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Abstract	In the safety-critical process industry, workplace learning during vocational education and training (VET) is essential when developing the safety competence of process operator students. Due to the Finnish VET reform, workplace learning needs to be reorganized and requires new methods. This study aims to examine the current development needs regarding the guidance of workplace learning in the process industry with respect to VET. Expert interviews (n = 12) and a workshop (16 participants) were carried out with participating organizations. The results were reviewed from the perspectives of process industry companies

and VET providers. Based on the results, further actions are suggested to help companies and VET providers adapt to the new situation and process safety requirements. The results can help guide companies and VET providers toward shaping future process safety and the safety culture in the process industry.

Keywords (separated by '-')	Process safety - Process industry - Vocational education and training - Safety competence - Workplace learning

Developing Safety Competence Process for Vocational Students

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Keywords: Process safety · Process industry
Vocational education and training · Safety competence · Workplace learning

1 Introduction

In the process industry, work is typically done using dangerous materials, under extreme conditions, and with high potential for major accidents. Consequently, even though safety systems and regulations have evolved during the last few decades, safety criticality is still emphasized in the process industry [1].

Young and inexperienced workers typically encounter accidents more commonly than other employees [2, 3]. In terms of process safety, safety culture and competence are key performance determinants in the field of process safety, when automation systems and technologies become more complicated [4]. At the same time, the ageing workforce increases the need for skilled workers in the process industry [5], and new workers must be introduced to a safe working mode from the very beginning of their career [2].

In the safety-critical process industry, workplace learning during vocational education and training (VET) is essential when developing the safety competence of process operator students. The students are provided with basic safety understanding and practices during vocational studies [6], but this knowledge needs to be further strengthened at the workplace to take company-specific safety requirements into account.

In the future, VET will be increasingly organized through workplace learning, elevating its importance [7, 8]. In fields of business other than the process industry, the close collaboration between workplaces, VET providers, and students is found to be beneficial in increasing learning, as well as in developing competence in organizations [9–11]. However, the in-company trainers typically need education and support for guiding the students at the workplace [9, 12]. Hence, workplace learning in the process industry needs to be reorganized and requires new methods.

To make the most of this educational reform, its benefits should be pointed out for the industry. Some of these benefits include the development of in-company competence and guidance procedures, a decrease in recruitment costs, and an increase in enticement and engagement of qualified workers [13–17].

Despite ongoing changes in the education system and the need for novel approaches, research has thus far overlooked this topic. This study aims to fill this gap by surveying the current development needs regarding the guidance of workplace learning in the process industry with respect to the process operator vocational qualification.

2   Materials and Methods

This study employed a qualitative approach [18] due to its descriptive and contextual nature. Seven international companies from the chemical and process industry and five VET provider organizations participated in the study. Congruent with the qualitative approach, the data for this paper were collected through expert interviews (n = 12) and a workshop directed at the contact persons (n = 16) of the participating organizations in the spring of 2018 (see summary in Table 1).

Table 1. Summary of the participating organizations and data.

Companies (n = 7)	Industry	Chemical and process industry
	Revenue	Between 11 and 13,217 million €
	Personnel	Between 38 and 5,297 persons
VET providers (n = 5)	No. of students*	Between 1,400 and 18,000
	No. of employees*	Between 236 and 1,200
Interviews and workshop	Participants	Contact persons (n = 16) at the organizations involved in the planning of workplace learning guidance
	Participants' job title	HR managers, development managers, HSEQ managers, education managers, and teachers
	Duration	Interviews of 30–60 min, one-day workshop

*Number of all students and employees, not only within the process industry.

The companies and VET providers were selected so that each company cooperated with at least one VET provider and vice versa. In addition, a concrete need and the will to develop cooperation were part of the selection criteria. Moreover, the VET providers represented different geographical areas in Finland.

One interview was carried out in each participating organization. The interviews were mainly individual interviews, however, more interviewees participated in some of them. The interviews were conducted as semi-structured phone interviews. The interview questions concentrated on development needs in the guidance of workplace learning. The interview results were validated in and complemented by a workshop, through discussions and exercises. The development needs identified in the interviews were presented and reviewed from the perspectives of the process industry companies and the VET providers. The interviewees and participants of the workshop were the same contact persons of the participating organizations, involved in the planning and direction of the guidance of workplace learning.

3 Results

The results show that both the process industry companies and the VET providers consider that the aim of education, whether realized at an educational institution or in the workplace, is to ensure that the students studying toward a degree have sufficient process safety knowledge and competence. However, both parties highlighted several developmental needs regarding the guidance of workplace learning. Most of these insights correlate between the companies and the VET providers, but some diverging views are also noted. These insights are summarized in Table 2 and discussed here in more detail.

The companies and the VET providers agree that knowledge and understanding of the reform and its detailed requirements are still limited and, hence, require improvements. The industry representatives consider this blurriness to be a result of the novelty of the reform, as well as of fragmentary information. They indicate that the realization of different procedures is still unclear (e.g. assessment of competence). Limited information and misleading news have caused criticism among some, typically smaller, companies and therefore the VET providers are concerned about the negative effects of such poor knowledge on insights in companies. These companies fear that educational responsibilities are shifted from the VET providers to the companies. Furthermore, both parties are concerned about the practical training arrangements for students under 18 years of age, because many process industry companies do not employ young trainees for safety reasons.

In addition, training and support of the workplace guidance personnel require improvement. The companies' representatives believe that the role of guidance personnel is still vague and that, therefore, a detailed description of the role and the operating process for such personnel would be beneficial. This description should also pay attention to student diversity, as some students may require more guidance than others—in which case the question is whether teachers or workplace guidance personnel would be able to provide such necessary additional guidance? In addition, the VET providers express their concerns about the workplace guidance personnel's possibilities to personalize their

Table 2. Aspects requiring development and further attention.

Category	Companies	VET organizations
Knowledge about the effects of the reform	Due to the novelty of changes, knowledge is too limited and clarification of procedures is needed	Criticism in companies due to misleading news and deficient information
Support of workplace guidance personnel	Role unclear, detailed description of the role and process considering student diversity needed	Realization of training varies, uniform model is required
Teachers' competence and resources	Better understanding of companies' needs and of the practical work life is required	Means to increase the teachers' practical training periods in the companies
Collaboration between different parties	Knowledge sharing requires strengthening; means and tools of communication need improving	
Understanding content of studies	Clarification of the competences of the students starting training is needed	Understanding of the students' learning requirements is needed; company training is needed
Responsibilities and agreements	Clarification of each party's different responsibilities is needed	Bureaucracy needs to be lowered
Personnel turnover	Additional effort needed due to frequent changes in contact personnel	
Congruent working practices	Shared means between companies and VET providers would increase the skills of students	
Attitude and activity		Open-mindedness towards the students' skills and diversity; activity in educational development

guidance based on specific student needs and interests. The VET providers also highlight the need for workplace guidance personnel training; at the moment, there is no specific model for implementing such training, but training is organized when needed and in the manner considered most suitable for that particular situation.

In addition to the competence of the workplace guidance personnel, the representatives of both parties highlight the need for improving the teachers' competence and the resources allocated for practical training. The companies consider that the VET providers should have a better understanding of how companies operate in general, but also that the teachers' practical know-how about work life could be enhanced. Similarly, the VET providers express a desire to further their knowledge of the companies' needs, so that they could ensure the best possible training for their students. Both parties report that some years ago the teachers were more involved with the companies through practical training periods, but that this practice was abandoned due to decreasing resources.

Both parties also highlight the need for the strengthening of collaboration between the companies and the VET providers. In addition, the means and tools for improving communication are longed for. However, the VET providers express their concern regarding the sufficiency of the companies' resources for additional collaboration.

Understanding the content of the studies is also perceived as an aspect requiring improvement. The companies desire clarification of the skills of those students starting practical training in a company—what the students already know and can do, and what the companies are expected to teach them. The VET providers also point out that the companies do not always fully understand what the students should learn during the training period. They further highlight the need for additional training on this topic in the companies, particularly if the training requirements change.

Both parties point out the high amount of bureaucracy pertaining to training contracts. The companies are also concerned about responsibility issues, as it is still unclear which party is responsible of which aspects. In addition, both parties are slightly frustrated regarding the additional amount of work and effort created by changes in personnel. The frequent contact personnel changes, both in the companies and at the VET providers, require discussions about agreed practices to be restarted every two years.

One of the rare divergent insights between the companies and the VET providers relates to the congruency of working practices, which is longed for only by the companies. They wish for shared means with the VET providers (e.g., risk assessments and evacuation practices) that could be practiced during studies, not only at workplaces. Furthermore, the companies wish that students would master the rules for correct behavior (e.g., restrictions for phone usage at the workplace) when entering the worksites. On the other hand, the VET providers long for open-mindedness from the companies, as the trainees are only students not graduate professionals. They pointed out that the companies prefer the most proficient students for the training periods, but that the less skillful students also require training to gain proper competence. In addition, the VET providers hope for more interaction from the companies in various activities (e.g., participation in trainings and other events, as well as in planning educational content), so that these would better respond to the companies' needs.

4   Discussion

This paper reviews the current developmental needs regarding the guidance of workplace learning in the process industry. The current VET reform causes uncertainty about the collaboration between the companies and the VET providers, because new procedures are still only in the developing phase. For example, new training modules for the in-company trainers are required, but the training is under revision due to the reform.

This study reveals that the process industry companies and the VET organizations share insights about developmental needs to a great extent. These shared viewpoints include the need for additional information about the reform effects, for support and training of both the guidance personnel in the workplaces and the teachers in the VET organizations, as well as for clarification of the studies' content and the objectives of

the workplace training. In addition to these shared views, only some sporadic aspects specific to the companies or the VET providers are expressed. The consensus among the parties involved in workplace training forms a fruitful foundation for future developmental efforts and for the creation of shared practices regarding the VET reform.

Most of the identified developmental needs, it would seem, can be solved with reasonable effort, but since the resources are limited both in the companies and at the VET providers, the progress of the developmental work requires increased collaboration and focus on the most critical and timely issues. Based on the results, further actions can be implemented to help the companies and the VET providers adapt to the new situation in the VET [7, 8] and to current process safety requirements [4]. The results of this paper can guide companies and VET providers toward shaping process safety competence and safety culture with respect to workplace training realized in process industry companies. Developing the process safety competence of vocational students provides a qualified workforce for the process industry in the future. Moreover, it may support companies in competence development of their current workforce, as well as help them to entice, recruit, and engage new workers [16, 17].

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