Review

Characteristics of learning environments at the boundary between school and work – A literature review

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1. Introduction

In preparing students for occupational practice, vocational education facilitates learning in the contexts of school and work. Therefore, vocational curricula are generally comprised of a combination of school-based learning and workplace learning (Schaap, Baartman, & de Bruijn, 2012). A wide range of learning environments has been designed to facilitate learners' experiences across educational and practice settings (Billett, 2011). Examples of such learning environments are work-related projects (Tynjälä, 2008), hands-on simulations (Khaled, Gulikers, Biemans, & Mulder, 2015), workplace simulations (Jossberger, Brand-Gruwel, Boshuizen, & Van, 2010), school-based vocational training (Jonasson, 2014); work-related learning arrangements (Lappia, 2011); hybrid learning configurations (Cremers, 2016) and regional learning environments (Oonk, Gulikers, & Mulder, 2016). Many terms are used to refer to these learning environments at the school-work boundary, but little consistency is found in the use and definition of these concepts (Fenwick, 2006). This lack of conceptual consistency makes it hard to study the value of learning environments at the school-work boundary. Thus, we first need to describe and define such learning environments in a comprehensive way and gain deeper understanding on how they are designed.

Studies on curriculum design are scarce in the field of educational research in general; even teacher education programs pay little attention to curriculum design and teachers find it difficult to articulate a design rationale and to reflect on their design work (McKenney, Kali, Markauskaite, & Voogt, 2015). Studies on vocational curricula design are particularly rare. Although some recent studies focus on curriculum design in vocational education in developing countries (Albashiry, Voogt, & Pieters, 2015), designs for professional expertise development (Elvira, Imants, Dankbaar, & Segers, 2017), higher education curricula (Zitter, De Bruijn, Simons, & Ten Cate, 2011) or on design principles for a specific type of learning environment (Cremers, Wals, Wesselink, & Mulder, 2016), there is little understanding of the design characteristics of learning environments at the school-work boundary. Since educational institutions are increasingly expected to broaden 'the institutional base beyond school' and create 'dynamic learning systems' (OECD, 2014), more understanding is needed of vocational curricula that aim to accomplish these goals (Harms, Hoeve, & den Boer, 2017; Zitter et al., 2011).

This article extends current insights into vocational curriculum design by presenting a conceptual framework to describe and characterize learning environments at the school-work boundary. To frame our literature review, we first elaborate on the motives underlying the provision of learning environments at the school-work boundary, how a boundary crossing lens may provide understanding of the design rationale behind these learning environments and what it entails to study the design of learning environments.

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2. Background and purpose

2.1. Motives for developing learning environments at the school-work boundary

Learning in the context of work and learning in the context of school aim for different contributions to students' learning. Learning in the context of work can contribute to the acquisition of knowledge and skills that are not easily acquired at school, like conflict management skills, entrepreneurship, or team-working skills (Fazekas & Field, 2013). Furthermore, real-world working experiences can be motivational (Allan, 2014) and contribute to student engagement (Lyngsnes, 2011). However, workplace learning does not always result in the kind of learning as intended: what students do and learn at the workplace is influenced by production needs and workload and students can even learn 'bad things' (Billett, 2011; Illeris, 2009; Tynjälä, 2008). Furthermore, the possibilities of workplaces to facilitate learning activities may be limited (Billett, 2014a, b; Harris, Willis, Simons, & Collins, 2001; Istance & Kools, 2013). Therefore, workplace learning is often supplemented with school-based learning (Aarkrog, 2005).

Learning in the context of school aims to be relevant to develop more generic knowledge and skills (Tynjälä, 2008), like conceptual reasoning skills and the ability to analyse and synthesize information. School is typically a highly regulated learning context with planned learning activities, where students and teachers are the main actors and learning outcomes are formalized in a curriculum and validated by assessment (Bronkhorst & Akkerman, 2016). Such a regulated learning environment may be focused and predictable, but does not lead to high student engagement nor reflect the way knowledge and skills are used in real life (Herrington & Oliver, 2000; Mandl, Gruber, & Renkl, 1994). To prevent that what students learn in school remains inert, attention needs to be paid to the learning environment design (Renkl, Mandl, & Gruber, 1996) and how learners are supported to connect what they learn in different contexts.

Combining the contexts of school and work can lead to robust vocational knowledge and skills (Billett, 2014a, 2014b, 2015; Tynjälä, Välimaa, & Sarja, 2003) and to the integration of learning in the two contexts (Endedijk & Bronkhorst, 2014; Helle, Tynjälä, & Olkinuora, 2010; Stenström & Tynjälä, 2009), but also poses significant challenges. The diverse and multi-dimensional nature of vocational knowledge makes it hard to position in vocational curricula (De Bruijn & Bakker, 2017; De Bruijn & Leeman, 2011; Schaap et al., 2012). Furthermore, tensions arise when educators try to support the 'acquisition and use of a way of knowing and thinking that is based on vocational theory and its underlying theoretical discipline' (De Bruijn & Leeman, 2011, p. 700). Knowledge and experiences are often offered in a fragmented manner (Zitter & Hoeve, 2012) and alignment between practice-based and school-based activities remains weak (Messmann & Mulder, 2015; Onstenk & Blokhuis, 2007; Poortman, Reenalda, Nijhof, & Nieuwenhuis, 2014). Improving the connectivity is often chosen as a strategy to meet these challenges (Cremers, Wals, Wesselink, Nieveen, & Mulder, 2014; Veillard, 2012; Wesselink et al., 2010). 'Connectivity' refers to 'the relationship between work experience, learning and knowledge' (Griffiths & Guile, 2003, p. 56). Connective curriculum frameworks promote strong connections between educational institutions and workplaces (Guile & Griffiths, 2001) and may support learners to deal with socio-cultural differences and with the frequent changes of roles and perspectives when crossing boundaries between the contexts (Schaap et al., 2012). To gain deeper understanding in the ways in which learning across contexts can be supported, this study uses a boundary crossing lens.

2.2. Using a boundary crossing lens to study learning environments

Learning across contexts implies that learners interact with, move across or participate in different practices and thus cross boundaries between these practices (Akkerman, 2011). This boundary crossing can cause difficulties because each practice has 'a specific, local and routinized way of doing, talking, relating and organizing' (Bronkhorst & Akkerman, 2016, p. 20). Work is strongly influenced by business demands, while school is focused on educational outcomes. Sociocultural differences between these practices can result in discontinuities in action or interaction (Akkerman & Bakker, 2011). Discontinuities can be problematic, for instance, when students do not recognise in the workplace what they have learned in school. A boundary crossing lens helps to identify interventions aimed at (re)establishing continuity between learning in school and out-of school (cf. Bronkhorst & Akkerman, 2016). The present paper addresses work as an out-of school context and uses a boundary crossing lens to identify characteristics of learning environments intentionally designed to restore continuity in action or interaction across contexts (Bakker & Akkerman, 2017). Such intentional design efforts are driven by a rationale regarding the contribution of each practice and how continuity should be established or restored.

With 'rationale' we refer to the logical basis or 'basic philosophy' of a curriculum design (Van den Akker et al., 2009). The rationale addresses approaches to learning (e.g. problem based learning) and pedagogical interventions applied to encourage learners to participate (e.g. treating students the same way as you would treat employees). Articulating these aspects improves awareness of stakeholders, mutual intelligibility and accountability for design choices (Goodyear, 2005). We focus on the rationale of school-work connections (Griffiths & Guile, 2003) and on the tangible characteristics of learning environments that educational designers wish to afford at the school-work boundary.

2.3. Studying the educational design of learning environments

The present review focuses on the educational design of vocational learning environments. Educational design is a complex activity, both conceptually and in its implementation, that involves continuous balancing of a myriad of design considerations about the curriculum (Akkerman, Bronkhorst, & Zitter, 2013; Kirschner, Carr, Merriënboer, & Sloep, 2008; Ornstein & Hunkins, 2009) and about ways to support learning in particular cases (Goodyear, 2005). It is distinguished both from *instructional design* which is mostly

focused on the instruction of learners, and from *development* which is focused on developing lesson plans, tasks, tools and materials (Goodyear, 2005; Romiszowski, 1981). This study addresses the concrete materialization of the curriculum in learning environments that support learning across contexts.

A learning environment is a system that is designed and managed (Goodyear, 2005). It is embedded in a larger program and influenced by an organisational context. There are no limits on the scale of a learning environment as a conceptual entity. It may involve a small group of learners and a single task or a large group with multiple tasks over a longer period of time. Thus, a learning environment is a manifestation of the curriculum at the micro level, whereas the nano level refers to the learning processes students are engaged in, the meso level to the institutional level and the macro level to an entire educational system and/or nation (Albashiry et al., 2015; Van den Akker, 2010; Van den Akker et al., 2009).

The learning environment includes (1) the intentionally designed physical/digital and socio-cultural setting in which learner perform their tasks, including (2) all artefacts that may be needed to work on specific tasks (e.g. tools, documents, information sources), (3) the social environment in which learners perform their tasks and, (4) the temporal aspects of learning environments (Carvalho & Goodyear, 2017; Goodyear, 2001; Zitter & Hoeve, 2012). To understand designs of vocational learning environments this study takes into account the rationale of the design and the 'designable elements' that constitute learning environments; i.e. those elements that can be purposefully designed (Ellström, Ekholm, & Ellström, 2008). Together with the tasks set for the learners, designable elements influence the learning activities learners engage in (Carvalho & Goodyear, 2017).

Four perspectives are used in this study to specify the designable elements (Carvalho & Goodyear, 2017; Zitter & Hoeve, 2012):

1) the spatial perspective, to study the physical and digital spaces in which learning tasks take place;
2) the instrumental perspective, to study the tools used to facilitate the learning of participants, including artefacts that are instrumental to deliver intermediary and final results of the tasks, like checklists, formats, professional tools;
3) the temporal perspective, concerning timeframe and sequence of tasks;
4) the social perspective, to study the roles enacted by actors within learning environments. Actors are participants in learning environments (teachers, students, clients); they enact educational roles, like coach or expert, or work-related/professional roles, like manager or employee.

Studying learning environments from these perspectives helps to improve understanding on ways in which continuity in action or interaction across practices can be (re)established. Changing into a uniform or moving between spaces, for instance, can help learners to switch from being students to being workers (like nurses or cooks). The use of 'boundary objects' (such as a portfolio) and clear demarcation of actors' responsibilities may contribute to effective collaboration across practices (Bakker & Akkerman, 2017). From a temporal perspective having time to reflect can contribute to learners' understanding of differences and similarities between contexts. Therefore, besides the rationale regarding the school-work boundary, the spatial, instrumental, temporal and social perspectives are relevant when studying vocational learning environments, with the aim to answer the following research question: What are the characteristics of designs of learning environments at the school-work boundary in vocational education?

3. Methods

This literature review is a qualitative systematic review with an interpretative aim (Grant & Booth, 2009): it aims at broadening understanding of learning environment designs and presents an overarching framework, based on frequent themes across the selected studies. A systematic review requires the use of techniques to minimize bias (Cohen, Manion, & Morrison, 2011), including an elaborated search strategy and transparent selection process and analysis technique.

The search strategy was developed by the first author and discussed during research group meetings with the second and third author. Trial searches were done to determine which queries and which grammatical structures appeared most suitable for the purpose of our study. Search queries were refined by adding asterisks, changing search terms and removing ineffective search terms (e.g. queries with the terms 'professional' and 'program' led to a too large number of results with low content relevancy). Refinements led to three sets of keywords that were used for the final search: one set with terms referring to 'learning environment', one set referring to 'school-work boundary' and one set referring to the context of the study, namely, 'vocational'. Table 1 shows how the three sets of search terms were combined.

The literature search was conducted between March and December 2016. The following databases were selected to ensure a broad

Table 1
Keywords literature search.

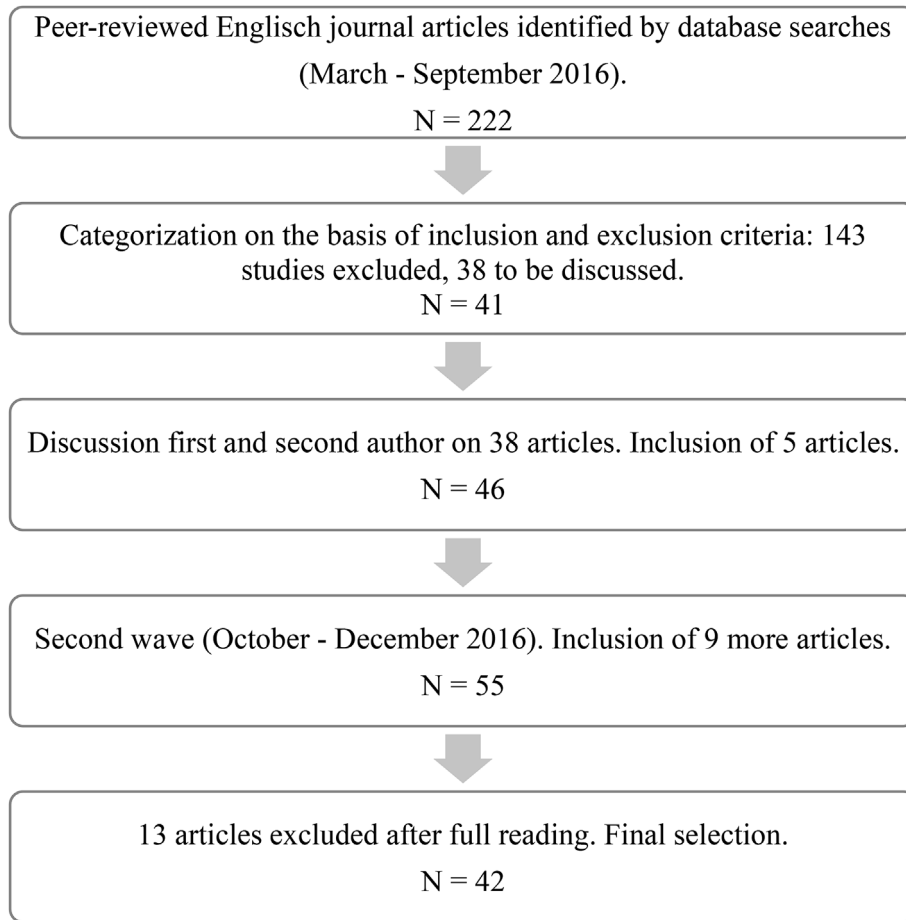| Learning Environment		Boundary		Vocational
learning environment		boundary		
OR		OR		
learning arrangement		school AND work		vocational
OR	AND	OR	AND	OR
learning context		education AND workplace		occupational
OR		OR		
curriculum		school-based AND practice-based		

Fig. 1. Selection process.

spectrum of articles in the educational, behavioural and social sciences: Education Resources Information Center (ERIC), PsycINFO, Scopus, and Web of Science. Depending on the database, queries were limited to the domain of social sciences (Scopus) or educational research and education scientific disciplines (Web of Science). To safeguard the quality and relevancy, queries focused only on journal articles and reviews published in peer reviewed journals since 2000. The final, refined queries presented in Table 1 led to the retrieval of 222 unique studies.

Titles and abstracts of the 222 retrieved studies were screened to identify potentially relevant studies. The inclusion and exclusion criteria were discussed within the research group. Studies were included that relate to vocational education and contain descriptions or conceptual insights of learning environments at the school-work boundary. With these inclusion criteria in mind, the relevance of studies was determined firstly on the basis of their title and abstract. In case of doubt, the full article was read. 38 studies were discussed between the first and second author to reach agreement about possible exclusion. Studies were excluded on the basis of the following exclusion criteria:

- other types of 'boundaries' than the school-work boundary are central to the study (e.g. personal, professional, or geographical boundaries);
- the study focuses solely on the systems level (educational policy at the macro curriculum level), without mentioning implications at the micro curriculum level;
- the study addresses some form of workplace learning, but not explicitly in connection with a school context.

After applying the exclusion criteria, 42 articles were retained for further analysis (see Fig. 1). These articles were summarized through data extraction forms. The format of these forms was discussed with four colleague-researchers in the field, tested by extracting two articles, and consequently adapted. Data extracted with the final form included: general reference information, publishers' key-words, context of the study, object of study, features of the learning environment described (if applicable), main findings, theoretical framework and research information (design, methods, duration, population and sample size). Appendix one summarizes the key aspects extracted from the reviewed articles, displaying the references' country of study, educational field, research design and central concept or type of learning environment.

Table 2
Analysing learning environments.

	Coded Elements
Design Rationale	View on relative contributions of school and work; chosen strategies to establish school-work connections and afford cross-contextual learning through the learning environment design.
Designable Elements	
a) Spatial Perspective	Location of the learning environment; proximity to institutions, clients etc.; spaces where tasks are being carried out; how these spaces are furnished.
b) Instrumental Perspective	Objects, tools, instruments or products that are instrumental to the tasks; functions of these artefacts.
c) Temporal Perspective	Sequence of activities; timespan; how long learners are present; how time is purposefully influenced.
d) Social Perspective	Which actors play roles (educators, professionals, students, other actors); which roles are enacted by these actors.

The 42 reviewed studies address a variety of topics related to learning environments at the school-work boundary, varying from workplace learning and industry-school partnerships to, for instance, student-run clinics, workplace simulations and inter-professional practice. The selected articles originate from fifteen different countries, most of which have a tradition of vocational education as a combination of learning in school and work such as Australia, Finland, Germany and The Netherlands (Billett, 2011).

Thematic analysis (Thomas & Harden, 2008) was conducted with qualitative data analysis software (NVivo). Recurring themes were identified and coded (Cohen et al., 2011). Insights from boundary crossing theory (Akkerman & Bakker, 2011) were used as sensitizing concepts (Bowen, 2006). Identification of design rationales regarding the school-work boundary and the corresponding designable elements (Carvalho & Goodyear, 2017; Ellström et al., 2008; Zitter & Hoeve, 2012) of the described learning environments took place. Table 2 provides examples of coded elements relating to the design rationale and designable elements.

4. Results

4.1. Design rationales of learning environments at the school-work boundary

The ways of viewing the boundary and the relative contributions of different practices are helpful to identify design rationales, i.e. the underlying vision and fundamental principles which guide decision making in a design process. Three design rationales could be distinguished in the selected literature: 1) a rationale based on *alignment* between two separate practices, 2) a rationale based on *incorporation* of elements from one practice into the other practice and 3) a rationale based on (partial) *hybridisation* between the two practices. The appendix displays which rationale is most salient in each of the reviewed articles.

The first rationale is based on *alignment* between the separate practices of school and work. Pedagogic practices at school are aligned with those at the workplace. Each practice is intended to have its own unique contribution: practical training and socialization mainly take place at the workplace, while theoretical training and development of generic skills typically take place at school (Aarkrog, 2005; Illeris, 2009). The school-work partnership consists of formal arrangements at the individual level and agreements between schools and professional organizations on students' tasks and guidance (Kessels & Kwakman, 2007; Messmann & Mulder, 2015). School-work alignment is facilitated through periodical meetings between representatives and interventions that activate students to engage in professional learning at work (Pineda-Herrero, Quesada-Pallarès, Espona-Barcons, & Mas-Torelló, 2015). Reflective peer group meetings are planned to help students understand the nature of their experience and the relationship between the practices (Onstenk & Blokhuis, 2007; Tanggaard, 2007). Both peer group meetings and teachers' support are aimed at mediating and supporting students' boundary crossing between school and the workplace (Sappa & Aprea, 2014; Tanggaard, 2007). Within the learning environment, learners are supported to understand the differences and similarities between school and work, the boundaries that may be experienced between the practices, and how to cross those boundaries. Examples of learning environments based on this rationale include group sessions at school with the purpose of students discussing and reflecting on their work experiences (Akkerman & Bakker, 2012; Schaap et al., 2012; Wegener, 2014) and goal-setting sessions in which educators and students discuss learning goals to be accomplished at school and at work (Messmann & Mulder, 2015; Virtanen, Tynjälä, & Eteläpelto, 2014).

The second rationale is based on the *incorporation* of tasks, artefacts or actors from work into school or incorporation of such elements from school into work. The (future) work situation of the students forms the basis of the tasks and artefacts that are brought into the learning environment (Farnsworth & Higham, 2012; Jossberger et al., 2010; Makovec-Radovan & Radovan, 2015; Watts & Burnett, 2012). Learners are afforded ways to become familiar with tools, skills or the social context of the work practice (Jossberger, Brand-Gruwel, van de Wiel, & Boshuizen, 2015). Two forms of 'boundary-work' can be found with this underlying design rationale: one that advocates the specific character of school and work and another that focuses more on similarities and thus blurs the boundaries (Berner, 2010). This latter boundary-work, aimed at blurring the boundaries, involves the reconstruction of the work practice through (a) specific instructional forms (such as modelling, scaffolding and coaching), through (b) the reconstruction of the social setting and the general ways of operating and/or collaborating at a workplace (Nowak, Klimke-Jung, Schäfer, & Reif, 2016; Tennant & Yates, 2005), or through (c) simulation (Kneebone et al., 2005). At school, educators use their knowledge and experience of the occupation to contextualize the curriculum with examples from professional practice and enact the school-work dialogue (Farnsworth & Higham, 2012; Harreveld & Singh, 2009). Other examples of incorporation of work elements into the school practice are learning environments based on authentic assignments formulated by companies, involving real work tasks performed at school, guided by teachers visiting the companies to discuss progress and results (Illeris, 2009; Onstenk & Blokhuis, 2007). Examples of

incorporation of elements of school into work are work-based training sessions where elements are used that are familiar from school, like in-house tutorials on specific work-related content (McKenna, Burke, & O'Sullivan, 2010) or ways of simulating practice (Kneebone et al., 2005), to prepare students to work at real worksites.

The third rationale is based on *hybridisation*. According to this rationale, learners can simultaneously learn and work, grow into a community of practice and thus develop vocational skill, understanding and professional identity (Cremers et al., 2016). Through close collaboration between school and work practices, a hybrid practice is constructed in which learning and working processes can be merged (Poortman et al., 2014). School-work partnerships may consist of formal arrangements at the institutional level about co-teaching and co-producing the learning environment, to serve mutually beneficial objectives (Flynn, Pillay, & Watters, 2016). In such learning environments, learning and working opportunities can be manipulated to relate practical problems to theoretical insights and to give immediate feedback to learners on their executed tasks (Schaap et al., 2012). Examples of learning environments that focus on affording students a context in which they can simultaneously learn and work are hybrid learning environments, social developmental projects, social labs or learning in the region (Poortman et al., 2014; Schaap et al., 2012; Tyson, 2016; Zitter, Hoeve, & de Bruijn, 2016).

4.2. Designable elements of learning environments at the boundary

The design rationales presented in the previous section can be related to considerations about the designable elements of learning environment. These designable elements correspond to the spatial, instrumental, temporal and social perspectives of the learning environment design.

4.2.1. The spatial perspective

From a spatial perspective, the selected literature reveals choices for the learning environment design with respect to: (a) the physical site, (b) the kind of building or digital platform, (c) the specific spaces available for learning and/or working tasks, (d) the necessary furnishings, and (e) the surroundings, like the proximity to relevant resources (e.g., to expertise or to patients, clients or suppliers).

In *designs based on alignment*, individual learners move between different physical sites (a school and a workplace) and guidance is provided to the learners either in one or in both physical sites (Goh, 2014). Group meetings are held at a specified location, learners reflect on and share their experiences and educators introduce relevant concepts. The chosen location may be a classroom in a school building (Akkerman & Bakker, 2012) or, when several learners work at the same workplace, a suitable space at the workplace. A meeting room, for instance, may function as a 'reflection zone' where learners, educators from school and workplace supervisors interact (Wegener, 2014).

In *designs based on incorporation*, like simulations and school-based projects, most activities take place at one physical site and specific spatial requirements need to be met at that site. These requirements have to do with the need to be able to perform certain procedures and/or work in a specific setting (Makovec-Radovan & Radovan, 2015; Taylor & Watt-Malcolm, 2007; Van Schaik, Van Oers, & Terwel, 2011). Depending on the occupational tasks, a specially equipped room may be needed, like the minor procedures room of a hospital (Kneebone et al., 2005). Sometimes a classroom functions as a workspace, where students perform working tasks (Farnsworth & Higham, 2012; Tennant & Yates, 2005). A field trip can create a 'third learning space' to invoke emotional and sensory experiences that are relevant for the (future) profession, like meeting a minister at the church to hear about experiences with dying patients at an eldercare centre (Lippke & Wegener, 2014).

In *designs based on hybridisation*, the preferred space seems to be a real or lifelike worksite. Such a worksite can be purposely selected or designed at a specific location to increase the perceived authenticity and provide access to relevant actors. For instance, a student-run consultancy agency is situated at a business park (instead of on school grounds) to foster an authentic experience for the learners (Cremers et al., 2016) and a dental unit is built near a hospital in the city to provide students with a large variety of patients (Lynch, Ash, & Chadwick, 2010). The needed space for the learning environment may also be created on school properties and designed to fully mirror a professional workplace. Examples are a school-based building site, designed to look and function as a real worksite (Fjellström, 2014) and a school-based restaurant (Zitter et al., 2016), which has both professionally equipped kitchens and demo kitchens, where cooking processes can be shown on television screens.

4.2.2. The instrumental perspective

The instrumental perspective of the design involves the artefacts, tools and instruments that are needed for the learners to perform their learning and working tasks. The selected literature reveals different choices regarding the nature of the instruments and artefacts, depending on the occupation students are educated for and on the rationale behind the learning environment design.

Artefacts and instruments in a *design based on alignment* can contribute to connecting the practices of school and work. Students receive assignments for this purpose, like presenting about their work at school (Akkerman & Bakker, 2012). Tools or formats such as checklists are used by educators and students to plan and discuss learners' tasks and progress and to reflect on their experiences. Student-initiated objects (personal attributes related to a specific experience) can fulfil a bridging function as reflection objects (Lippke & Wegener, 2014; Wegener, 2014). Giving students a voice in the objects may prevent the situation where students make two products; one in compliance with the workplace, and one that complies with what they are taught at school (Goh, 2014).

In *designs based on incorporation*, artefacts are incorporated in the learning environment to simulate a real work practice. Important artefacts are professional products and services the students work on and the necessary resources and tools. Specific professional equipment is frequently needed for simulation purposes; in a technical school workshop this comprises special machines

and professional workplace equipment such as welding tools (Van Schaik et al., 2011). In clinical simulations specific artefacts are needed to simulate an injury or part of a body, like a pad of simulated skin to perform wound closure on, or a catheterisation model for a urinary catheterisation procedure (Kneebone et al., 2005). If students work on cases, case examples are needed, like the cases healthcare students use to generate a joint treatment and care plan (Nowak et al., 2016).

In *designs based on hybridisation*, artefacts come forth from both the contexts of school and work. Access to equipment is needed for the students to be able to perform the required tasks. This is the case for instance in a dental unit (Lynch et al., 2010), where all necessary equipment and dental materials are provided for the students to work and learn with. Additionally, artefacts are needed for educational purposes, such as written assignments (Cremers et al., 2016) or forms used to monitor the progress on personal learning goals (Virkkula, 2016). Some artefacts function both as a professional artefact and as a tool to construct a consistent school curriculum, as is the case with the restaurant menu in the hospitality case presented in Zitter et al. (2016), in which the curriculum is organised in accordance with a restaurant menu to provide a clear structure for the learners.

4.2.3. The temporal perspective

From a temporal perspective, designable elements of learning environments found in the literature are: (a) the timespan, (b) the way tasks are structured and sequenced, (c) the way time pressure is applied and (d) whether specific work-related aspects apply, like working in shifts.

The timespan of *designs based on alignment* varies from a few weeks to a year, though usually not fulltime. Alternation between the physical sites of school and the workplace is enriched with scheduled group meetings at a set location. The timespan of the practice period is communicated beforehand, as are the amount of hours or days to be completed. The scheduled meetings and learning dialogues are planned in advance (Akkerman & Bakker, 2012; Goh, 2014; Wegener, 2014).

In *designs based on incorporation* the timespan varies considerably between learning environments, depending on the nature of the replicated work process; a clinical simulation takes only a few hours (Kneebone et al., 2005), an emergency simulation a few days (Andersson, 2016) and setting up and running a school-based radio station may take six months (Farnsworth & Higham, 2012). When students need to work in teams, the design may take into account the time needed to build a culture of 'effective and trustworthy communication' (Nowak et al., 2016). A minimum duration is also inherent to the learning objectives. When the objective is to prepare for an apprenticeship, for instance, students need sufficient time to obtain a specific qualification to enter the trade in question (Taylor & Watt-Malcolm, 2007). Sometimes, the time students have to perform certain tasks or to consult others is purposefully limited to provide a 'time urgent context' (Andersson, 2016).

In *designs based on hybridisation*, the temporal perspective is influenced both by work and by school practices. The timespan of the learning environment depends on the learning and working tasks the students need to be able to perform and on their experiences prior to entering the learning environment. Some learning environments have strict entry requirements to secure a certain level of performance, e.g. students have to participate in several weeks of practical training experiences prior to starting at an inter-professional training ward (Falk, Hult, Hammar, Hopwood, & Dahlgren, 2013). The weekly schedule of learners may be influenced by temporal features of the work practice: students working at medical wards, for instance, are required to be present all day or to work in shifts (Falk et al., 2013; Jacobsen, Fink, Marcussen, Larsen, & BæK Hansen, 2009). Temporal features of the work practice can have an impact on students' learning outcomes, for instance because a regular working process lasts longer than the student's involvement in the learning environment (Fjellström, 2014). Likewise, features of the school practice can have an effect on the working pace; for instance when the working process is slowed down to allow for time to acquire relevant knowledge or to evaluate an activity (Boersma, ten Dam, Wardekker, & Volman, 2016). When feedback during the professional task is not possible, this can be organized immediately after the completion of the task (e.g. after the music performance in Virkkula, 2016).

4.2.4. The social perspective

From a social perspective, relevant characteristics of learning environments at the school-work boundary that emerged from the reviewed literature are: (a) the amount and variety of actors involved; (b) the roles designed for the actors in question; and (c) how the actors enact these roles.

In *designs based on alignment*, the amount of actors is limited to students and educators from school practice and workplace supervisors and co-workers from work practice. Educators from school are responsible for the organisation of workplace learning and the communication with workplace supervisors. This communication usually consists of telephone and email contact about the initial placement of the student and midterm visits by the teacher to the workplace (Akkerman & Bakker, 2012). Educators also have a role as a 'reflection facilitator', facilitating reflection of the students at the different physical sites (Wegener, 2014). At the workplace, a student is guided by the workplace supervisor. Students may also turn to co-workers when seeking advice. It depends on the workplace whether students are considered to participate as a co-worker, as a learner or as both (Goh, 2014).

In *designs based on incorporation*, the amount of actors is also limited, though these actors do fulfil different roles. Students often work in project-teams and fulfil their roles accordingly, for instance as employees of a fictional agricultural consulting firm (Watts & Burnett, 2012). Students can also assume the role of observant to provide feedback to other students (Kneebone et al., 2005). Educators provide students with work-based experiences and translate the demands of the occupation into everyday reality for students through the use of examples from their own experiences in the trade (Farnsworth & Higham, 2012). Educators act as 'supportive mentor of the communication process' who guide students' reflections (Nowak et al., 2016) and stimulate learners by giving feedback, providing direct instruction, and increasing responsibility for the learners to become self-directed (Jossberger et al., 2010). Educators may need to be accredited to assess vocational tasks (Tennant & Yates, 2005), or be qualified in a certain trade/profession, to be able to train vocational skills at a special training site (e.g. in carpentry in Taylor & Watt-Malcolm, 2007).

When the design is based on incorporation, other actors often need to be present in the learning environment, besides students and educators, to successfully reconstruct workplace realities. Volunteers, for instance, act as a (mock) victim in an emergency simulation (Andersson, 2016) or as a patient in a clinical simulation (Kneebone et al., 2005). In project work, an experienced professional enacts the role of client and is interviewed by students on requirements of the product the students subsequently work on (Van Schaik et al., 2011; Watts & Burnett, 2012).

In *designs based on hybridisation*, both students and educators fulfil several roles simultaneously: students fulfil concurrently the role of learner and the role of, for instance, a dentist (Lynch et al., 2010), a nurse, therapist, physiotherapist or doctor (Jacobsen et al., 2009), teacher assistant (Boersma et al., 2016) or restaurant staff (Zitter et al., 2016). Educators fulfil at the same time educational roles like coach or instructor and professional roles like senior restaurant chef (Zitter et al., 2016) or senior professional consultant (Cremers et al., 2016). In these roles, educators guide the students both in the application of relevant concepts and in the execution of professional tasks. Usually educators are present all the time, walk around and offer assistance when needed (Zitter et al., 2016).

When the design is based on hybridisation, other roles enacted in the learning environment often include those of real clients, customers, patients, co-workers and experts. The client or patient may be a paying customer, such as a restaurant client (Zitter et al., 2016); a patient that needs medical treatment (Jacobsen et al., 2009; Lynch et al., 2010) or an external client representing a non-profit organization in need of advice (Cremers et al., 2016). The role of co-worker or expert is usually fulfilled by experienced professionals from the field. The interactions with these professionals are meant contribute to learners' membership of the professional community. The interactions may consist of consultations with professionals during a project (e.g. when preparing a morning of activities for 6–8 years-old children at a primary school site in Boersma et al., 2016) or of collaborating side-by-side on a project (e.g. when students work with a professional musician towards a real-life performance in Virkkula, 2016). When the hybrid practice is also intended to support interprofessional learning (Falk et al., 2013; Jacobsen et al., 2009), access to actors from different disciplines and professions becomes an important feature. An interprofessional learning environment for physiotherapy students, for instance, provides students with access to nurses, doctors, physiotherapists, technicians and other workers (Patton, Higgs, & Smith, 2013).

5. Conclusions and discussion

5.1. Conclusion: three categories of learning environment designs

The purpose of this review study was to identify characteristics of learning environment designs at the school-work boundary. Relevant literature for this purpose was analysed with a boundary crossing lens. An important finding is the distinction between three design rationales underlying learning environment designs at the school-work boundary. These rationales can be concretised with specific designable elements representing the enactment of these learning environments. The conceptual model as depicted in Fig. 2 synthesises the findings, by representing: (a) designs based on alignment; (b) designs based on incorporation; and (c) designs based on hybridisation.

The categorization in Fig. 2 is supported by two recent studies on ways to establish continuity between contexts. In a study on continuity between in-school and out-of-school contexts, three ways of establishing continuity between in-school and out-of-school contexts were found: (a) by visiting out of school contexts; (b) by using objects or persons as representation of practices; and (c) by creating hybrid practices in which constituents from school and out-of–school interact (Bronkhorst & Akkerman, 2016). In this study a similar categorisation was found, but contrary to Bronkhorst and Akkermans's study, we focused specifically on learning environments in vocational education and on work as out-of-school context.

In a study on workplace learning, three models were presented for academic universities and universities of applied sciences to enact their relationships with the working world: (a) one in which workplace experiences remain separate from other learning activities; (b) one in which pedagogical approaches realise connections; and (c) one in which educational programmes are conducted in close collaboration between schools and workplaces (Tynjälä, 2013). In our study we identified similar varieties in the connection between vocational institutions and work-related contexts and we elaborated on the design rationale behind these connections.

The present study further reveals how the three categories of learning environment designs can be concretised with specific
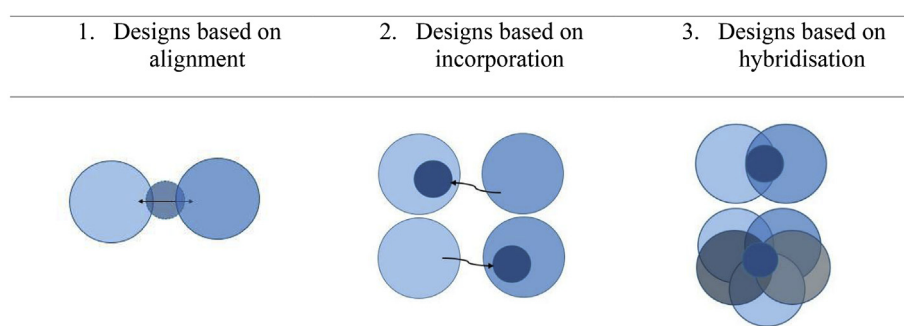

| 1. Designs based on alignment | 2. Designs based on incorporation | 3. Designs based on hybridisation |

Fig. 2. Three categories of learning environment designs.

Table 3
Learning environment designs at the school-work boundary.

	Designs Based on Alignment	Designs Based on Incorporation	Designs Based on Hybridisation
Design Rationale of the Learning Environment			
	Afford learners to alternate between two separate practices while ensuring alignment between the practices through goal-setting and reflection sessions. Aspects of the experienced work processes are discussed.	Afford familiarization with certain work-processes, procedures, rules of the work practice. Focus on replications and simulations of parts of the work process.	Afford a hybrid practice for learners to simultaneously learn and work in that practice. Focus on learning and executing a whole work process.
Designable Elements of the Learning Environment			
Spatial Perspective	Situated at school and/or workplace. Individual learners move between the physical settings of school and work and come together with other learners at a specific location. No specific spatial requirements apply.	Located at school, at a workplace or training centre. Special physical requirements to replicate professional practice, perform certain procedures and/or work with specific tools. If situated in a school building a regular classroom can function as workplace. Occasional field trips.	Often located at a worksite and in the proximity of relevant businesses, experts or clients. If it is situated in a school building the spaces are fully furnished and equipped to function as real workplaces, while simultaneously serving as a place for instruction and reflection.
Instrumental Perspective	Artefacts, instruments and tools are used to align the practices of school and work, like checklists used to discuss students' tasks.	Tools, artefacts and instructions from the relevant work practice are used to replicate that practice and train specific skills.	Artefacts from school and professional practice are used to perform the required working and learning tasks.
Temporal Perspective	Fixed timespan, alternation between practices, scheduled group meetings. No work-related temporal features are mentioned.	Timespan depends on working situation that is replicated or on skills to be trained. Time may be reserved to build a culture for collaboration. Purposeful limitation of time to simulate time urgency or purposeful extension to allow for more training and reflection.	Temporal aspect is influenced by both school and work contexts. Pace corresponds to workplace practices (e.g. working in shifts) or is purposefully influenced for instruction, evaluation and reflection.
Social Perspective	Students have the role of learners, apprentices or trainees. Educators from school have the role of coach, mentors, reflection facilitators. Professionals have the role of workplace supervisor and colleague.	Students often have project roles and act as observant or colleague to each other. Educators from school have the role of mentors and create suitable situations in which they provide instruction and guidance. Actors, volunteers, professionals, students and educators can have a role as simulated patient or client.	Both educators and students fulfil hybrid roles, i.e. they are at the same time educator/learner and perform a professional role (nurse, therapist, senior or junior employee). Large variety of actors and disciplines. Learners work with real patients, clients and professionals. Experienced professionals have the role of co-worker or expert.
Examples of Learning Environments from the Reviewed Studies			
	Peer group meetings at school and reflection meetings at the workplace during apprenticeships.	Inter-professional school projects, workplace simulations.	Medical training wards, student-run businesses (restaurant, consultancy firm).

designable elements, as summarized in Table 3. This table illustrates which elements can be used to develop a learning environment in line with a chosen design rationale. However, whether the intended aim is actually accomplished, depends to a large part on the conceptions and agency of the participating actors. Agency refers to participants' ability and will to shape their activity systems (Engeström & Sannino, 2010). Agency is influenced by conceptions. Actors in a learning environment can have different conceptions of the learning environment (Sappa & Aprea, 2014), affecting it's potential. With designs based on incorporation, for instance, the potential of the learning environment can be affected by actor's attributions of less positive qualities to school-based and work-resembling practices (Jonasson, 2014). If little attempt is made to facilitate integration of learning in the context of school and work, students will probably adopt a rather conventional conception of the school-work relationship and consider work to be more 'real' (Tennant & Yates, 2005).

Educational designers aim at influencing participants' conceptions by deliberately changing designable elements. From the temporal perspective, for instance, students' conceptions may be influenced through the use of deadlines (Lappia, 2011). Although learners may appreciate the slower, saver pace of a school-based learning environment because it allows them to build accuracy, it may also be perceived as 'a holiday from work' (Harris et al., 2001). Thus, designers should carefully consider when learners should be given ample time to practice skills and when time constraints matter (Jonasson, 2014). From the social perspective, students' agency can be influenced, for instance, by their roles. Studies on workplace learning show that learners' agency can be influenced by (a) giving learners an influential role in the learning environment; (b) affording them to observe others and work both independently and with others; and (c) stimulate engagement through collective guidance from fellow learners or students from other disciplines (Mikkonen, Pylväs, Rintala, Nokelainen, & Postareff, 2017).

Another way to influence students' agency and attribution is through careful design of the tasks students will carry out. Students' motivation to work on tasks seems to increase if it is a real-world assignment (Cremers et al., 2016). Furthermore, it appears to be more effective to design tasks according to a whole work process or task (Kirschner & Van Merriënboer, 2008), instead of partial tasks (for instance preparing a whole menu, instead of just practicing on how to make a certain sauce; Jonasson, 2014). A complicating

aspect regarding whole tasks is that it is hard to design whole work processes that actually represent real-work practice and are indeed experienced as such by the actors involved, i.e. students, educators and professionals from the field (Jonasson, 2014). Lastly, designers are challenged to design tasks with an adequate level of complexity in line with learners' knowledge and abilities (Messmann & Mulder, 2015; Renta Davids, Van den Bossche, Gijbels, & Fandos Garrido, 2017).

Regarding the agency and attributions of educators, empirical studies show that educators often take a pragmatic approach when designing learning environments and tend to prioritize practical aspects and feasibility, in congruence with their own beliefs and convictions (McKenney et al., 2015). Furthermore, educators' identities influence how the curriculum is enacted: it is easier for educators to provide students with authentic work-based experiences if they can draw on their own identities as (former) professionals from the trade or work field in question. Moreover, an educator 'who maintains membership in both teaching and trade communicates of practice' is able to act as a broker and create connections for students between the contexts of school and work (Higham & Farnsworth, 2012, p. 466). Educators' views also influence the pedagogical strategies enacted in the learning environment: educators adopting an integrative view are more likely to apply pedagogical strategies aiming to help students integrate their learning and working experiences and to identify continuities as well as contradictions at the school-work boundary (Sappa & Aprea, 2014).

5.2. Limitations of the present study

Although the findings of the literature review are encouraging in terms of characterizing learning environments at the school-work boundary, some limitations of our research are worth noting at both the review-level and the level of the findings.

Regarding the review method, not all relevant literature might have been included, since only journal articles published in English were selected and English search terms were used. We might have missed studies from countries with few English publications or with a different vocabulary to describe vocational learning environments. Additionally, inclusion criteria regarding the type of publication may have led to the exclusion of, for instance, conference papers or book chapters that might otherwise have refined our findings. However, the inclusion of studies from fifteen different countries and the richness of the data, leads us to hypothesize that the presented framework is also relevant to analyse and describe learning environments from other countries and sources than the ones included in this review.

Regarding the findings, our focus was on educational design at the micro curriculum level. As a consequence, no insights were gained into the complex interrelation between a prevailing educational system at the macro level and learning environments found within such a system. Furthermore, this focus entailed that most of the selected studies were descriptive studies which contribute to our understanding of what cross-contextual learning environments may look like, but do not provide specific evaluative data to reach conclusions about learning outcomes. Finally, although we found studies in multiple occupational fields, considering the number of studies and the nature of the sample, no conclusions could be drawn on characteristics in relation to specific occupational fields. Further empirical research is needed to compare learning environments in different educational systems and occupational fields.

5.3. Implications for (further) research and for educational practice

As stated in the introduction, terms and concepts in work-learning scholarship mean different things in different studies. Although this may be inevitable, this study adds conceptual clarity that helps to distinguish existing and emergent phenomena, that might otherwise not have been 'acknowledged explicitly in the submersion in work-learning soup' (Fenwick, 2006, p. 174). This framework may serve as common ground to study different types of vocational learning environments and facilitate educators and scholars to make effective use of the growing body of literature on interesting, and often innovative, learning environments at the school-work boundary.

Since the focus of the present study was on vocational curriculum design, the selected literature was framed primarily from the perspective of educational institutions (see also Smith & Harris, 2001). To further develop our understanding, empirical studies are needed that take into account the perspective of other stakeholders and organizations participating in the learning environments, specifically, professionals from the occupational fields involved.

Moreover, empirical evidence from a range of educational practices is needed to support the presented insights into learning environments at the school-work boundary and to validate the presented categorization. That way, we can develop knowledge on the efficacy of different curriculum designs and aid educators to make informed design decisions in daily educational contexts.

Appendix

Table A1
Overview of features of the reviewed studies

	Short citation	Country (ISO code)	Field	Research design	Central concept or learning environment	Design category
1	Aarkrog (2005)	DK	Sales	Qualitative study, based on observations and diaries of 16 sales trainees.	Combining school-based and workplace-based learning.	1
2	Akkerman and Bakker (2011)	NL	Laboratory	Qualitative study, based on observations and interviews with 10 apprentices.	School-work interactions during apprenticeships and release days.	1
3	Andersson (2016)	SE	Police, Ambulance and Rescue services	Qualitative study of a single case (exercise with 166 students).	Boundary work and boundary awareness in multi-disciplinary exercise.	2
4	Berner (2010)	SE	Industry	Qualitative design based on two ethnographic studies	Boundary work in school-based training.	2
5	Boersma et al. (2016)	NL	Care & Welfare	Qualitative design with evaluative data from 132 students and interviews with six teachers at two schools.	Innovative learning environments, community of learners, simulated workplace.	3
6	Cremers et al. (2016)	NL	Technical, Agricultural, Environmental, Land-use planning	Educational design research during three iterations of design and implementation (15–35 students per iteration).	Hybrid learning configuration	3
7	Falk et al. (2013)	SE	Healthcare	Survey design based in a single institution with 454 students from different disciplines.	Interprofessio-nal training ward	3
8	Farnsworth and Higham (2012)	UK	Building & Construction, Media communica-tions, Automotive, Transport, Manufacturing.	Case-study approach with five work-related secondary school programmes.	Work-related programmes	2 and 3
9	Fjellström (2014)	SE	Building & Construction	Qualitative design with 11 full-day observations and four (focus group) interviews with students.	Project-based vocational education at a real building site	3
10	Flynn et al. (2016)	AU	Industry (Aerospace, Building & Construction, Minerals and Energy)	Qualitative case study methodology with several data sources (50 interviews, 60 documents).	Industry School Partnerships	3
11	Goh (2014)	BN	Vocational and Technical teacher training	Qualitative study of a group of 12 student teachers.	Teacher training programme	1
12	Harreveld and Singh (2009)	AU	n/a	Case study methodology with 21 educational leaders.	'Contextualised learning' and boundary crossing among education, training and work systems	2
13	Harris et al. (2001)	AU	Building & Construction	Qualitative study based on interviews with 32 apprentices, 21 host employers, and six TAFE teachers and four focus groups.	Alignment on-the-job and off-the-job training	1
14	Illeris (2009)	DK	n/a	The article builds on many years' theoretical and practical work in the field.	School-workplace integration	1
15	Jacobsen et al. (2009)	DK	Healthcare	Qualitative study with a total of five interviews and focus groups with students, tutors, managers and others.	Interprofessional training unit	3
16	Jossberger, Brand-Gruwel, Boshuizen, & van de Wiel (2010)	NL	n/a	Theoretical analysis and synthesis.	Workplace simulations and interaction between student, teacher and environment	2 and 3
17	Jossberger, Brand-Gruwel, Van de Wiel., & Boshuizen (2015)	NL	Engineering & Technology, Care & Welfare, Agriculture	Interview study through a semi-structured group interview with 20 teachers from three schools.	Workplace simulations	2 and 3
18	Kessels and Kwakman (2007)	NL	n/a	Literature study and secondary analysis of evaluation and policy data.	Coop education	1
19	Kneebone et al. (2005)	UK	Healthcare	Qualitative design based on interviews and observations of 22 undergraduate medical students.	Quasi-clinical scenarios, scenario-based simulation	2

(*continued on next page*)

Table A1 (*continued*)

	Short citation	Country (ISO code)	Field	Research design	Central concept or learning environment	Design category
20	Lippke and Wegener (2014)	DK	Technology, Healthcare	Qualitative design based on two ethnographic field studies.	Boundary-pushing in school-based setting	2
21	Lynch et al. (2010)	UK	Healthcare	Analysis of student perspectives and opinions based on surveys completed by 257 dental students.	Outreach teaching unit	3
22	Makovec-Radovan and Radovan (2015)	SI	Technology	Survey conducted in 10 Slovenian vocational middle schools with a sample of 226 students.	Competence-based didactic units	3
23	McKenna et al. (2010)	IE	Healthcare	Survey-study with questionnaires completed by 142 dental graduates.	Vocational dental training	1–3
24	Messmann and Mulder (2015)	DE	Technology	Survey with questionnaires completed by 70 apprentices.	School-work alignment	1
25	Nowak et al. (2016)	DE	Healthcare	Qualitative analysis of process data and learning results of 164 students from different professional programmes.	Interprofessional training program	2
26	Onstenk and Blokhuis (2007)	NL	n/a	Explorative design, based on policy analysis, literature review and meta-analysis of research on workplace learning.	Apprenticeship and curricula, which integrate learning places as well as learning experiences	1
27	Patton et al. (2013)	AU	Healthcare	Exploration of learning theories underpinning physiotherapy clinical education	Clinical learning experiences in physiotherapy	3
28	Pineda-Herrero et al. (2015)	ES	Administration & management, Electricity & electronics, Machine manufacturing, Socio-cultural & community services, hotel business & tourism.	Quantitative design with a questionnaire with 57 items, applied to 1026 VET students.	Coherence school training and workplace learning	1
29	Poortman et al. (2014)	NL	Healthcare, Agriculture, Business, Technology, Society & Human behaviour, Education, Language & Culture.	Qualitative multiple case study with seven cases.	Workplace learning in dual training programs	1
30	Sappa and Aprea (2014)	CH	Industry, Business & Administration	Phenomenogra-phic study with a total of 26 vocational school teachers, company trainers and apprentices.	Conceptions of learning and teaching across different learning sites	1–3
31	Schaap et al. (2012)	NL	n/a	Literature review (24 articles).	Learning processes in vocational schools and workplaces	n/a
32	Tanggaard (2007)	DK	Technology	Qualitative analysis of field study with interviews and observations of 10 apprentices.	Learning in practice, boundary crossing	1
33	Taylor and Watt-Malcolm (2007)	CA	Carpentry	Case-study with data from 60 questionnaires, and focus groups and interviews with 30 apprentices and 12 workplace supervisors.	Carpentry program at three sites: school, training centre and worksite.	1–3
34	Tennant and Yates (2005)	AU	Information Technology, Hospitality	Comparative exploration with two school-based cases studies.	School-based VET	2
35	Tyson (2016)	SE	n/a	Narrative case-study	Social development project	3
36	Van Schaik et al. (2011)	NL	Technology	Case study of 14 lessons in a novel educational programme.	Knowledge-rich (simulated) workplace	2
37	Virkkula (2016)	FI	Music	Qualitative case study of 11 popular and jazz music workshops, with 62 students as participants.	Performance workshops	3
38	Virtanen et al. (2014)	FI	Social services & Healthcare, Technology & Transport	Internet questionnaire, completed by 1603 final-year vocational students.	Workplace learning	1
39	Watts and Burnett (2012)	US	Agronomy	Analysis of a stratified random sample of 12 recommendation reports made by students	Integrated course with an actual farmer client	2
40	Wegener (2014)	DK	Care & Welfare	Ethnographic field study	Boundary-crossing activities	1
41	Zitter, De Bruijn, Simons & Ten Cate (2012)	NL	Communication & Journalism	Multiple case-study with three VET cases.	Project-based, technology-enhanced learning environments	2
42	Zitter et al. (2016)	NL	Hospitality	In-depth descriptive, embedded, single-case study of a distinctive curriculum innovation.	Hybrid VET-curriculum/ educational innovation project	3

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