning.

The *design principles* question pack is aimed at the providers, designers or commissioners of training. It is largely based on the principles outlined in the study of **(Saks & Belcourt, 2006)** investigating the factors facilitating transfer of training in organizations. By contrasting and comparing the design of their trainings to the principles identified by Saks and Belcourt, providers and designers can assess the strength of their programs, and recognize and act upon points of improvement.

The second question pack relates to measuring the perceived *satisfaction* and *usefulness* of the training program by the trainees, thus relating to the level 1 – reaction – of the Evaluation 123 model. Several influential aspects related to the overall experience with trainings program have been identified, such as mastery experiences, cognitive development,

quality of teaching, interaction and enjoyment (**Athiyaman, 1997; Cunningham, 2007; So & Brush, 2008**).

Lastly, given that many trainings nowadays are either in an online or hybrid environment, an instrument to measure satisfaction with e-learning was added (Wang, 2003).

All these question packs were compiled and edited in a digital format to facilitate the use and implementation by evaluators. Separating and organizing them digitally in online forms packs (GForms²) also complies with the evaluators' needs for simple, easily implemented and cost-effective solutions. Digital platforms, such as Google or Microsoft forms are widely accessible and can collect, store, and in some cases perform simple analysis of the data obtained.

At level 2 – learning outcomes – and level 3 – transfer of learning -, tests are based on objective measurement of knowledge and skills, and subjectively through the self-reported assessment of learning goals.

Evaluation 123 Reference Manual

During the analysis and exploration phase, the lack of experience and knowledge of organizations and providers of training in designing evaluations was identified as one of the main constraints to their implementation, potentially reducing the expectations and outcomes of the evaluation process to a minimum.

² https://drive.google.com/drive/folders/1qCc3j950wi2_RkUaQKyoghGHdEtPZCL1?usp=sharing

Therefore, an Evaluation123 Reference Manual (see Appendix C) was developed to guide potential evaluators in designing and implementing the evaluation process. This manual covers several topics, such as:

- Reasons for evaluating
- Structuring an Evaluation123
- Determining learning goals (and usage of the proposed tool)
- Designing an evaluation
- Implementation

Phase 3 – Evaluation and Reflection

In the evaluation/reflection phase, the designed product is tested to determine both its theoretical solidity, practical usefulness and viability, either under the scrutiny of specialists or in pilot-tests. Lastly, an attempt to reflect on the design process and its outcomes is performed, resuming findings and opening for discussion on future iterations or research.

This is currently an undergoing process, in which results will inform the future directions and improvements of the Evaluation 123 model and its applicability.

Conclusion

This study seeks to provide organizations in the construction and energy transition industries with a viable and practical tool for designing evaluations that measure the effectiveness of the training programs they provide. There are several challenges that need to be considered, such as the diversity of stakeholders, competences and skills involved, modalities of training, availability of human, material and financial resources, as well as societal influences and legislation. Whereas this is a complex enterprise, this study seeks to contribute

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with these efforts by rendering the necessary expertise for the development of assessment programs. As the European Union moves towards more sustainable and energy efficient practices, it is imperative that these evaluation efforts are harmonized and widely recognizable within the European community.

The main needs in guidance and support identified when developing assessment programs were lack of focus on learning goals, use of ineffective instruments and insufficient knowledge on assessment design and implementation. This information was used to develop adequate tools that could support commissioners and providers of training to properly assess the effectiveness of their programs, either for improvement or certification purposes, by relying on scientific knowledge and methods rather than practical experience. A set of tools was designed, developed and pilot-tested to provide a solid but yet practical model for assessments design and their implementation.

Future directions of this study include the use of learning analytics and study of learning paths to identify the constraints and limitations faced by trainees, in order to inform improvements on training programs and facilitation of learning.

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Appendix A

Learning Goals Tool

https://docs.google.com/spreadsheets/d/1yC3A1TJVPzP3mUrtjVv9TeE_eKtqEAZZevuuVDKJ_I/edit?usp=sharing

  		
	Abilities	Description of category
Conceptual Knowledge	<p>Recognize and retrieve relevant knowledge</p> <p>Constructing meaning from instructional messages</p>	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.
Procedural Skills	<p>Carry out or use a procedure in a given situation</p>	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.
Analytical Thinking	<p>Breaking down information into component parts and their relation</p> <p>Making judgements based on criteria and standards</p>	<p>Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.</p> <p>Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.</p>

First, select your preferred language for an automatic translation. (Provided by Google Translate)	Select a language
Write here the time condition (e.g. After the training..., At the end of the workshop...) 	
Write here who are the participants / target audience of the training (e.g. employees, trainees, consultants, installers, etc.) 	

Tip: You can add your own text by clicking twice in any yellow box.

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1	WHEN	WHO	SELECT	Objective	WHAT
			will be able to	Objective	
	, will be able to Objective				

, will be able to Objective

2	WHEN	WHO	SELECT	Objective	WHAT
			will be able to	Select or Write action verb	
	, will be able to Select or Write action verb				

, will be able to Select or Write action verb

3	WHEN	WHO	SELECT	Objective	WHAT
			will be able to	Select or Write action verb	
	, will be able to Select or Write action verb				

, will be able to Select or Write action verb

Scenario 1	I can apply a test before and after the training	PRETRAINING A	TRAINING	POSTTRAINING
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Scenario 2	I can only apply a test after the training	TRAINING	POSTTRAINING	PRETRAINING B
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POST-TRAINING	To be applied AFTER the training.	
1	, I am able to Objective	, I am able to Objective
2	, I am able to Select or Write action verb	, I am able to Select or Write action verb
3	, I am able to Select or Write action verb	, I am able to Select or Write action verb
4	, I am able to Select or Write action verb	, I am able to Select or Write action verb
5	, I am able to Select or Write action verb	, I am able to Select or Write action verb

PRE-TRAINING A	Two-tests condition (pre and post-training tests performed separately)	
To be applied BEFORE the training.		
1	I am able to Objective	I am able to Objective
2	I am able to Select or Write action verb	I am able to Select or Write action verb
3	I am able to Select or Write action verb	I am able to Select or Write action verb

PRE-TRAINING B	One-test condition (pre and post-training tests performed together)	
We still apply both tests, but in inverted order (post ⇒ pre)		
Type time condition here	➡ Before the training	Ex: BEFORE the training...
1	Before the training, I was able to Objective	Before the training, I was able to Objective
2	Before the training, I was able to Select or Write action verb	Before the training, I was able to Select or Write action verb
3	Before the training, I was able to Select or Write action verb	Before the training, I was able to Select or Write action verb

Appendix B

Sample items from Question Pack

Mastery Experience

Mastery experiences relate to how much a person is satisfied with how much they have improved their skills after an activity, when compared to a given starting point.

1. Please indicate your level of satisfaction with the following aspects of the training:

Mark only one oval per row.

	Not satisfying at all	Not satisfying	Neutral	Satisfying	Very satisfying
The opportunity to learn new skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The degree to which I improved on particular skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How much I learned about how to perform better in this activity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My improvement in performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My opportunity to practice new skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Satisfaction with decision

This survey assesses the satisfaction of the trainee with regards to their decision in engaging in a learning experience.

8. Please indicate your level of agreement to the following aspects of the training:

Mark only one oval per row.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am satisfied with my decision to attend the training	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I had to do it all over again, I would not enrol in the training	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My choice to enrol in the training was a wise one	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel bad about my decision to enroll in the training	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think I did the right thing when I decided to enrol in the training	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am not happy that I enrolled in the training	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Appendix C

Manual Cover

<https://drive.google.com/file/d/1Y7dCedeqJKciy3AfpWmB-jbybodkZe3a/view?usp=sharing>



Content page

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Appendix D



Dedicated to stimulate demand for sustainable
energy skills in the construction sector

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Document:	Rubric educational effectiveness
Prepared by:	Loes de Jong & Maaïke Endedijk, UT
Date:	14-09-2021
Partners involved:	ISSO, AVE, LIT, EnE, AEA, IVE



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Measuring educational effectiveness: design principles

Items on the design of trainings to be scored by DESIGNERS OF TRAINING OR TRAINERS								
0	Design principles (Saks & Belcourt, 2006)	Not applicable at all	Not applicable	Neutral	Applicable	Strongly applicable	Not relevant	Unknown
	Pretraining activities							
	Trainee input and involvement							
	Employees are given advanced notification about training content prior to attending a training program.							
	Training needs of employees are identified prior to training.							
	Employees have precourse discussions with their supervisors prior to attending a training program.							
	Employees have input in decisions about training program content and/or methods.							
	Supervisor involvement							
	Employees are given release time to prepare for a training program.							
	Supervisors discuss the content and benefits of a training program with employees prior to a training program.							
	Supervisors participate in advance orientation or training sessions regarding the training programs to which they will send their employees.							
	Supervisors set goals with employees that focus on improving specific skills before employees attend training programs.							
	Training attendance policy							
	Employees have a choice as to whether or not they will attend any particular training program.							
	Attendance at training programs is voluntarily							
	Employees from the same department or functional group are trained together.							
	Trainee preparation							
	Trainees are given preparatory reading prior to attending a training program.							
	Training programs include activities or assignments that trainees are required to do before they arrive for the actual training program.							
	Activities during training							
	Training programs provide trainees with training experiences and conditions (surroundings, tasks, equipment) that closely resemble those in the actual work environment.							
	Training programs provide trainees with a variety of training stimuli and experiences, such as several examples of a concept, or practice experiences in a variety of situations.							
	Training programs teach trainees the general rules and theoretical principles that underlie the training content and the use and application of the trained skills.							
	Trainees are given feedback and information about their performance of the training tasks and material during the training program.							
	Trainees are rewarded during training for learning and performing training material and tasks.							
	Trainees leave training programs with a written performance contract with goals to be achieved.							
	Training programs prepare trainees to cope with obstacles or difficulties that might prevent them from successfully applying the training material when they return to the work environment.							
	Post training activities							
	Supervisor support							
	Supervisors are instructed to provide trainees with support to help them use newly acquired skills after attending a training program.							
	Supervisors are instructed to ensure that trainees have opportunities to practice and apply newly acquired knowledge and skills after attending a training program.							
	Supervisors are instructed to praise or reward employees for using newly acquired skills developed in a training program.							
	Organization support							

GUIDING UPSKILLING EVALUATIONS IN THE FIELD OF THE ENERGY TRANSITION

Some form of booster session is conducted as an extension of a training program in which the trainer meets with trainees.							
Efforts are made to ensure that employees have the resources (e.g., tools, equipment, materials, supplies, etc.) that are necessary in order to apply the knowledge, skills, and/or abilities developed in training programs.							
The performance appraisal system considers trainees' use of knowledge, skills, and/or abilities acquired in training programs.							
Accountability							
Trainees are required to submit a post-training report after attending a training program.							
Trainees are required to participate in an interview or discussion as part of a follow-up to a training program they attended.							
Evaluation and feedback							
Employees are paired with each other following completion of a training program in order to assist each other by providing feedback and reinforcement to ensure they use the skills developed in a training program.							
Employees are evaluated on their use of new skills or knowledge following completion of a training program.							
Employees are required to undergo an assessment following completion of a training program in order to evaluate their learning.							

Measuring educational effectiveness: level 1 (reaction to training)

Items on level 1 of educational effectiveness of training to be scored by TRAINEES								
1.1	Satisfaction with training (Cunningham, 2007, slightly adapted to better match target group)	Not satisfying at all	Not satisfying	Neutral	Satisfying	Very satisfying	Not relevant	Unknown
	Mastery experiences							
	The opportunity to learn new skills							
	The degree to which I improved on particular skills							
	How much I learned about how to perform better in this activity							
	My improvement in performance							
	My opportunity to practice new skills							
	Cognitive development							
	What I learned concerning the technical aspects of the activity							
	How much I learned about the various strategies used in performing the activity							
	What I learned about the basic content of the activity							
	The knowledge about the fundamentals of the activity I have gained							
	The extent to which I learned the essential concepts of the activity							
	Teaching							
	The quality of the overall instruction							
	The clarity of the instructor's lessons							
	The instructor's enthusiasm during the training							
	The empathy the instructor showed for the students in the training							
	The instructor's ability to effectively communicate content matter							
	My performance compared to others in the training							
	Normative success							
	The superiority of my skills in comparison to others in the training							
	How I am able to perform better than other students in the training							
	My skills compared to others in the training							
	My ability to outperform others in the training							
	Interaction with others							
	The chance I had to meet people with similar interests							
	The interaction I had with others in the training							
	The opportunity to make new acquaintances in the training							
	My communication with others in the training							
	The chance I had to socialize with others							
	The overall social atmosphere of the training							
	Fun and enjoyment							
	My overall enjoyment in the training							
	How much fun I had in the training							
	The pleasant experiences I had in the training							
	The extent to which I had a good time in training							
1.2	Satisfaction with training (So & Brush, 2008, slightly adapted to better match the target group)	Not applicable at all	Not applicable	Neutral	Applicable	Strongly applicable	Not relevant	Unknown
	I was able to learn from discussions in the training							
	I was stimulated to do additional readings or research on topics discussed in the training							
	Discussions assisted me in understanding other points of view							
	As a result of my experience with this training, I would like to take another training in the future							
	This training was a useful learning experience							
	The diversity of topics in this training prompted me to participate in the discussions							

GUIDING UPSKILLING EVALUATIONS IN THE FIELD OF THE ENERGY TRANSITION

	My level of learning that took place in this training was of the highest quality							
	Overall, the learning activities and assignments of this training met my learning expectations							
	Overall, the instructor for this training met my learning expectations							
	Overall, this training met my learning expectations							
1.3	Satisfaction with training (Athiyaman, 1997, slightly adapted to better match the target group)	Not applicable at all	Not applicable	Neutral	Applicable	Strongly applicable	Not relevant	Unknown
	I am satisfied with my decision to attend the training							
	If I had to do it all over again, I would not enrol in the training (reversed item)							
	My choice to enrol in the training was a wise one							
	I feel bad about my decision to enrol in the training (reversed item)							
	I think I did the right thing when I decided to enrol in the training							
	I am not happy that I enrolled in the training (reversed item)							
1.4	E-learning (Wang (2003), slightly adapted to better match the target group)	Strongly applicable	Applicable	Neutral	Not applicable	Not applicable at all	Not relevant	Unknown
	Interface							
	The e-learning system is easy to use.							
	The e-learning system is user-friendly.							
	The content provided by the e-learning system is easy to understand.							
	The operation of the e-learning system is stable.							
	The e-learning system makes it easy for trainees to find the content they need.							
	Learning community							
	The e-learning system makes it easy for trainees to discuss questions with other trainees.							
	The e-learning system makes it easy for trainees to access the shared content from the group.							
	The e-learning system makes it easy for trainees to discuss questions with trainers.							
	The e-learning system makes it easy for trainees to share what they learned with the group.							
	Content							
	The e-learning system provides up-to-date content.							
	The e-learning system provides content that exactly fits the trainees' needs.							
	The e-learning system provides sufficient content.							
	The e-learning system provides useful content.							
	Personalization							
	The e-learning system enables trainees to learn the content they need.							
	The e-learning system enables trainees to choose what they want to learn.							
	The e-learning system enables trainees to control their learning progress.							
	The e-learning system records trainees' learning progress and performance.							

Measuring educational effectiveness: level 2 (learning from training)

Items on level 2 of educational effectiveness of training to be scored by DESIGNERS OF TRAINING OR TRAINERS								
2.1	How it is assessed	Not applicable at all	Not applicable	Neutral	Applicable	Strongly applicable	Not relevant	Unknown
	Trainees are assessed by (pre and post) knowledge testing (performed by trainees themselves)							
	Trainees are assessed by (pre and post) skills observation (performed by trainer, manager or researcher).							
2.2	Level of learning (Bloom (Oliver et al. 2004; Bloom)	Not applicable at all	Not applicable	Neutral	Applicable	Strongly applicable	Not relevant	Unknown
	After the training, trainees are able to remember (i.e. recall facts from the training material).							
	After the training, trainees are able to comprehend (i.e. understand, translate, and interpret the training material material).							
	After the training, trainees are able to apply (i.e. use the knowledge from the training material in a new context).							
	After the training, trainees are able to analyse (i.e. identify relationships).							
	After the training, trainees are able to synthesize (i.e. (re)assemble parts into a new whole).							
	After the training, trainees are able to evaluate (i.e. make judgements).							

Measuring educational effectiveness: level 3 (change in behaviour due to training)

Items on level 3 of the educational effectiveness of training to be scored by DESIGNERS OF TRAINING OR TRAINERS 1 month/3 months/1 year after training								
3.1	How it is assessed	Not applicable at all	Not applicable	Neutral	Applicable	Strongly applicable	Not relevant	Unknown
	The trainees' transfer of skills (depending on the topic of the training) to the workplace is assessed by <i>observations</i> in the workplace (performed by trainer, manager or researcher).							
	The trainees' transfer of skills (depending on the topic of the training) to the workplace is assessed <u>one month</u> after the training by <i>log/user data</i> in the workplace (that is automatically generated).							
Items on level 3 of educational effectiveness of training to be scored by TRAINEES 1 month/3 months/1 year after training								
3.1	Self-perceptions (Chauhan et al., 2016)	Not applicable at all	Not applicable	Neutral	Applicable	Strongly applicable	Not relevant	Unknown
	Usage of skills acquired from training has helped me improve my work							
	I can complete my work faster than I could before attending the training							
	I can complete my work in a better way after attending the training							
	The quality of my work has improved after using skills acquired from training							
	I make fewer mistakes in job when I use the skills I have acquired from training							