



Research paper

Vocational teachers' professional learning: A systematic literature review of the past decade

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H I G H L I G H T S

- Learning can occur in academia, school workplace, and industry settings.
- Learning can be conducted in various formal and informal ways.
- Outcomes are related to changes of teachers, students, and institutions.
- Changes in teaching practice were the most frequently examined outcomes.

A R T I C L E I N F O

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A B S T R A C T

In the last decade, how to promote in-service vocational teachers' capabilities has become one of the most important concerns in the field of vocational education. This study presents the results from a systematic review of vocational teachers' learning activities and outcomes, based on an analysis of 54 journal articles published between 2010 and 2021. These results illuminate that, first, vocational teachers' learning can occur in academia, school workplace, and industry settings, and in various formal and informal ways. Second, vocational teachers' learning outcomes are related to the changes in their cognition and behaviour as well as student and institutional benefits.

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1. Introduction

Vocational teachers play a crucial role in ensuring vocational graduates' competitiveness in the labour market. To raise the quality of vocational education, vocational teachers are expected to seize opportunities to develop themselves, both inside and outside school (Dymock & Tyler, 2018; Schmidt, 2019; Virkkula & Nissilä, 2014). In recent years, the professional learning of vocational teachers has obtained much attention as contemporary society and industry are changing rapidly, which means vocational teachers have to adapt their teaching practice to the newest developments (Andersson & Köpsén, 2018; Hoekstra & Newton, 2017). In order to support vocational teachers to deal with these ongoing changes, a

variety of professional learning initiatives or activities have been employed. Moreover, a substantial number of innovations or reforms have been implemented in the field of vocational education, which alters competence requirements of vocational teachers and hence stimulates them to keep up with professional learning. For example, in the Netherlands 'competence-based education' was introduced, i.e., an educational innovation that entails curricula in vocational education should be derived from an analysis of actual roles of professionals in society. To realise it, vocational teachers across different disciplines are advocated to work jointly and engage in team learning (van Griethuijsen, Kunst, van Woerkom, Wesselink, & Poell, 2019; Wijnia, Kunst, van Woerkom, & Poell, 2016).

Vocational teachers' work is based on dual professionalism and they are expected to keep their competencies of both teacher and professional up to date (Andersson & Köpsén, 2015; Fejes & Köpsén, 2014; Köpsén & Andersson, 2017; Virkkula & Nissilä,

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2014). As Lloyd and Payne (2012) explained in their research, 'For those teaching vocational programmes, there are 'dual' skill needs which require them to keep up to date with their particular craft or trade, while also developing the pedagogic skills needed to impart this knowledge to learners.' (p.2) This dual focus has been a common guide to implement pre-service or in-service vocational teacher learning activities in most countries. For example, in Germany, aside from vocational teacher training, vocational student teachers have to conduct subject-related internships, work, or other practical activities for at least 12 months before starting their teaching career (der Länder, 2018). In China, a country with a typical school-based vocational education system, the concept of 'dual qualified teachers' has been developed, which implies that vocational teachers are supposed to possess both theory-based and work-based teaching abilities (The State Council of the People's Republic of China, 2005). In addition to regular professional development, all vocational teachers are required to engage in the industry context for at least one month every year (The State Council of the People's Republic of China, 2019).

In the past decade, an increasing number of studies have strived to characterise vocational teachers' professional learning. Some studies mixed vocational teachers with general teachers, while other studies only explored vocational teachers. Based on these studies, four main topics can be distinguished: learning needs, antecedents, activities, and outcomes (Hoekstra, Kuntz, & Newton, 2018; Serafini, 2018). More than learning needs and antecedents, learning activities and outcomes are the heart of understanding learning processes. They provide an overview of what vocational teachers do and with which results when developing professionally. Yet these findings are scattered over various studies and many of those only cover one particular activity or outcome. Until now, a comprehensive overview is still missing. Therefore, in this study, we aim to synthesise vocational teachers' learning activities and outcomes. Two questions directed our research:

RQ1. How can vocational teachers' professional learning activities be characterised?

RQ2. What outcomes of vocational teachers' professional learning can be distinguished?

2. Method

2.1. Literature search

In this study, we followed the principle of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) 2020 statement and explanation and elaboration (Page et al., 2021). The literature search was performed across all electronic databases with the number of 779 available at the Library of Leiden University, such as Web of Science, Educational Resources Information Center (ERIC), and Social Science Research Network (SSRN). We employed the following search terms combined with Boolean operators: Title included professional development OR professional learning OR teacher training OR teacher learning AND Any field included vocational teachers OR VET teachers. The literature search was restricted to the period from Jan 2010 to August 2021 because of two reasons. First, a body of research on vocational teachers' professional learning has emerged since 2010. Second, new developments in society and vocational education, including vocational teachers' professionalisation occurred from 2010, which was already predicted by Bédoué et al. (2009, pp. 15–65). To ensure the quality of our study, only journal articles were selected that were peer-reviewed, which means there was no grey literature

included. This search resulted in 1307 hits.

2.2. Literature screen and selection

As shown in Fig. 1, after removing 15 duplicates, we screened the titles and abstracts of the remaining 1292 articles based on the following initial inclusion criteria: 1) Participants in the studies are in-service vocational teachers, i.e., either teachers in vocational schools or vocational teachers in general schools. 2) The topic of the studies is professional learning. Drawing upon these criteria, 53 articles were included and 904 articles were excluded. However, a barrier appearing in the process of screening was that a number of studies did not explicitly describe the participants in their abstracts. Therefore, 335 articles were further scrutinized by screening the methods sections of the full texts. As a result, 42 articles were added for eligibility assessment.

To evaluate the eligibility of the selected 95 articles, two more specific criteria were employed in our study. First, the included research had to be focused on vocational teachers' professional learning with consideration of either learning activities or outcomes, or both. Second, we excluded the studies with vocational teachers and other types of teachers as participants that did not present findings for vocational teachers separately. After this final step, 41 articles were excluded and 54 articles were included in further analysis.

2.3. Literature coding and analysis

In order to analyse the full texts of the selected literature, we first selected the fragments linked to vocational teachers' professional learning activities and outcomes. Learning activities and learning outcomes have been described in 54 articles and 37 articles, respectively. Three categories of learning activities have been generally distinguished: pre-defined professional development programmes, school-based learning, and industry-based learning, which focus on formal learning in programmes, informal learning in school workplace, and formal and informal learning in industry workplace, respectively. Although informal learning outside school and industry, such as informal online learning has been indicated as an emerging learning approach (Macià & García, 2016), we only found two studies that reported this kind of learning, consisting of 'accessing materials, resources, or communities online' (Broad, 2016) and 'watching online presentations' (Hoekstra et al., 2018). Although these two activities were conducted in a virtual context, they can be deemed as an updated form of self-directed or collaborative learning in workplace. Therefore, we moved them to the category of school-based learning. Furthermore, as collaborative learning has been a particularly important component of school-based learning (Oude Groote Beverborg, Slegers, Endedijk, & Van Veen, 2015), we then split school-based learning into self-directed/initiated and collaborative learning, which means four categories of learning activities were finally generated. The descriptions for coding categories were listed in Table 1.

To categorise vocational teachers' learning outcomes, the model of learning outcomes developed by Harland and Kinder (2014) was applied as a coding scheme. Although this model is developed for general teachers, it proved to be useful for analysing vocational teachers' learning outcomes as well (Zhou and Tigelaar, 2021). Two categories (i.e., material and provisionary and informational outcomes) were not found and one category (student outcomes) was added. The coding categories are described in Table 2. To further describe the characteristics of these learning outcomes, we

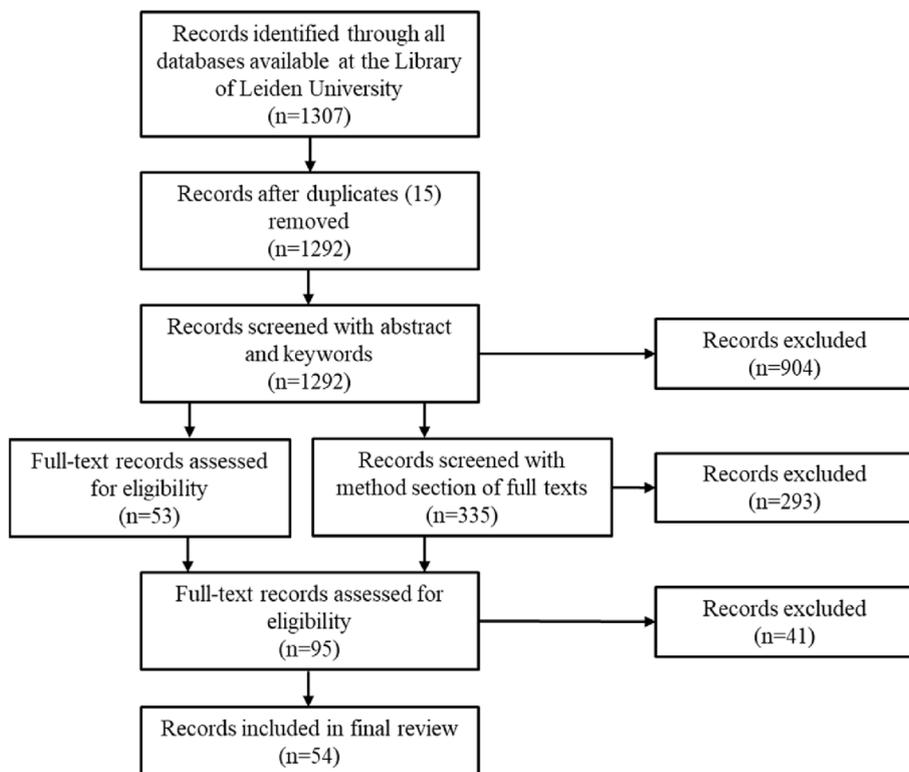


Fig. 1. Flowchart of the article search and selection.

Table 1
The coding categories of learning activities.

Learning activities	Descriptions	Examples
Pre-defined professional development programme	Learning activities which are well-designed and organised inside or outside school (excluding industry).	Academic course, Formal education, Academic workshops.
Self-directed/initiated activities in school	Learning activities in which vocational teachers have ownership over their learning process in school.	Learning from doing, Learning from reflection, Learning from reading.
Collaborative activities in school	Learning activities which need interactions or cooperation with colleagues, supervisors, or students in school.	Peer sharing, Peer observation, Asking feedback from students.
Industry-based activities	Learning activities occurring in the industry context or being organised by companies.	Work placement, Part-time job, Industrial conference.

assessed the significance of the outcomes with positive, negative, mixed, or non-significant.

3. Findings

All 54 selected studies were empirical, using qualitative, quantitative, or mixed research methods. The majority of the reviewed studies were conducted in Europe (40), particularly in the Netherlands (20). Others were conducted in North America (6), Oceania (5), Asia (2), and Africa (1). Besides, most of the selected articles were about secondary vocational education, of which graduates can either apply for a job or follow higher education. In this section, we will report the findings derived from the selected articles with respect to vocational teachers' learning activities and

outcomes. In Appendix A, we summarised how the studies were classified.

3.1. Vocational teachers' professional learning activities

All 54 selected studies were found to be connected with vocational teachers' professional learning activities. The learning activities in these studies were classified into the following four categories:

3.1.1. Pre-defined professional development programme

Overall, 32 studies reported pre-defined learning programmes or activities, which were usually purposefully designed and supported by schools, educational departments, or scholars working

Table 2
The coding categories of learning outcomes.

Categories	Descriptions	Examples
Material and provisionary	Physical resources obtained from participation in learning activities.	Teachers get working manuals, pictures, and videos from industry practice.
Informational outcomes	Background information about curriculum and management developments.	Teachers get the latest information of the educational reform in vocational education.
Knowledge and skills	Teachers' deeper understanding of the issues related to pedagogy and teaching content.	Occupational knowledge, Pedagogical knowledge.
Value congruence	Teachers' personalised perspectives which are in line with others' views of 'good practice'.	Teachers perceive importance of learning content for their teaching.
Affective outcomes	Teachers' emotional experience with learning.	Teachers are satisfied with their learning experience.
Motivational and attitudinal outcomes	Teachers' motivation to apply the ideas obtained from learning and changes in their attitudes.	Teachers desire to make application of learning in their teaching.
New awareness	Teachers' perceptual or conceptual shifts.	Teachers acquire a new insight from learning with respect to their teaching.
Institutional outcomes	Collective effects on teacher groups or other stakeholders.	Team performance, Industrial development.
Impact on practice	Teachers' changes in practice.	Teaching quality including classroom management, learning support, and application orientation.
Student outcomes	The changes in students' learning achievement or engagement.	Quality of student workplace learning.

inside or outside the schools. Some of them were organised nationwide for vocational teachers, such as the Swedish national initiative and Indonesia community-based teacher training (Andersson & Köpsén, 2015; Sumaryanta, Mardapi, Sugiman, & Herawan, 2019). Usually, a pre-defined professional development programme comprises several specific learning activities and is implemented over a long period.

Five of the 32 studies did not identify specific activities but used general terms to represent them, such as in-service teacher training programs, and education development days (Bouwman, Runhaar, Wesselink, & Mulder, 2019; Csíkos, Kovács, & Kereszty, 2018; Iqbal, Khan, Mohmand, and Mujtaba (2020); Sirk, Liivik, & Loogma, 2016; Sumaryanta et al., 2019). Other studies explicitly specified and described those well-structured learning activities. Of these activities, a common one was a course, in which vocational teachers mainly learn from expert presentations, either in an online or off-line setting. Based on the descriptions of the eight reviewed studies that reported on courses as a learning activity, the courses were often designed with several sessions and performed for from several weeks to a semester. The topics of these courses were often related to vocational teachers' pedagogical skills, such as assessment skills and ICT skills (Castaño-Muñoz, Kalz, Kreijns, & Punie, 2018; Cochrane & Narayan, 2011; Hoekstra & Newton, 2017; Sandal, 2021; Winberg & Pallitt, 2016).

Another learning activity linked to courses was formal education, which was reported in four studies. Formal education is executed to upgrade vocational teachers' educational attainment or qualifications with a systematic combination of courses. The field of formal education was found to be related to teaching qualifications or specific vocations (Andersson, Hellgren, & Köpsén, 2018; Andersson & Köpsén, 2018; Lahiff, 2015; Lloyd & Payne, 2012). Regarding teaching qualifications, a number of vocational teachers attended in-service initial teacher training while already being employed in schools (Lahiff, 2015).

Moreover, some separate learning activities, i.e., workshops, seminars, conferences, forums, and meetings were also mentioned in 21 studies. These activities were always concentrated on a specific topic and conducted in one day or several days within a period. All of these separate activities in the selected studies were described with a high demand for interactions among vocational teachers except for conferences (Hodes, Foster, Pritz, & Kelley, 2011).

Apart from the above-mentioned learning activities, coaching/mentoring was also found to be a common activity, concerning specific guidance from professional supervisors for vocational teachers with regard to their practice in school. In the seven studies that reported on coaching/mentoring, these activities were not organised independently, which means it was usually followed by or combined with other formal activities, such as workshops or short courses (Smets & Struyven, 2020; Zeggelaar, Vermeulen, & Jochems, 2018, 2020, pp. 1–21). The duration of coaching or mentoring was usually at least several months.

3.1.2. Self-directed/initiated activities in school

Similar to general teachers, the school workplace is also an important context for vocational teachers' professional learning. As an important part of workplace learning activities, the self-directed/initiated activities in the school workplace emphasise vocational teachers' learning by their active exploration. Of the 54 selected studies, 19 studies reported about learning from school-based and self-directed/initiated activities and more than half of them examined at least two specific activities.

More specific, 11 of 37 studies reported the activities 'learning from experimenting' and 'doing', which, respectively, concern vocational teachers' attempts to learn through trying new ideas or approaches, and through undertaking daily work without a purpose of learning. Ketelaar, Koopman, Den Brok, Beijgaard, and Boshuizen (2014) investigated eleven vocational teachers' learning experiences and found their learning activities had to do mostly with both learning from experimenting and doing. However, compared to learning from doing, learning from experimenting was more frequently presented in the reviewed studies. Runhaar, ten Brinke, Kuijpers, Wesselink, and Mulder (2014) found that learning from experimenting was a beginning and basic activity for implementing an educational innovation. Hoekstra et al. (2018) use 'trial and error' as a classification for referring to vocational teachers' learning activities concerned with making mistakes and trying to fix them.

Furthermore, learning from reflection is recognised as a common learning activity in 12 reviewed studies. In particular, many quantitative studies used reflection as an important activity to measure vocational teachers' engagement in professional learning (Messmann, Mulder Regina, & Gruber, 2010; Oude Groote Beverborg et al., 2015; Runhaar, Sanders, & Yang, 2010). Hoekstra

et al. (2018) distinguished three levels of vocational teachers' reflective learning activities, i.e., action-oriented reflection (an evaluation of their actions), meaning-oriented reflection (a rational reason for selecting a certain way), and rapid/intuitive responses (a rapid/intuitive cognition).

Another self-directed/initiated activity mentioned in seven reviewed studies was learning from materials, such as books and videos (Andersson et al., 2018; Andersson & Köpsén, 2018; Chatigny, Levesque, & Riel, 2012). In particular, reading books was more frequently reported in the reviewed studies and the types of books were diverse, like textbooks, journals, and professional literature (Chatigny et al., 2012; Runhaar et al., 2014; Sirk et al., 2016). In the study of Runhaar et al. (2014), reading was found to occur much more frequently at the beginning of the implementation of an educational reform. Considering all the self-directed/initiated activities, reflection is frequently identified as the most common activity by the selected studies.

3.1.3. Collaborative activities in school

In addition to self-directed/initiated activities, collaborative activities are also an important source for vocational teachers' professional learning in the context of school. Of the 54 studies, 26 reported on vocational teachers' collaborative learning activities. Most of these activities happened among vocational teachers and some of them were implemented with a form of teacher professional learning community or team (Alhanachi, de Meijer, & Severiens, 2021; Bouwmans et al., 2019; Runhaar et al., 2014; Vangrieken, Dochy, & Raes, 2016).

Concretely, several activities of peer collaboration were reported in the reviewed studies. Of these activities, sharing among vocational teachers was identified as the most common and basic activity (reported in 14 studies), which specifically refers to vocational teachers' exchange of materials, methods, and practical information and opinions. Although the researchers of the selected studies utilised different words to describe this activity, such as 'discussing different ideas' (Lloyd & Payne, 2012), 'learning in dialogue' (Hoekstra & Crocker, 2015), 'exchanging experiences' (Sirk et al., 2016), and 'informal talk' (Runhaar et al., 2014), 'ask colleagues for advice' (Hoekstra et al., 2018), sharing was seen as a fundamental feature of this activity.

In addition, peer observation or coaching was another valued activity (reported in 10 studies), which was particularly important for novice vocational teachers (Bouwmans et al., 2019; De Jong, Meirink, & Admiraal, 2021; Hoekstra et al., 2018; Hoekstra & Newton, 2017). However, Runhaar et al. (2014) found that this activity was seldomly carried out by vocational teachers due to their lack of time.

Moreover, some studies reported a series of activities with a higher level of interaction among vocational teachers, which were related to collaborative work or research. These activities concerned lesson study, or preparing lessons or assignments together, and were usually carried out in teams or professional learning communities (PLCs) (Alhanachi et al., 2021; Bouwmans et al., 2019; Runhaar et al., 2014). Throughout the above-mentioned activities, sharing was not only described as a separate activity, but also frequently mentioned as a learning activity during peer observation or coaching and joint work activities (Hoekstra & Newton, 2017; Saunders, 2013).

Aside from colleagues, vocational teachers were also reported to learn from others, i.e., their vocational students and supervisors.

For example, feedback from students and supervisors promotes them to reflect on their teaching practice and subsequently, to make changes in their practice (Hoekstra & Crocker, 2015; Hoekstra et al., 2018). Regarding students' feedback, based on an analysis of the results from three related studies, vocational teachers were found to be merely actively instead of passively engaged in collecting feedback from their students, particularly when they were making changes in their class (Hoekstra & Crocker, 2015). With regards to supervisors' feedback, the performance management cycle is an important source for vocational teachers to receive feedback. For example, in the study of Hoekstra and Newton (2017), vocational teachers were assessed by supervisors based on classroom observations and by using a feedback template, and these activities were being carried out in the context of a performance management cycle.

3.1.4. Industry-based activities

Due to the characteristics of vocational education and the dual-skill demand for vocational teachers, industrial working life has been considered a crucial context for vocational teachers' professional learning. This is particularly the case for teachers from school-based vocational education systems (Andersson & Köpsén, 2015, 2018). Learning activities occurring in an industry setting were reported in 12 of the 54 studies. In particular, Andersson and Köpsén (2018) and Broad (2016) summarised vocational teachers' possible learning activities related to specific vocations and a part of them were characterised as 'industry-based'.

Specifically, since plenty of vocational teachers take a responsibility for supervising or coordinating students in their placement or internships, they need to access to industrial places frequently, which may provide them with learning opportunities (Andersson et al., 2018; Andersson & Köpsén, 2019). While being engaged with such activities, vocational teachers sometimes discuss with others (such as employees, and managers) in the industry about the current skill requirements and developments in regards to a certain area. Additionally, courses organised by manufacturers are also an important source for vocational teachers' learning (Andersson et al., 2018; Andersson & Köpsén, 2018, 2019; Broad, 2016). Different from academic courses, these courses are usually focused on improving vocational teachers' occupational and practical expertise.

Moreover, learning from industry practice was reported by 10 studies addressing vocational teachers' learning through authentic experience in the real work context. In the research of Broad (2016), vocational teachers' practice in the industry was carried out by more than 60% of participants. In particular, working part-time jobs and undertaking their work placement in the industry were deemed as the most common learning activities. Compared to working part-time, work placement in industry is more prone to vocational teachers' professional learning in terms of its non-financial purpose. Until now, work placement has been implemented in many countries, such as England and Australia (Lloyd & Payne, 2012; Schmidt, 2019). In Sweden, it is even considered as a primary activity and vocational teachers who participate in this activity are supported by the government (Andersson & Köpsén, 2015).

Other separate PD activities are also provided in the industry context, such as industry conferences, involvement with a professional body, and conducting research or projects in the industry (Andersson et al., 2018; Broad, 2016; Schmidt, 2019). Considering

all the activities occurring in the industry, learning from industry practice is becoming a more common activity that recently has been advocated more often by policymakers and school leaders (Andersson & Köpsén, 2015).

3.2. Vocational teachers' professional learning outcomes

With regards to the second research question, we found 37 studies that examined the learning outcomes of vocational teachers. And most learning outcomes were recognised as positive. Based on the model of Harland and Kinder (2014), eight types of learning outcomes were yielded.

3.2.1. Knowledge and skills

Among 37 reviewed studies on learning outcomes, 15 studies investigated vocational teachers' knowledge and skills as a type of learning outcome. Based on the descriptions in these studies, knowledge and skills were mainly divided into pedagogical and occupational aspects. More than half of these selected studies clarified pedagogical knowledge and skills, which specifically refer to vocational teachers' knowledge of employing and utilising student assessment (Hodes et al., 2011; Sandal, 2021), stimulating students' reflection (Tigelaar & Sins, 2020; Verberg, Tigelaar, & Verloop, 2013), understanding and responding to student differentiation (Alhanachi et al., 2021; De Jong et al., 2021), and applying technologies in the classroom (Cochrane & Narayan, 2011). Occupational knowledge and skills are described as vocational teachers' knowledge with regard to subject-related occupations or crafts. These knowledge types are rather professional and practical in nature, which is in accordance with what students most need in vocational education. Only two studies explicitly focused on vocational teachers' pedagogical content knowledge (PCK). And learning PCK was found to be particularly promoted when teachers have to teach a course which was not taught before (Hoekstra et al., 2018; Virkkula & Nissilä, 2014).

3.2.2. Teaching practice

Changes in teaching practice were the most frequently reported outcome of vocational teachers' professional learning. These changes in teaching practice were examined in 25 of the 37 articles which reported on learning outcomes. According to our category system, vocational teachers' intended changes for teaching practice are also involved in this category, because the occurrence of impact on teaching practice usually needs an extensive time span (De Jong et al., 2021). The changes in vocational teachers' teaching practice were mainly reflected and examined in the following two aspects.: First, vocational teachers use what they have learned to try out new ideas or make changes in their classroom practice. For example, Voerman, Meijer, Korthagen, and Simons (2015) found that feedback interventions could significantly facilitate vocational teachers' frequency of offering feedback. Second, carrying out professional learning activities has been associated with an overall improvement of vocational teachers' teaching quality instead of particular behavioural changes. For instance, Warwas and Helm (2018) found that certain types of vocational teachers' professional learning community (PLC) were associated with their instructional quality including classroom management, learning support, and application orientation. This suggests that vocational teachers' learning outcomes with regard to teaching practice were examined with either a specific or general perspective.

3.2.3. Affective outcomes

Affective outcomes were reported in 9 of 37 reviewed studies on learning outcomes, and address vocational teachers' feelings associated with learning, usually classified as 'reaction'. The reaction of vocational teachers towards their own learning has been described to become manifest in two forms, i.e., personal concerns and satisfaction. With regards to personal concerns, in four of the reviewed studies, the concerns-based adoption model (Hall & Hord, 2006) was used to describe the affective journeys of professional change experienced by vocational teachers while being involved in certain learning programmes or activities (Saunders, 2012, 2013; Zeggelaar et al., 2018, 2020). This model illustrates four types of concerns, consisting of unrelated concerns, self-concerns, task-concerns, and impact concerns (George, Hall, & Stiegelbauer, 2006). The findings of Saunders (2012) indicated that collaboration which belongs to impact concern, is the highest stage of concern of vocational teachers. Besides, vocational teachers' satisfaction with their learning experience was also investigated in four studies. The scholars posited that most vocational teachers were satisfied with their learning availability, learning experience or learning transfer to their classroom practice (Hodes et al., 2011; Lloyd & Payne, 2012).

3.2.4. Value congruence

Value congruence refers to that vocational teachers perceive the importance of what they have learned for their teaching practice, and was reported in nine reviewed studies. From the reviewed studies, Sandal (2021) examined vocational teachers' professional development in assessment for learning within a programme and found that vocational teachers perceived 'the importance of setting goals together with the students, and as a basis for monitoring learning processes'. Smets and Struyven (2020) observed that vocational teachers who attended a programme related to differentiated instruction perceived the usefulness of what they implemented for their classes. Winberg and Pallitt (2016) explored the effect of an e-portfolio-related programme on vocational teachers' teaching practice and the results showed that vocational teachers began to understand how the e-portfolio could enhance and develop their teaching experience. Although most outcomes of value congruence were reported as positive, there was also a study reporting that vocational teachers believed learning from publications had little use for their teaching (Broad, 2016).

3.2.5. Motivational and attitudinal beliefs

The category motivational and attitudinal beliefs describes vocational teachers' enhanced enthusiasm and desire to apply what they learned in their teaching practice, and was examined in 5 of 37 reviewed studies on learning outcomes. According to Harland and Kinder (2014), this category could also include vocational teachers' sense of self-efficacy and their identities. To begin with, three reviewed studies conceptualised vocational teachers' working or learning motivation as learning outcomes. For example, the vocational teachers participating in the study of Smets and Struyven (2020) expressed their desire to improve the use of assessment data based on their learning experience. In addition, vocational teachers' self-efficacy was identified as a crucial attitudinal outcome by some reviewed studies. A few qualitative studies reported that the vocational teachers participating in courses and workshops indicated in interviews that they felt more confident in their capabilities and implementation of what they learned in their classroom practice (Cochrane & Narayan, 2011; Sandal, 2021;

Saunders, 2013). Some quantitative literature also yielded positive effects of vocational teachers' professional learning on their self-efficacy (Oude Groote Beverborg et al., 2015). Moreover, only one study uncovered vocational teachers' identities as a learning outcome (Andersson & Köpsén, 2019). The identities were separated into teacher identity and occupational identity, which were related to vocational teachers' dual competencies.

3.2.6. Institutional outcomes

Institutional outcomes in our study describe the benefits or impact of professional learning on collegial, school, and even industry work-life development. There were 13 studies that reported this type of outcome. Concretely, regarding collegial development, most of these 13 studies focused on team learning or professional learning community (PLC) and employed quantitative methods. The results show that vocational teachers' team learning or professional learning community (PLC) facilitated shared cognition, task and goal interdependence among team members as well as team performance (Runhaar et al., 2014; Vangrieken et al., 2016). Besides, Schaap and De Bruijn (2018) presented not only colleagues' benefits from vocational teachers' professional learning, but also school benefits, including school environment benefits. Considering industrial development, the reviewed research discovered that vocational teachers' professional learning can promote industrial development. Broad (2016) noted that the hairdressing vocational teacher participants were more likely to recommend the manufacturer's tools and products to their students when they received guidance in their professional development activities from the manufacturer. Also, promoting vocational teachers' networks in the industry, and improving the industry's interests in vocational education were also considered as the outcomes of industrial development (Andersson & Köpsén, 2018).

3.2.7. New awareness

As outlined in the methods, based on the findings from the reviewed studies, we use an extended definition of the category new awareness from the framework of Harland and Kinder (2014), i.e., it both refers to vocational teachers' shifts of their prior assumptions related to the curriculum and their teaching and also to an awareness that was not perceived before as learning. Among the 37 studies reporting on learning outcomes, 5 studies identified vocational teachers' new awareness as a learning outcome. For example, Hoekstra et al. (2018) reported that a vocational teacher after participating in a series of learning activities proposed a new insight that vocational students might need an orientation to new teaching strategies. Ketelaar et al. (2014) who explored how to promote vocational teachers to familiarise themselves with their coaching role through work-based learning revealed that 28 vocational teachers thought the learning experience brought new insights for them. Also, Verberg, Tigelaar, and Verloop (2015) in their study on teacher learning with regards to supporting vocational students' reflections through negotiated assessment, found that the learning experience helped vocational teachers to become aware of their competence.

3.2.8. Student outcomes

The category student outcomes is an additional learning outcome category, based on the reviewed studies on vocational teachers' professional learning, which was not included in the model of Harland and Kinder (2014). It addresses students' changes resulting from vocational teachers' professional learning. However,

only three studies examined vocational students' benefits from teachers' professional learning. Respectively, Schaap and De Bruijn (2018) employed questionnaires to investigate students' benefits from teachers' learning in professional learning community (PLC), and their findings showed that students' mean scores varied with different types of professional learning communities (PLCs) and time. More specific, students' benefits had the highest score on a professional learning community (PLC) in which reflective dialogues were perceived as meaningful. In the study of Verberg et al. (2013), 15% of vocational teachers reported on changes in their students' learning outcomes halfway through the learning procedure and 12% of them reported such changes at the end of the procedure. Andersson and Köpsén (2019) found that vocational teachers' visits to the industry could promote the engagement of supervisors in students' learning process and then influence the quality of workplace learning of students.

4. Discussion

This study provides an overview of findings on vocational teachers' professional learning in the past decade (2010–2021). To our knowledge, this is the first study to generalise the professional learning of vocational teachers. The review results provide an overview of vocational teachers' learning activities and outcomes with consideration of a variety of contexts.

4.1. Learning activities

Four categories of learning activities were identified in our study, i.e., pre-defined professional development programme, self-directed/initiated activities in school, collaborative activities in school, and industry-based activities. These categories confirm that vocational teachers' professional learning can occur in academia, industrial, and work settings, and in both formal and informal ways.

Specifically, concerning pre-defined professional development programme, most of the relevant learning activities are also implemented commonly for general teachers, which means vocational teachers' professional development experience is similar to general teachers. Our finding that initial teacher training was available for in-service vocational teachers could well be caused by the backgrounds of vocational teachers (Lahiff, 2015; Lloyd & Payne, 2012). In many countries, such as England, initial teacher training is not a precondition for being a vocational teacher. Vocational teachers who transform from the industry may not receive any teacher training, despite already being employed in schools (Lahiff, 2015). Moreover, we found that, in a number of studies, specific learning activities were organised as following each other, in particular mentoring/coaching or other experimenting activities. This could be an indication that the design of vocational teachers' learning procedures is becoming more coherent and consecutive, which might provide vocational teachers a better learning experience.

Considering school-based learning activities, our study enriches previous framework of school-based learning activities and makes it more comprehensive in the context of vocational education. Specifically, school-based learning activities were separated into self-directed/initiated activities and collaborative activities in school, the findings suggest that this classification provides a typical description of vocational teachers' school-based learning. As Oude Groote Beverborg et al. (2015) noted, 'VET colleges are

expected to improve instruction through fostering individual and collaborative learning.' Regarding self-directed/initiated activities, our findings show that the learning activities in this category align well with four activities of general teachers' work-based learning activities developed by Meirink, Meijer, and Verloop (2007), and this suggests that vocational teachers' individual learning is quite similar to how other teachers learn within the school context. Although collaborative activities in school are also involved in the categories of Meirink et al. (2007), which is called 'learning from others with interaction', our study provides more detailed descriptions and classifications of it. We found that sharing, peer observation or coaching, and collaborative work or research were in accord with three categories of general teacher collaboration developed by Little (1990).

Furthermore, industry-based activities can be seen as a unique category of learning activities for only vocational teachers. There are many specific learning activities situated in the industry, and among these, a common one is learning from industry practice, which addresses working in a part-time job or doing a work placement in particular. Although relatively few studies focused on this category, the value of it has been emphasised. For example, Andersson and Köpsén (2018) explained the reason for engaging in the industry as 'current vocational knowledge is situated in specific work-life practices separated from the practice of school.' In addition, we found that relevant studies of this category were mainly conducted in certain countries, such as Sweden, Australia, Finland, and England. The reason might be that the importance of vocational teachers' occupational competence is particularly attached in these countries.

4.2. Learning outcomes

Our systematic review also examined the learning outcomes of vocational teachers within different learning contexts. The model of learning outcomes from Harland and Kinder (2014) was utilised as a framework in our study. Generally, this model is proven to be useful to analyse and interpret vocational teachers' learning outcomes. The findings show that most of the relevant fragments could be framed well within this model, yet still, some adaptations were made for the role of vocational teachers. Firstly, material and provisional outcomes and informational outcomes were not able to be observed in any of the reviewed studies. An explanation for this could be that both these two categories are considered as the lowest level within the hierarchy structure of learning outcomes in the model of Harland and Kinder (2014), and possibly the reviewed studies rarely investigated the outcomes which were preliminarily obtained by vocational teachers. Secondly, an additional category of student outcomes was supplemented to enrich the model. The adapted model extended learning outcomes from vocational teachers' changes in cognition and behaviour to students' achievements, which enriches our understanding of the influence route of vocational teachers' professional learning.

A notable finding is that most of the learning outcomes reported in the reviewed studies were classified as positive, while negative, mixed, or non-significant results of learning outcomes were hardly reported. This is possibly due to a publication bias, because articles with significant and positive results of learning outcomes are more likely to be published or reported (Pigott, Valentine, Polanin, Williams, & Canada, 2013). Among the categories of learning outcomes, we found that knowledge and skills, as well as teaching

practice, were the most frequently identified learning outcomes. In terms of knowledge and skills, we found that most of the relevant studies concentrated on pedagogical and occupational knowledge and skills. The latter is more related to the real production or service instead of merely subjects, which enriches 'subject matter knowledge', a fundamental type of professional knowledge defined by Grossman (1990). Furthermore, pedagogical content knowledge (PCK), as an important component of teachers' professional knowledge, was not often explicitly mentioned in the reviewed studies. However, Hoekstra et al. (2018) claim that vocational teachers have 'a large portion of learning episodes involving PCK and pedagogy'. It appears that the learning of vocational teachers in terms of PCK has been overlooked in existing research on vocational teacher learning. Apart from changes in vocational teachers' knowledge and teaching practice, their emotional and attitudinal changes (such as affective outcomes and new awareness) were also illustrated in our findings, however, these were often only described in very general terms. An explanation could be that some of these aspects are not within the research concern of scholars. Moreover, the category of student outcomes was least frequently explored in the selected studies, possibly because student outcomes are only indirectly influenced by teachers' learning activities, and come along with changes in teaching practice.

4.3. Limitations

The current study has several limitations. Firstly, although we tried to generalise vocational teachers' professional learning, we only focused on learning activities and outcomes. Others, such as learning needs and antecedents have been not synthesised yet. Secondly, the findings are based on the search strings we have used. These search strings are related to combinations of informal and formal learning activities of vocational teachers. This focus has two limitations. The first one is that some studies did include vocational teachers but together with general teachers and it was not clear which findings were related to which type of teachers. These studies were left out of the analyses. Furthermore, the search yielded activities and outcomes that were explicitly labelled as 'learning', either formal or informal. Yet it might be that studies on teachers' activities in school, industry or elsewhere include learning activities and outcomes of vocational teachers without labelling these as such. This might be the case for some studies on teachers' collaboration in school, which can be aimed at either work performance or learning or both.

Thirdly, in our literature search, we have restricted the language to English, which means that studies on our topic written in other languages have been excluded. This limitation might mean that we have missed out relevant publications in this field. This might be especially the case for regions with many potentially interesting studies like the well-documented vocational system in German-speaking countries in Europe.

Fourthly, although informal learning activities outside school and industry have been indicated as an emerging trend in professional learning (Macià & García, 2016), only two studies were extracted in this literature review. The reason might be that many of these studies are not explicitly presented as studies about learning activities of vocational teachers.

4.4. Implications

With the rapid development of contemporary society and industry over the past decade, vocational teachers are facing challenges in maintaining their teaching and industry currency. In this context, vocational teachers' professional learning has become more important and has raised more attention from policymakers, school leaders, and scholars. As noted previously, this is the first study that reviews vocational teachers' professional learning. The findings provide an overview of vocational teachers' learning activities and outcomes, which can be used as a theoretical basis for future researchers to discuss vocational teachers' learning as well as can offer certain potential directions for future professional development.

For theoretical implications, regarding vocational teachers' learning activities, first, our study summarised learning activities into four categories, which provides a comprehensive understanding of vocational teachers' learning approaches. This overview can be employed as a framework to investigate vocational teachers' engagement in professional learning and whether learning activities are different for vocational teachers and general teachers. Second, the descriptive characteristics of learning activities may help scholars to select a focus of future research on professional learning. For example, reflection came out as the most common activity in school workplace, learning from industry practice as the most frequent activity in the context of industry, and peer observation or coaching as particularly important for novice teachers.

Concerning learning outcomes, firstly, the adapted model with eight types of learning outcomes enriches our insights into vocational teachers' learning results and can be used as a general framework to examine vocational teachers' learning outcomes in various contexts. Secondly, although knowledge and skills were frequently explored by previous studies, PCK as an important aspect of it was less examined. Thirdly, in contrast with knowledge and skills and teaching practice, the other learning outcomes were much less reported in previous work. This might stimulate future researchers to extend their focus on vocational teachers' learning outcomes.

In addition, our results provide practical implications for the organisation of learning programmes or activities. For programme designers, to begin with, our findings showed that the current learning programmes usually contain more than one activity and those activities were connected well, which seems that the design of vocational teachers' learning programmes is becoming more coherent and consecutive. Some of the descriptions of current programmes or activities from the reviewed studies can provide designers with information of how designs of programmes might look like and can support them to think about how to improve their programme designs. For example, in the study of [Smets and Struyven \(2020\)](#), a programme includes two consecutive phases: first an academic training on a specific pedagogical topic, and second an implementation period in which the participants were coached. Additionally, the eight types of learning outcomes summarised by us could be both the learning objectives and the desired learning outcomes of programmes. So, designers could take into account all of these outcomes as specific objectives to guide their programme designs. Finally, as we found that learning content

varied with learning activities, programme designers may make use of these results to select appropriate activities to match certain learning content. For example, in the reviewed studies, teachers usually participated in academic courses to obtain pedagogical knowledge and skills, whereas their participation in industry practice was mainly aimed at improving their occupational knowledge and skills.

For school leaders, the first implication is that they may encourage vocational teachers to learn from a combination of different contexts instead of one single context. The review showed that vocational teachers' professional learning can occur in academia, school workplace, and industrial context, and with formal and informal learning ways. Second, our study also illustrated the conditions for the occurrence of learning activities. For example, learning from experimenting is particularly common, when implementing an educational innovation. Peer observation or coaching, however, are seldomly conducted by vocational teachers because of lack of time. These results could reinforce school leaders to consider measures on how to promote vocational teachers' learning engagement or outcomes. Third, the adapted model of eight types of learning outcomes could be a practical framework for school leaders to assess vocational teachers' learning.

4.5. Concluding remarks

Vocational teachers' professional learning is still not synthesised yet. Our research systematically reviewed 54 articles on vocational teachers' professional learning. Four categories of learning activities were identified with consideration of various learning contexts and eight types of learning outcomes were classified, which related to teachers' changes in cognition and behaviours as well as student and institutional outcomes. These results contribute to a basic but comprehensive theoretical overview for future scholars and provide practical suggestions for school leaders or programme designers to support vocational teachers' professional learning.

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Availability of data and material

Data are available from the corresponding author upon reasonable request.

Code availability

Code is available from the corresponding author upon reasonable request.

Declaration of competing interest

No potential conflict of interest was reported by the authors.

Appendix A. Studies coded by learning activities and outcomes

	Learning activities				Learning outcomes							
	Pre-defined professional development programme	Self-directed/ initiated activities in school	Collaborative activities in school	Industry-based activities	Knowledge and skills	Teaching practice	Affective outcomes	Value congruence	Motivational and attitudinal beliefs	Institutional outcomes	New awareness	Student outcomes
1.Alhanachi et al. (2021)			+		+	+-		+			+	
2.Andersson et al. (2018)	+	+		+	+	+-				+		
3.Andersson and Köpsén (2015)	+			+								
4.Andersson and Köpsén (2018)	+	+		+	+	+				+		
5.Andersson and Köpsén (2019)				+		+				+		+
6.Bound (2011)	+							+	+			
7.Bouwman et al. (2019)	+		+									
8.Broad (2016)	+		+	+	+	+				+		
9.Bükki and Fehérvári (2021)			+									
10.Castaño-Muñoz et al. (2018)	+											
11.Chatigny et al. (2012)	+	+		+				+				
12.Cochrane and Narayan (2011)	+				+	+		+				
13.Csíkos et al. (2018)	+	+	+									
14.De Jong et al. (2021)			+		+	+						
15.de Paor (2018)	+											
16.Hodes et al. (2011)	+				+	+	+	+				
17.Hoekstra and Crocker (2015)		+	+									
18.Hoekstra and Newton (2017)	+		+	+								
19.Hoekstra et al. (2018)	+	+	+	+	+	+					+	
20.Iqbal et al. (2020)	+					+						
21.Ketelaar et al. (2014)		+	+			+					+	
22.Kunst, Woerkom, and Poell (2018)	+	+	+								+	
23.Lahiff (2015)	+											
24.Lloyd and Payne (2012)	+	+	+	+				+				
25.Messmann et al. (2010)		+				+						
26.Oude Groote Beverborg, Slegers, and van Veen (2015a)		+	+									
27.Oude Groote Beverborg, Slegers, and van Veen (2015b)		+	+									
28.Oude Groote Beverborg et al. (2015)		+								-		
29.Oude Groote Beverborg, Slegers, Moolenaar, and van Veen (2020)			+							+		
30.Runhaar et al. (2010)		+	+									
31.Runhaar et al. (2014)		+	+									
32.Sandal (2021)	+				+	+		+	+	+		
33.Sandford, Dainty, Belcher, and Frisbee (2011)		+	+									
34.Saunders (2012)	+	+				+	+					
35.Saunders (2013)	+	+	+			+	+					
36.Schaap and De Bruijn (2018)			+			+				+-		+-
37.Schmidt (2019)				+								
38.Sirk et al. (2016)	+	+	+	+								
39.Smets and Struyven (2020)	+					+	+	+	+			
40.Sumaryanta et al. (2019)	+				+							
41.Tigelaar and Sins (2020)	+				0							
42.Vangrieken et al. (2016)			+							+		
43.Verberg et al. (2013)	+				+	+	+				+	+
44.Verberg et al. (2015)	+										+	

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