Designing learning environments at the school-work boundary

CURRICULUM DEVELOPMENT IN VOCATIONAL EDUCATION

Erica Bouw

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Curriculum development in vocational education

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General introduction

1.1 Expectations of vocational education and curriculum design

As society changes, new demands are placed on education and curriculum design (OECD, 2019). These demands impact the connection between working and learning (Tynjälä et al., in press). In early societies, all education took place as part of everyday life. With the transition to new manufacturing processes during the industrial revolution and the mechanization of labour, education became institutionalised in separate educational institutions. In the 19th and early 20th century, efficient mass education with a standardised curriculum model matched the demands of the labour market to efficiently prepare future workers for the standardised work processes (OECD, 2019). In the late twentieth century, the demands of the labour market changed: much of the manual tasks were automated and the age of internet started, leading to new industries and jobs. Education has increasingly become a parameter for economic growth and global competition (Illeris, 2009). In the current 21st century, students entering the labour market need a strong "foundation for lifelong learning, effective citizenship and a successful career" (OECD, 2010, p. 14). Especially in the last decade, accelerated technological innovations are leading to new demands on education and a shift in the position of schools within society. Schools are becoming part of a larger eco-system and increasingly collaborate with other organisations (OECD, 2019).

Vocational education, in particular, faces the challenge of meeting the changing societal demands. Vocational education aims at preparing learners for their role in an increasingly complex society and equipping them with the vocational competences needed for dynamic work practices and future learning throughout life (Cedefop and ETF, 2020). The term vocational education is used to refer to all education and training aimed at preparing learners for work: they learn about work requirements and are supported to select a suitable vocation, to develop specific competences needed to meet changing performance requirements, and to have experiences that help them understand working life (Billett, 2011, p. 32). Moreover, vocational education is also concerned with more general educational purposes, including "personal, social, learning to learn, citizenship and cultural awareness and expression competences" (Cedefop, 2020, p. 24). Internationally, vocational education may be part of a countries' education system, part of the labour system, or embedded both in the education and in the work system.

The form and nature of vocational education differ across countries (Billett, 2011). Differences are related to tradition and culture (including issues of prestige), government policy and regulation (e.g. national qualification frameworks, funding), and institutional factors. A vast range of institutions can be involved in the provision of vocational education, both from the "world of school" and from the "world of work". Vocational education can be enacted in schools for secondary vocational education[1] or, at the level of higher education in institutions

[1] For example, *Fachschule* in Germany and Austria, *Schools for further education* in Britain, I*nstitutions for Technical and Further Education* in Australia.

or universities for higher vocational education[2]. Many countries also have other types of organisations that offer educational facilities, such as centres or enterprises established to develop skills for specific occupations, for instance about specific vehicles, equipment, or software. Depending on the institution and the countries' traditions, the shape and form of the vocational education provided can vary. In most Western societies, work and learning are organised in two strong societal systems, school and work, each with its goal rationalities (De Bruijn & Westerhuis, 2016; Nieuwenhuis & Van Woerkom, 2007). In the next section, we elaborate on these rationalities and the tensions that may arise as a result.

1.2 Tensions between school and work

The focus of the present dissertation is on vocational education as part of the public vocational education system (including both institutions for VET and Universities of Applied Sciences, see also 1.7). Since public vocational education relies on both the education and the work systems, tensions between these systems are inherent to vocational education (Choy et al., 2018a). These tensions can become apparent in different ways and at different levels: at the level of the systems, and at the institutional, interpersonal, and intrapersonal levels (De Bruijn et al., 2017a; De Bruijn & Westerhuis, 2016):

a) At the level of the systems: Within work as a system, vocational education is mainly oriented towards preparation and enhancement of competences related to a specific vocation, while within the school-system vocational education focuses on broader goals, such as good citizenship, lifelong learning, and 21st-century skills (De Bruijn et al., 2017b; De Bruijn & Westerhuis, 2016).
b) At the institutional level, tensions are related to the more specific goals of the institutions involved, for instance, to the duration, or the sequence of work-based learning periods (Eiríksdóttir, 2018).
c) At the interpersonal level, tensions can arise between actors, for instance between vocational teachers and workplace supervisors, due to different values and insufficient shared interests (Andersson, 2018).
d) At the intrapersonal level actors involved may experience difficulties when navigating the boundary between the two systems because of differences between the norms of the two systems (Berner, 2010; Ferm et al., 2018).

Considering the multilevel nature of the tensions between school and work, designing vocational curricula that help to connect the two contexts is challenging (Wesselink & Zitter, 2017). Improving connectivity is often chosen as a strategy to meet these challenges (Cremers et al., 2014; Veillard, 2012; Wesselink et al., 2010a). *Connectivity* as a concept refers to connections that can be made at different levels, that is, between individuals, between institutions, and between systems (Stenström & Tynjälä, 2009). In the context of vocational

[2] *Vocational high schools* in the US, *Polytechnics* or *Institutes for technology* in New Zealand and Singapore, *Universities of applied sciences* in several European countries.

education, connectivity is used to refer to the interaction between educational institutions and workplaces and between actors from the contexts of school and work (Sappa & Aprea, 2014).

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 a deeper understanding of how learning across contexts can be supported, this study uses a boundary-crossing lens. A boundary-crossing lens can be helpful to understand the designs of learning environments at the school–work boundary (Bakker & Akkerman, 2019; Zitter et al., 2016).

1.3 Boundary crossing between school and work in vocational education

Most vocational curricula include periods in which the students take part in work practice, for example, through an apprenticeship, work placement, or other work-related settings. As a consequence, learners need to make transitions between school and work settings. These transitions are reported to be problematic: learners experience no or insufficient connection between what they learn in school and what they learn at the workplace (Baartman et al., 2018; Illeris, 2009; Schaap et al., 2012). The experienced problems with the school–work transitions can be conceived as *boundaries*, and the process of establishing continuity between the practices can be conceived as *boundary crossing* (Akkerman & Bakker, 2012, p. 55). The concept of boundary crossing is used by scholars to conceptualise learners' participation across different social practices (Akkerman, 2011; Akkerman & Bakker, 2011; Bakker & Akkerman, 2019). The concept matches a participative approach to learning: boundary crossing between practices implies negotiating the dynamic of strangeness and familiarity and thus gaining access to a position within the practice (Tanggaard, 2007).

The concept of boundary crossing can be seen as an alternative to the concept of *transfer*, which was mainly based on the preconception that knowledge can be learned at school and consequently applied in practice. This preconception "completely neglects the influence of context, resources, and people upon the process of learning" (Guile & Griffiths, 2001, p. 126). In real life, abstract knowledge is not transferred from one situation to another (Veillard, 2012). The transfer metaphor does not help understand the dynamics of how students need to connect what they learn in the different practices of school and work (Bakker & Akkerman, 2019; Griffiths & Guile, 2003; Hager & Hodkinson, 2009). First, because the direction in which students move is not mono-directional: students move back and forth between school and work. Next, because the transfer metaphor seems to suggest that people learn something in one practice and apply it in another setting. A boundary-crossing lens, instead, matches with a more participative approach, since it focuses on how people gain increasing familiarity with artefacts, people, and so forth, in and across different social practices (Bakker & Akkerman, 2019). Crossing boundaries can be considered as a stimulus for learning because the familiar experiences of one practice may be challenged by another practice, which calls for

modification and connecting learning across settings (Onstenk & Blokhuis, 2007; Tanggaard, 2007; Unwin, 2009).

1.4 Learning environments at the boundary of school and work

In this thesis, we use the concept of *learning environment* to refer to the socio-cultural, physical, and social setting in which people engage in activities and interactions intended to support learning. Learning environments are embedded in a larger educational programme and influenced by the organisational context of the practices involved in the enactment of the programme (Albashiry et al., 2015; Thijs & Van den Akker, 2009). To increase understanding of the design of learning environments, we study the elements that can be purposefully designed (Ellström et al., 2008; Zitter & Hoeve, 2012). These so-called "designable elements" (Ellis & Goodyear, 2016; Zitter et al., 2011) are intended to lead to affordances that may be consequential for learning.

The concept *affordance* was coined by the psychologist James Gibson to refer to environmental cues or possibilities for action provided to users in an environment and has since been applied also to indicate the relationship between aspects of a socio-material environment and the people in that environment (Rietveld & Kiverstein, 2014). In line with Rietveld and Kiverstein, we view affordances in a broad sense, that is not only relating to motoric actions (e.g. grasping, sitting, walking) but including all activities that people can undertake in a given social practice. Affordances depend on the abilities of the people to function, taking into consideration the norms of the practice in question. In this sense, affordances can be seen both as relational and as a resource. Since the focus of this thesis is on learning environments, we use the concept of affordance to indicate the latent potential of the designable elements to trigger learning.

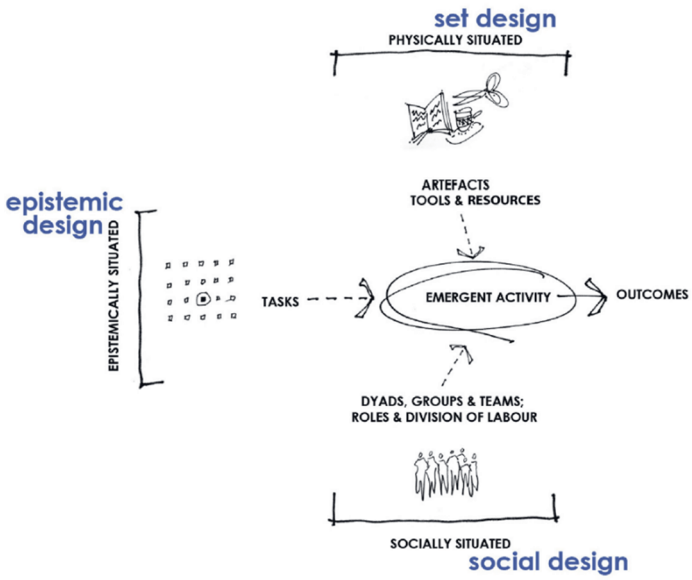
In the context of work, affordances are seen as opportunities for learning provided by workplaces, that is, opportunities for workers to engage in work activities and to access the support of co-workers or mentors. Learning at the workplace is shaped by the activities individuals engage in, by the social environment (co-workers, guidance, and access to expertise), and by the physical environment (including all kinds of resources and tools) (Billett, 2001; Filliettaz, 2014). In the context of school, many studies have focused on the match between the affordances of learning spaces, both material and digital, and the educational needs (Ellis & Goodyear, 2016). In modern-day educational design, it is viewed as increasingly important to consider aspects related to space and place, including geographical proximity to specific practices, and affordances such as IT access, PC use, laptop points, LCDs, availability of suitable laboratories for teaching and learning (Harrison & Hutton, 2013; Young et al., 2019). These and other kinds of tools and artefacts make up the physical setting of the learning environment and co-constitute affordances for the learners (Goodyear et al., 2014).

This thesis departs from the assumption that tasks, spaces, tools, people, and so forth, may incite learners to engage in activities that are expected to activate learning. In line with

Carvalho and Goodyear (2018), we think that learning itself cannot be designed, but "the physical and social components of the situation in which learning activity unfolds *can* be designed" (Carvalho & Goodyear 2018, p. 35, authors' italics). A design may influence individuals' activities by shaping the setting and inviting learners to engage in tasks that are seen as relevant (Goodyear & Carvalho, 2014). In this view, *activity* is seen as emergent and epistemically, physically, and socially situated (Carvalho & Goodyear, 2018; Ellis & Goodyear, 2016). Carvalho and Goodyear illustrate this with their Activity Centred Analysis and Design model (ACAD model) (see Figure 1).

Figure 1

Carvalho & Goodyear's ACAD model



Our focus is on activities emerging in learning environments at the school–work boundary, that is, learning environments that combine affordances from both the contexts of school and work. Considering the importance of the temporal dimension of activity (Engeström, 2001), in this thesis we include the temporal elements in the framework, referring to all time-related aspects of a learning environment design (Zitter & Hoeve, 2012).

1.5 Research on educational design

Two main research strands within research on educational design are combined in this thesis: the technical strand that focuses on the *design process*, and the realist strand, which focuses on the *design expertise* (McKenney et al., 2015). The technical strand examines the decision-making process on how to deliver the curriculum (Huizinga et al., 2014). This decision-making process is largely implicit (Kirschner et al., 2002). Contrary to design in other disciplines, such as

engineering disciplines, there are no conventions of systematic documentation in educational design (Edelson, 2002). As a consequence, a retrospective analysis of the design is seen as an effective method to understand the design process (Edelson, 2002; Van den Akker, 2003). For this purpose, we will examine the *characteristics* of learning environments at the school–work boundary, and zoom into the designable elements of different manifestations of these learning environments. Moreover, to further increase understanding of the design process, we will analyse the design considerations that typically remain implicit (Van den Akker, 2003). Our focus lies on the curriculum as intended (ideal curriculum). However, we will also look at the implemented curriculum (the operational curriculum or curriculum-in-action) (Van den Akker, 2003), to try to grasp the design features of the intended design. We want to gain insights into the "wisdom of practice" of the people who are actively involved in curriculum design (Voogt et al., 2019).

1.6 Problem statement and aim of this thesis

Studies on learning environment design are scarce in the field of educational research. Even teacher education programmes pay little attention to design. As a consequence, teachers find it difficult to articulate a design rationale and to reflect on their design work (McKenney et al., 2015). Studies on the design of vocational learning environments are particularly rare. Although some recent studies did focus on designs for professional expertise development (Elvira et al., 2017), the design of learning environments in higher professional education (Zitter et al., 2011), and on design principles for a specific type of learning environment (Cremers et al., 2016; Istance & Kools, 2013; Koenen et al., 2015; Wesselink & Zitter, 2017), there is little understanding of the design of learning environments at the school–work boundary.

Furthermore, insights presented in other studies are mostly coupled with specific manifestations of learning environments. These studies are difficult to relate to each other because a multiplicity of terms is used, to refer to the large range of learning environments at the school–work boundary: "cooperative education" (Eames & Coll, 2010), "work-based learning" (Onstenk, 2017), "school-based vocational training" (Jonasson, 2014), "work-related projects" (Tynjälä, 2008), "work-related learning arrangements" (Lappia, 2011), "hands-on simulations" (Khaled et al., 2014), "workplace simulations" (Jossberger et al., 2017), "interprofessional training units" (Falk et al., 2013), "hybrid learning configurations"(Cremers et al., 2016), "regional learning environments" (Oonk et al., 2016), etcetera. Little consistency is found in the use and definition of the large variety of terms in the "work-learning soup" (Fenwick, 2006). This lack of conceptual consistency makes it difficult to study the value of learning environments at the school–work boundary. It is hard to study differences and similarities between vocational learning environments since there are few frameworks for analysing, describing, and designing vocational curricula: it is not clear which types are being compared, what the specific features of each type are, what manifestations might be considered as typical, or which design considerations underpin the different designs.

Additionally, little is known about what is needed to facilitate the co-construction of learning environments. Although we do know that collaborative design involves recursive considerations and the articulation of expectations by all stakeholders involved in the design (Voogt et al., 2019), discussing considerations and articulating expectations between stakeholders from school and work is challenged by the lack of a common understanding of the variety of learning environment designs and their specific features. The design of learning environments at the school–work boundary needs to be examined in more detail to improve our understanding of the multiplicity of vocational learning environments that are designed at the school–work boundary and to offer support for their design. 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 et al., 2017).

The central question of this study is: How are learning environments at the school–work boundary designed in vocational education?

The sub-questions that we intend to answer are:

- What are the characteristics of designs of learning environments at the school–work boundary in vocational education?
- Which manifestations of learning environment designs can be identified in vocational education and what are the specific designable elements of these designs?
- Which design considerations are taken into account when (re)designing curricula at the boundary of school and work?
- Which discontinuities are encountered from the perspective of work practice when co-constructing learning environments at the school–work boundary and which strategies are applied to counterbalance these discontinuities?

1.7 Context of this study: Dutch vocational education

Data for this study were collected in the context of Dutch vocational education. In the Netherlands, students can follow senior secondary vocational education (in Dutch: *middelbaar beroepsonderwijs*, abbreviated as *mbo*) or higher professional education (in Dutch: *hoger beroepsonderwijs*, abbreviated as *hbo*). Both levels of education qualify students for occupational practice. The levels correspond with Levels 3–6 of the International Standard Classification of Education (ISCED) and the European Qualification Framework (EQF). Senior secondary vocational education and training consists of four educational levels, from assistant training (level 1) to specialist training (level 4). Students can choose between two pathways in senior secondary vocational education: a school-based route and a work-based route. Both pathways are enacted by vocational schools (Smulders et al., 2019). Higher professional education consists of two educational levels: associate degree (level 5) and bachelor (level 6), and is enacted in universities of applied sciences (UAS). All levels of vocational education are enacted in cooperation with labour organisations.

Alongside other continental European countries, the Netherlands is seen as a “world class” VET system (European Commission, 2012). Vocational education is part of the public education system and educational institutions have a strong relationship with social partners, especially in senior secondary vocational education (De Bruijn et al., 2017a). Government and social partners cooperate to provide labour market-relevant vocational education that also prepares students for participation in society and further study. The Dutch system is funded by the government, but companies contribute substantially and are actively engaged in the delivery of vocational training at all levels. This leads to high participation levels since students are confronted with low private spending. In VET a large part of students’ study time (up to 65%) is spent on work-based learning. The quality of work-based learning is assured and satisfaction with upper secondary work-based learning is high (Westerhuis, 2018).

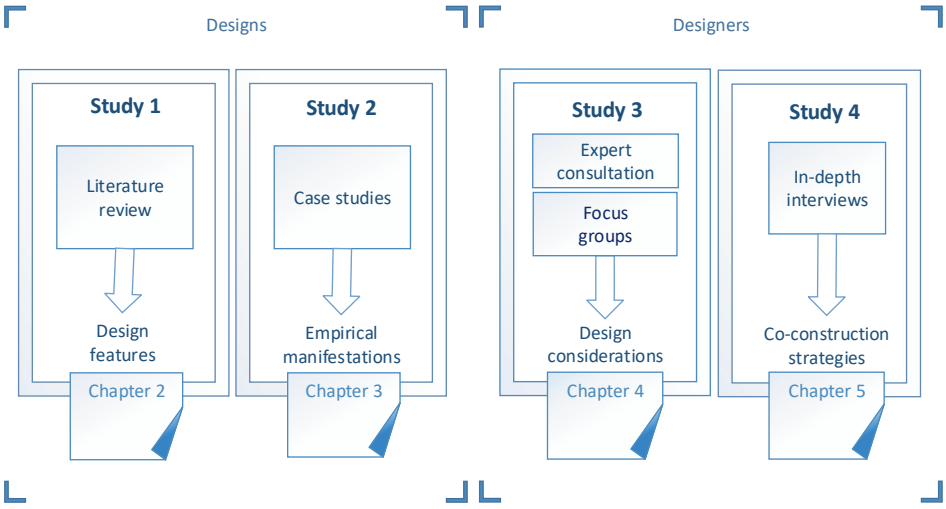
Related to curriculum development, the trend in Dutch educational policy is towards decentralization. Educational quality is measured through output criteria. Educational designers have a high degree of autonomy about how they design educational programmes and how they make site-specific choices, as long as they meet these criteria, which serve as a frame of reference for public accountability (Cedefop, 2016). In the last decades, vocational colleges and universities of applied sciences in the Netherlands, have implemented competency-based education, which changed a lot in the design of the curricula and instructional methods for vocational study programmes (Van der Sluis et al., 2014). Educational designers base their curricula on competence profiles and qualification files that are drawn up together with companies from the relevant occupational fields (or that are strongly informed by representatives of these fields). These competence profiles and qualification files can be considered as boundary objects that facilitate collaboration between the practices of school and work. As in many other European countries, making vocational education future-proof is a priority for Dutch policy makers (Cedefop, 2016).
Even though the studies in this thesis are conducted in the context of Dutch vocational education, the results are expected to be relevant for all education in which connectivity between the contexts of school and work is an important issue.

1.8 Research methodology and overview of the chapters in this thesis

The research problem is investigated in four consecutive qualitative studies: a systematic literature review to further understand characteristics of learning environments at the school–work boundary (study 1), a case study of six cases in Dutch vocational education to examine concrete manifestations of learning environments at the school–work boundary (study 2), and two interview studies to understand the design considerations made by educational designers during the design (study 3), and specific strategies applied by representatives of work practice when (co)constructing learning environments with educational institutions (study 4). Figure 2 shows the relation between the studies and the chapters of this thesis.

Figure 2

The studies central to this thesis and their relation to the chapters



Chapter 2 investigates the characteristics of learning environments at the school–work boundary, focusing on their designable features. The results of a systematic literature review are presented. Literature was selected relating to vocational education and containing empirical data about learning environments at the school–work boundary or conceptual insights into their design. This chapter aims at broadening our understanding of learning environment designs at the school–work boundary by reporting frequent themes across relevant scholarly work.

Chapter 3 builds on the insights of the first study and focuses on concrete manifestations of vocational learning environment designs. A case study approach was used to examine a purposefully selected sample of learning environments in Dutch vocational education. This chapter aims to contribute to insights into specific characteristics of different design categories, and into the designable elements that can be used to connect the contexts of school and work.

Chapter 4 also centres around the school–work connection, but instead of focusing on the designed learning environment, this chapter focuses on the considerations of educational designers. A focus group methodology was used to elicit educational designers' implicit decisions about the designable elements of learning environments. The chapter aims to explicate design considerations underpinning the construction of learning environments in the context of vocational education, thus further adding to the insights into ways of strengthening the school–work connection and of designing future-proof vocational curricula.

Chapter 5 explores the design issues from the perspective of representatives of work practice, focusing on their experiences with co-construction. This chapter reports discontinuities signalled by representatives from vocational practice who are strongly engaged in the co-construction of learning environments together with educational institutions. The chapter aims to increase understanding of the strategies employed by work practice to counterbalance discontinuities when co-constructing learning environments at the school–work boundary.

Chapter 6 encompasses the overall findings and conclusions of the individual studies and an overarching discussion. Practical implications, recommendations, and suggestions for further educational research are presented.

2

Characteristics of learning environments at the boundary of school and work[3]

[3] This chapter is based on: Bouw, E., Zitter, I., & De Bruijn, E. (2019). Characteristics of learning environments at the boundary between school and work–A literature review. Educational Research Review, 26(1), 1-15.

Abstract

Many learning environments in vocational education aim to connect the contexts of school and work. Examples are work-related projects, workplace simulations, student-run clinics, and hybrid learning configurations. The definitions and terms used to refer to these learning environments are not consistent and little is known about their characteristics. To contribute to conceptual clarity about learning environments at the school–work boundary a systematic literature review was carried out. Three categories of learning environments at the school–work boundary emerged from the reviewed literature: designs based on alignment, designs based on incorporation, and designs based on hybridisation of the contexts of school and work. These three categories could be concretised with specific designable elements from a spatial, instrumental, temporal, and social perspective. The designable elements help to distinguish between learning environments and to understand decisions during curriculum design. Empirical research is called for to further develop insights on cross-contextual learning environments.

Keywords: curriculum design; cross-contextual learning; learning environments; school–work boundary; vocational education.

2.1 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 et al., 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 et al., 2015), workplace simulations (Jossberger et al., 2010), school-based vocational training (Jonasson, 2014); work-related learning arrangements (Lappia, 2011); hybrid learning configurations (Cremers et al., 2017) and regional learning environments (Oonk et al., 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 a deeper understanding of how they are designed.

Studies on curriculum design are scarce in the field of educational research in general; even teacher education programmes pay little attention to curriculum design and teachers find it difficult to articulate a design rationale and to reflect on their design work (McKenney et al., 2015). Studies on vocational curricula design are particularly rare. Although some recent studies focus on curriculum design in vocational education in developing countries (Albashiry et al., 2015), designs for professional expertise development (Elvira et al., 2017), higher education curricula (Zitter et al., 2011), or on design principles for a specific type of learning environment (Cremers et al., 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 et al., 2017; Zitter et al., 2011).

This chapter extends current insights into vocational curriculum design by presenting a conceptual framework to describe and characterise 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 a deeper understanding of the design rationale behind these learning environments, and of what it entails to study the design of learning environments.

2.2 Theory

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 & Rismark, 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, 2014b; Harris et al., 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 et al., 1994). To prevent that what students learn in school remains inert, attention needs to be paid to the learning environment design (Renkl et al., 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, 2014c, 2015; Tynjälä et al., 2003) and to the integration of learning in the two contexts (Endedijk & Bronkhorst, 2014; Helle et al., 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 et al., 2014). Improving connectivity is often chosen as a strategy to meet these challenges (Cremers et al., 2014; Veillard, 2012; Wesselink et al., 2010a). *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 a deeper understanding of how learning across contexts can be supported, this study uses a boundary-crossing lens.

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, 2019). 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.

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 a continuous balancing of a myriad of design considerations about the curriculum (Akkerman et al., 2013; Kirschner et al., 2002; 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 programme 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. 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, 2018; 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; that is, those elements that can be purposefully designed (Ellström et al., 2008). Together with the tasks set for the learners, designable elements influence the learning activities learners engage in (Carvalho & Goodyear, 2018).

Four perspectives are used in this study to specify the designable elements (Carvalho & Goodyear, 2018; 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 of 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, 2019). 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?

2.3 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 et al., 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 authors. 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(me)* 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.

Table 1

Keywords literature search

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

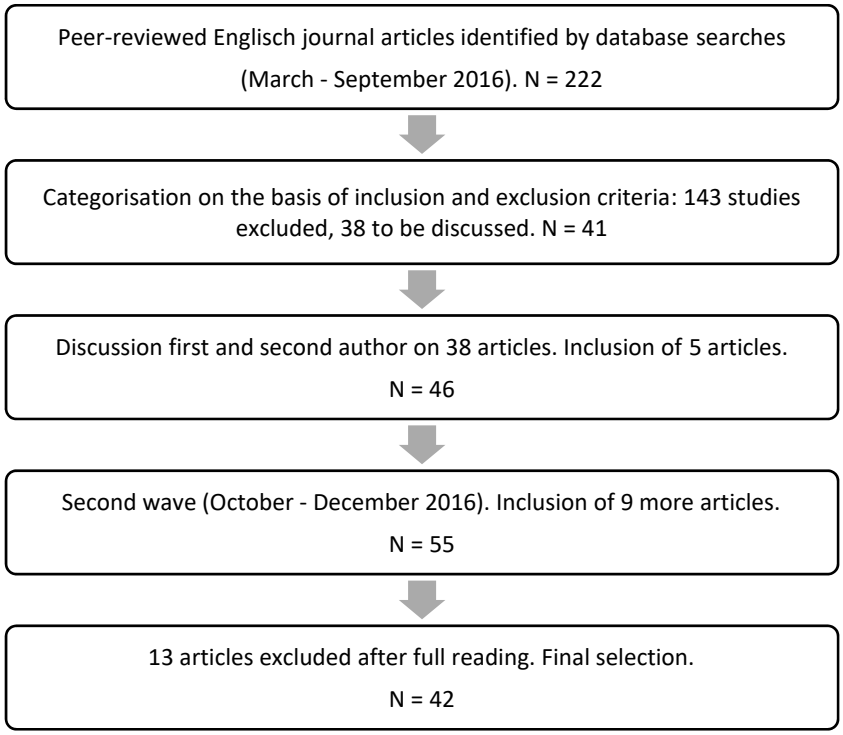
The literature search was conducted between March and December 2016. The following databases were selected to ensure a broad spectrum of articles in the educational, behavioural, and social sciences: Education Resources Information Center (ERIC), PsycINFO, Scopus, and Web of Science. Depending on the 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.

Figure 3 illustrates the selection process. 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 authors to reach an agreement about possible exclusion. Studies were excluded based on 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.

Figure 3

Selection process



After applying the exclusion criteria, 42 articles were retained for further analysis. 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, the 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). The appendix (see Appendix chapter 2) 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.

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, 2018; 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.

Table 2

Analysing learning environments

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

2.4 Results

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, that is, 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 *alignmen*t 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 (see Appendix chapter 2).

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 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 organisations 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 et al., 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 et al., 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 et al., 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 et al., 2016; Tennant & Yates, 2005), or through (c) simulation (Kneebone et al., 2005). At school, educators use their knowledge and experience of the occupation to contextualise 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 et al., 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 skills, 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 et al., 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 et al., 2016).

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 environments. These designable elements correspond to the spatial, instrumental, temporal, and social perspectives of the learning environment design.

***The spatial perspective*.** From a spatial perspective, the selected literature reveals choices for the learning environment design concerning: (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 et al., 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 et al., 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.

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 their workplace experiences 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 (Wegener, 2014; Lippke & 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.

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 full-time. The 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 number 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). 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 before entering the learning environment. Some learning environments have strict entry requirements to secure a certain level of performance, for example, students have to participate in several weeks of practical training experiences before starting at an inter-professional training ward (Falk et al., 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 et al., 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 students' involvement in the learning environment (Fjellström, 2014). Likewise, features of the school practice can affect 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 et al., 2016). When feedback during the professional task is not possible, this can be organised immediately after the completion of the task (e.g. after the music performance in Virkkula, 2016).

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 an everyday reality for students through the use of examples from their own experiences in the trade (Farnsworth & Higham, 2012). Educators act as "supportive mentors 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 the 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 organisation in need of advice (Cremers et al., 2016). The role of a co-worker or expert is usually fulfilled by experienced professionals from the field. The interactions with these professionals are meant to contribute to learners' membership in 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 et al., 2013).

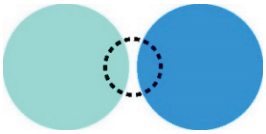
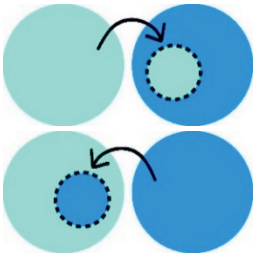
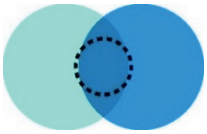
2.5 Conclusions and Discussion

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 a 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 Figure 4 synthesises the findings, by representing (a) designs based on alignment, (b) designs based on incorporation, and (c) designs based on hybridisation.

Figure 4

Three categories of learning environment designs

Designs based on alignment	Designs based on incorporation	Designs based on hybridisation
		

The categorisation in Figure 4 is supported by two recent studies on ways to establish continuity between contexts. In a study on the 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 an 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 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 its potential. With designs based on incorporation, for instance, the potential of the learning environment can be affected by actors' attributions of less positive qualities to school-based and work-resembling practices (Jonasson, 2014). If a little attempt is made to facilitate the 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, safer 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 et al., 2017).

Table 3

Designable elements of learning environments 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, a regular classroom can function as a 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.

	Designs based on alignment	Designs based on incorporation	Designs based on hybridisation
Temporal perspective	Fixed timespan, alternation between practices, scheduled group meetings. No work-related temporal features are mentioned.	Timespan depends on the 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.	The 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 colleagues 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 patients or clients.	Both educators and students fulfil hybrid roles, that is, they are at the same time educator/ learner and perform a professional role (nurse, therapist, senior or junior employee). A 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).

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, that is, 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 et al., 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" can 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).

Limitations

Although the findings of the literature review are encouraging in terms of characterising 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 hypothesise 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 about specific occupational fields. Further empirical research is needed to compare learning environments in different educational systems and occupational fields.

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, 2000). To further develop our understanding, empirical studies are needed that take into account the perspective of other stakeholders and organisations 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 categorisation. 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.

3

Designable elements of integrative learning environments[4]

[4] This chapter is based on: Bouw, E., Zitter, I., & De Bruijn, E. (2020). Designable elements of integrative learning environments at the boundary of school and work: a multiple case study. Learning Environments Research, 1-31.

Abstract

Learning environment designs at the boundary of school and work can be characterised as integrative since they integrate features from the contexts of school and work. Many different manifestations of such integrative learning environments are found in current vocational education, both in senior secondary education and higher professional education. However, limited research has focused on how to design these learning environments and not much is known about their designable elements, that is, the epistemic, spatial, instrumental, temporal, and social elements that constitute the learning environments. The purpose of this study was to examine manifestations of two categories of integrative learning environment designs: designs based on incorporation and designs based on hybridisation. A cross-case analysis of six cases in senior secondary vocational education and higher professional education in the Netherlands led to insights into the designable elements of both categories of designs. The paper reports findings of the epistemic, spatial, instrumental, temporal, and social elements of the studied cases. Specific characteristics of designs based on incorporation and designs based on hybridisation were identified and links between the designable elements became apparent, thus contributing to a deeper understanding of the design of learning environments that aim at connecting the contexts of school and work.

Keywords: designable elements, integrative learning environment, multiple case study, curriculum design, school–work boundary, Activity Centred Analysis and Design (ACAD) model

3.1 Introduction

A universally recognised characteristic of vocational education is its relation to the world of work. Therefore workplace learning or other varieties of practice-based learning are often integrated into the vocational curriculum (Billett, 2014a; Grollmann, 2018). The term vocational education is used here to refer to all education and training for vocations (Billett, 2011). The school–work relation that characterises vocational education has implications for learning environment design since features from school and from work need to be intentionally combined within the learning environment. Intentionally designed learning environments or systems at the boundary of school and work include authentic goal-directed work activities and physical settings in which learners can practise and be guided by experts from occupational practice (Billett & Choy, 2013; Harteis et al., 2014). Such activities and settings are needed to develop the kinds of knowing and skills required to be productive in work, to inform learners about their preferred vocations, and to assess their suitability for a vocation (Choy et al., 2018a). Thus, work is important not only as a context learners need to learn about but also as a context through which students can learn and develop (Guile & Griffiths, 2001). However, workplace learning is subject to limitations: the workplace is not always suited as a context for learning since workplace demands tend to override individual and educational goals (Fjellström & Kristmansson, 2016), students may only be allowed to work on simple tasks (Nyen & Tønder, 2018), or work cannot be paused for explanations (Schaap et al., 2012).

Educators strive at working around such limitations by facilitating connectivity between workplace-based and school-based activities (Griffiths & Guile, 2003). However, empirical studies illustrate that connectivity is not easy to achieve: collaboration between workplaces and education providers is problematic (Pylväs et al., 2018; Stenström & Tynjälä, 2009) and learners continue to experience difficulties integrating what they have learned in the contexts of school and work (Baartman & De Bruijn, 2011). A stronger connection between the contexts can be achieved through the design of "appropriate arrangements for integration" (Choy et al., 2018a, p. 11). The quest to design such integrative arrangements has led to "fruitful alternatives" to workplace learning (Poortman et al., 2014), which can be used as complementary learning environments *alongside* workplace learning in vocational curricula. Examples are school-based vocational learning (Lindberg, 2003), work-integrated learning programmes (Veillard, 2012), industry school partnerships (Flynn et al., 2016), hybrid configurations (Cremers et al., 2016), change laboratory workshops (Morselli et al., 2014) and hybrid learning environments (Zitter et al., 2016).

Despite the large variety of integrative learning environments at the school–work boundary, few studies have addressed their specific design characteristics. Although learning environment research has received growing attention in the last three decades (Zandvliet & Fraser, 2018), such studies in vocational education are still relatively scarce (Wesselink & Zitter, 2017). A large body of research on learning environments focuses on students' perceptions of

the learning environment and on variables affecting these perceptions (e.g. Telli et al., 2006). In vocational education, analogous studies have presented insights into how students' perceptions impact specific learning outcomes, for instance, self-regulation (Jossberger et al., 2017). Moreover, some studies in vocational education have contributed to our understanding of instruction from an integrative pedagogical perspective (Elvira et al., 2017), of designing learning environments for a specific purpose (e.g. to foster a community of learners; Boersma et al., 2016) and of designing a specific manifestation (e.g. hybrid configurations; Cremers et al. 2016). However, an overall framework with designable features of different types of learning environments in vocational education is still lacking. For educators to be able to make informed design decisions and for scholars to be able to study the effect of these decisions, insights are needed into the specific designable elements of different types of learning environments at the school–work boundary.

Context of the study

The context of this study is Dutch vocational education, which includes both senior secondary vocational education and higher professional education (De Bruijn et al., 2017a; Smulders et al., 2019). Both levels of education qualify students for occupational practice. The levels correspond with Levels 3–6 of the International Standard Classification of Education (ISCED) and the European Qualification Framework (EQF). In the Netherlands vocational education is part of the public education system: government, educational institutes, and social partners cooperate to provide labour market-relevant vocational arrangements that also prepare students for participation in society and for further study (De Bruijn et al., 2017a). Although the Dutch vocational system is primarily school-based, workplace learning is a considerable part of the curriculum and continuous efforts are made to establish connective relationships between workplace learning and learning in schools (Onstenk, 2017). In the last decade this has led to a variety of learning environment designs at the school–work boundary, in which learning and working are "merged" (Wesselink & Zitter, 2017). Even though the study is conducted in Dutch vocational education, the results are expected to be relevant for all education in which connectivity between the contexts of school and work is an important issue. The overall aim is to improve understanding of the variety of manifestations of vocational learning environments at the school–work boundary.

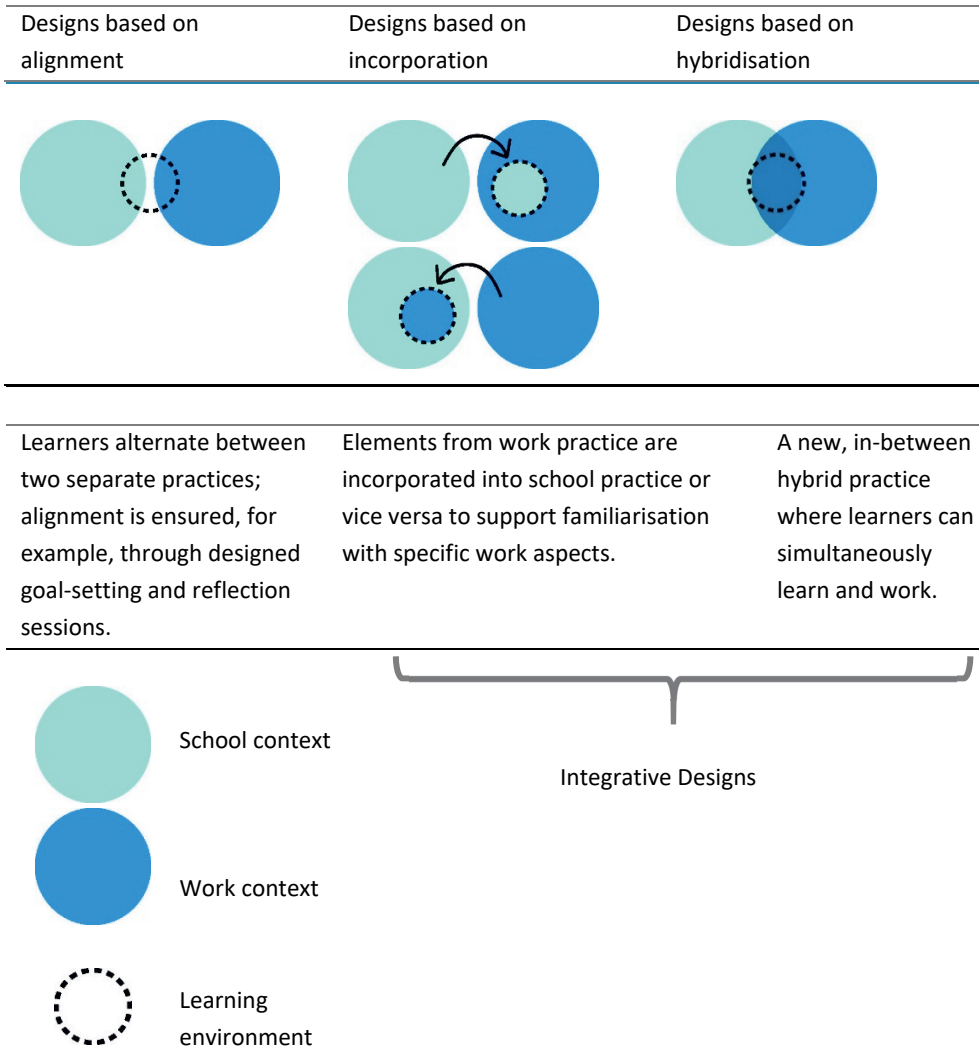
3.2 Theory

In this study, we use the term *learning environments* to indicate educational arrangements or systems that are designed and managed (Goodyear, 2005). These arrangements are embedded in a larger educational programme and influenced by the organisational context of the educational institution (Albashiry et al., 2015; Van den Akker et al., 2009). With *learning environment* we refer both to the socio-cultural setting and the physical/digital setting in which learners perform their tasks (Carvalho & Goodyear, 2018; Zitter & Hoeve, 2012). Tools and artefacts make up the physical setting of the learning environment and co-constitute a range of affordances for the learners (Goodyear et al., 2014). Next to the designable elements of a

learning environment, that is, elements that can be purposefully designed (Ellström et al., 2008; Zitter & Hoeve, 2012), this study takes into account the design rationale for the school–work connection of a learning environment (Bouw et al., 2019). Three rationales have been identified to connect the contexts of school and work: alignment, incorporation, and hybridisation (see Figure 5).

Figure 5

Three design rationales



Since school–workplace alignment has been the focus of several studies in the last decade (Akomaning et al., 2011; Messmann & Mulder, 2015; Nieuwenhuis et al., 2017), the present

study focuses on designs based on incorporation and hybridisation. Designs based on these two rationales are considered to be integrative: in designs based on incorporation, aspects of one context are integrated into another context without changing the nature of each practice; in designs based on hybridisation, school and work contexts are integrated in such a way that new in-between practices emerge at the school–work boundary (Akkerman & Bakker, 2011).

To unravel the complexity of integrative learning environment designs, we used a descriptive framework, based on the Activity Centred Analysis and Design (ACAD) model, presented by Carvalho and Goodyear (2018). The ACAD model has its starting point in the presupposition that although learning cannot be designed, "the physical and social components of the situation in which learning activity unfolds *can* be designed" (Carvalho & Goodyear, 2018, p. 35, original authors' italics). This presupposition acknowledges that human activity tends to be goal-directed and that a design can influence these activities by shaping the physical and social setting and by setting tasks, that is, suggestions about "something worth doing" (Goodyear & Carvalho, 2014). In the ACAD model design is seen as a way to invite learners to engage in tasks and activity as something emergent. This emergent activity is epistemically, physically, and socially situated (Carvalho & Goodyear, 2018). To include the temporal dimension of activity more explicitly (Engeström, 2001), our framework includes time-related aspects of a learning environment design (Zitter & Hoeve, 2012), leading to the framework as represented in Figure 6. The resulting framework distinguishes five designable elements: epistemic, spatial, instrumental, temporal, and social elements.

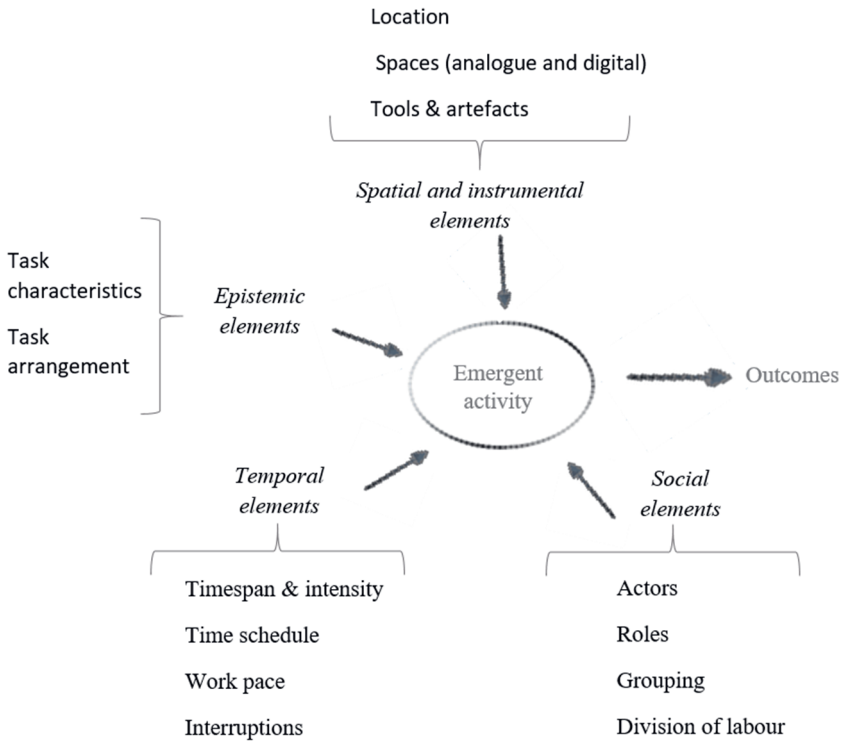
Epistemic elements of a learning environment design are the task characteristics and the task arrangement (Carvalho & Goodyear, 2018). These elements are based on the ways of knowing (including skills and attitudes) that are seen as worthwhile in the relevant domain and about how this knowing can best be presented and structured within the curriculum (Carvalho & Goodyear, 2018). In the context of vocational education, aimed at supporting students to learn a vocation, epistemic elements are related to the occupation learners are being prepared for. How people engage in work practice and what that practice affords to learners, is expected to have consequences for what they learn (Billett, 2001). Thus, a key step in curriculum design is to determine which practices are suited to the specific occupation (Billett & Choy, 2013), what kind of tasks learners are supposed to engage in, and what kind of information they need to perform those tasks (Kirschner & Van Merriënboer, 2008).

Spatial and instrumental elements of the learning environments' design include all physical features. Spatial elements are the location (school location, work location, or third location), spaces (analogue or digital), and how these spaces are furnished (e.g. as professional workspaces or as traditional classroom spaces) (Bouw et al., 2019; Zitter & Hoeve, 2012). Instrumental features include all tools and artefacts needed to perform relevant tasks. In the terminology of the ACAD model, these affordances constitute the *set design* of the learning environment (Carvalho & Goodyear, 2018). In vocational education, the set design is likely to comprise artefacts that facilitate communication and collaboration between school and work,

so-called “boundary objects” (Bakker & Akkerman, 2014). Professional artefacts that are used in occupational practice may serve as boundary objects and may also be used to enhance the consistency between different tasks within a learning environment (Zitter et al., 2016).

Figure 6

Descriptive framework for learning environments



Social elements are all actors present in a learning environment, roles they fulfil, how they are grouped and how tasks are appointed to and divided between different actors (that is, the division of labour). This is called the *social design* within the ACAD model and it includes all suggestions on how actors might interact (Carvalho & Goodyear, 2018). In vocational education, learning environments often involve multiple actors from the contexts of school and work who enact educational roles (e.g. coach, learner, assessor) and roles related to the profession (e.g. junior or senior colleague, or managerial roles) (Zitter & Hoeve, 2012). Role descriptions may vary from highly specified role descriptions to functions with multiple roles (Zitter et al., 2011).

In the present study *temporal elements* are included in the framework to illuminate the importance of considering affordances related to time. Designable temporal elements include timespan and intensity of the programme, nature of the time schedule, work pace (including

the amount of time pressure), and work interruptions to slow down, accelerate, or pause the work process for educational purposes (Bouw et al., 2019; Zitter & Hoeve, 2012).

Together, the designable elements influence the nature and pace of the emergent activity within a learning environment, that is, activities participants engage in. Insights into the variety of designable elements for different manifestations of integrative learning environments can contribute to our understanding of curriculum design in vocational education. The present study aims at collecting empirical evidence of a purposefully selected variety of learning environments, identifying designable elements, to improve understanding of "what is designable in advance, and what is not" (Carvalho & Goodyear, 2018, p. 10). To such purpose, the following research question was formulated: which manifestations of integrative learning environment designs can be identified in vocational education? To fully understand the empirical differences and similarities of the two categories of integrative designs, the following related question was posed: what are the specific designable elements of designs based on incorporation on the one hand and designs based on hybridisation on the other hand?

3.3 Methods

To map the empirical variation of integrative learning environments and uncover the designable elements of real-life manifestations in vocational education, a multiple case study design was chosen (Stake, 2013; Yin, 2014).

Case definition and selection

The unit of analysis of each case was a learning environment, that is, a bounded part of the curriculum. In line with the descriptive framework presented in the introduction (Figure 6), each unit of analysis comprised the epistemic, spatial, instrumental, social, and temporal elements of the learning environment. Cases were selected from a large pool of potential cases that could be accessed via the research group's nationwide network of key figures in Dutch senior secondary and higher professional education. Information-rich cases were identified and selected by combining theory-based and stratified purposeful sampling strategies (Palinkas et al., 2015). Theory-based sampling involved identifying learning environments that might correspond with one of the design categories, that is, designs based on incorporation or on hybridisation (Figure 5). We aimed at selecting at least two cases per category to be able to make statements about different categories (Yin, 2014). Furthermore, we wanted to study at least four cases in total, to reach a thorough understanding of the central phenomenon (Stake, 2013). Cases were selected by studying publicly accessible information about cases in the pool of potential cases, followed by an interview with a key person of promising cases. These interviews centred around the school–work connectivity and were to confirm our initial conjectures. Stratified purposeful sampling was applied to improve credibility and capture patterns that cut across occupational domains, educational levels, timespan, and years of existence of the learning environments:

- Occupational domain: six different occupational domains were selected.
- Educational level: both upper secondary Vocational Education and Training (VET; ISCED/EQF Level 3–4) and Higher Professional Education (HPE; ISCED/EQF Level 5-6) were included.
- Timespan within the curriculum: cases with varying timespans were included, varying from ten weeks to more than two years (of the three or four years of the whole educational programme).
- Years of existence: we selected only stable learning environments, existing from two to more than ten years.

With these selection criteria, the case selection as presented in Table 4 resulted.

Table 4

Case selection

Theoretical sampling	**Stratified purposeful sampling**					
Design category	Occupational domain	Description	Educational level		Timespan within curriculum	Years of existence
			VET	HPE		
Incorporation	Sport & Recreation	School to work; collective workplace learning	x		One year	> 2 years
	Agriculture	Work to school; multilevel project	x	x	Ten weeks	> 5 years
	Urban Studies	Work to school; multi-professional "lab"		x	Ten weeks	> 5 years
Hybridisation	Oral Healthcare	School & work; student-run clinic		x	Two years	> 10 years
	ICT & Media	School & work; student-run firm	x		Two years	> 5 years
	Legal Consultancy	School & work; multi-professional student-run consulting firm		x	Various possibilities, max. one year.	> 10 years

Next to the variety represented in Table 4, cases were also located in six different institutions and geographically spread over the country, with both urban and rural areas represented in the selection.

Data collection

Data were gathered about both the purposeful design and the emergent activity within each learning environment. Multiple data sources were used to ensure rich descriptions, data triangulation, and validity of the results (Yin, 2014): curriculum documents, an in-depth interview with a key figure of the learning environment, and site visits, which included short participant interviews and observations (see Table 5). The number of site visits per case ranged from one to three, depending on the variety of physical settings and planned interactions within the learning environment. Before each visit, the purpose of observations and interviews was discussed with a key-figure of the case, who informed the other participants and signed an informed consent form. During observations and before each interview participants' consent was double-checked orally. No personal data of the participants other than the key-figure was registered; all data were processed anonymously. During the site visits, photos were taken of artefacts, spaces, instruments, and interactions between actors. Actors were interviewed and asked to elaborate on the rationale underlying the activities they were (or had been) engaged in and about the epistemic, spatial, instrumental, social, and temporal elements of those activities. Table 5 shows details of the site visits per case.

Analysis

Data analysis codes were developed with the aid of a template, a thematically organised table with textual data from the cases, which was verified and modified through data collection and analysis (Cassell et al., 2014). A priori codes of the initial template were based on the presented theoretical framework (Figures 5 and 6) and were related to:

- the design rationale regarding the school–work connection, that is, *incorporation* or *hybridisation* and,
- the designable elements: epistemic, spatial, instrumental, temporal, social, and their subcategories (e.g. *spatial – physical space*, and *spatial – digital space*).

Codes that arose from the data during analysis, for example to code experienced "bottlenecks" mentioned by the actors, were added to the template. The template was discussed within the research group (i.e. together with the second and third author) until consensus was reached.

Table 5

Site visits

Design category	Case	Data sources during site visits		Data	
		Observations	Participant interviews	Observational data	Audio data (all interviews)
Incorporation	Sport & Recreation	8 hours, spread over 3 visits at 3 different locations	7 students, 2 teachers, 8 people from work (at 2 work locations)	70 photos	176 minutes
	Agriculture	8 hours, spread over 3 visits at 2 different locations	10 students, 5 teachers, 3 people from work	77 photos	127 minutes
	Urban Studies	6 hours spread over 2 visits at 1 location	6 students, 3 teachers, 1 person from work	33 photos	240 minutes
Hybridisation	Oral Healthcare	8 hours spread over 2 visits at 1 location	8 students, 5 teachers, 1 coordinator	83 photos	254 minutes
	ICT & Media	5 hours during 1 visit at 1 location	7 students, 3 teachers, 1 team leader	43 photos	168 minutes
	Legal Consultancy	7 hours spread over 2 visits at 2 locations	4 students, 3 teachers, 1 client	69 photos	236 minutes

During within-case analysis data from the different data sources were combined (audio, documents, photos) to create case-reports. Interview data were the primary data source, corroborated and expanded by findings from other data sources, thus deepening our understanding of the designable elements of the learning environments. Data triangulation took place by coding designable elements across several data sources. For example, a finding

related to a spatial element (e.g. based on a photo) would be compared with interview excerpts about how that space is being used (audio), and with a curriculum document that explains the design rationale relating to the use of spaces. Thus, findings were based on the convergence of evidence from different data sources (Yin, 2014). These findings were processed into case-reports, which were enriched with photos and excerpts from the documents and interviews. The case-reports were member-checked with the key-figure of the case and consequently adapted. Minor revisions to the case-reports resulted from these checks. Cross-case analysis entailed aggregating the findings across the six cases with tables (Yin, 2014) and worksheets (Stake, 2013). The tables displayed data from the six cases according to categories, thus capturing the findings per case for each designable element. Analysis of the characteristics presented in the tables enabled us to draw cross-case conclusions about the two design categories (incorporation and hybridisation). Stake's worksheet-approach was used as a complementary analysis method to determine each case's uniqueness among other cases and establish the prominence of relevant themes.

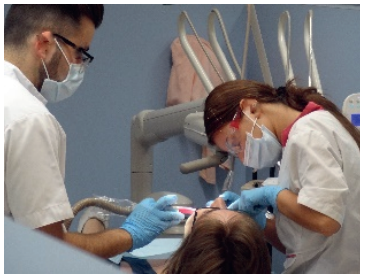
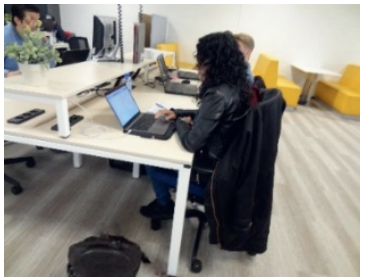
3.4 Results

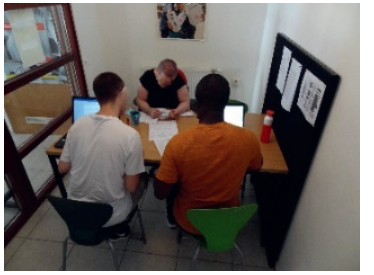
The six cases selected for this study were found to represent the two categories of integrative designs: designs based on incorporation and designs based on hybridisation. Table 6 on the next pages provides an overview of the designable elements of the six cases. This section elaborates on the designable elements and on the differences and similarities between the incorporation cases and the hybridisation cases. Detailed information about each of the designable elements of the cases can be found in Tables 16-20 of Appendices chapter 3.

Sport & Recreation, Agriculture, and Urban Studies were selected as designs based on incorporation. Gathered data support this categorisation: in all three cases, school and work practices preserve their own features while elements from one context are incorporated in the other context. In the Sport & Recreation case elements of school practice are incorporated in work practice to familiarise students with the professional field, under the supervision of a teacher. In the Agriculture and Urban Studies cases, aspects of occupational practice are incorporated in the school setting, where students work together in a way that mimics the reality of their future work setting. In these last two cases, a setting is constructed in which students can experience what it is like to work together with people from different levels of education (Agriculture) and different professions (Urban Studies).

Table 6

Overview of designable elements of the six cases

Incorporation cases		Hybridisation cases	
A class of VET students goes to a sport and leisure centre with their teacher (as coach). Students perform daily tasks for half a day per week during four periods in the 1st year of their three-year programme. They mostly work in pairs, supervised by a work field professional.	Sport & Recreation 	HPE students run a school-based Oral Healthcare clinic and work there two shifts a week, during the 2nd and 3rd year of their four-year programme. They work in pairs as oral hygienists, performing preventive oral care on real patients, supervised by teacher-oral hygienists.	Oral Healthcare 
VET and HPE students work in school-based project groups on a one-time, ten-week-long multilevel project, in the 3rd year of their three- or four-year programme. They work on this project for one day a week, preparing advice on dairy cow management for a farmer. They can consult work field professionals and their teacher-coaches.	Agriculture 	VET students run a school-based office and perform tasks related to the production of ICT applications for several organisations during most of their three-year programme. They work as employees during office hours, four days per week, supervised by their teachers-senior colleagues. They work in varying project groups.	ICT & Media 

Incorporation cases		Hybridisation cases	
HPE students from different educational programmes work in four varying multi-professional project groups for two days per week, spread over one year. They do this in the 2nd year of their four-year programme. Students work for several organisations on issues surrounding urbanisation and planning, with a work field professional as client/problem owner and a teacher-coach.	Urban Studies 	HPE students from different educational programmes run a Legal Consultancy office. They work as advisors, giving legal advice to clients for different periods, depending on the chosen arrangement. In the 3rd year of their four-year programme, they can work here for up to ten months, supervised by their teacher-supervisor.	Legal Consultancy 

Oral Healthcare, ICT & Media, and Legal Consultancy were selected as designs based on hybridisation. This was confirmed by the data from the cases: in all three cases the learning environment exhibits features of both school and work practices and the object of the learning environment is twofold, namely focused both on the contribution to learning and on the work task (patient care, ICT applications, and legal consultancy respectively). The three learning environments have been purposefully designed to provide a professional service in a relatively controlled and safe learning environment.

Table 7 summarises the main similarities and differences between the incorporation cases and the hybridisation cases. The following paragraphs elaborate on each of the designable elements.

Epistemic elements

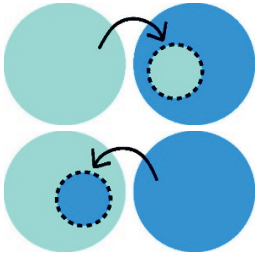
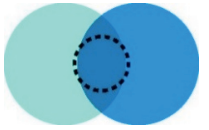
All six integrative designs are built around real-life work tasks. A difference between the incorporation cases and the hybridisation cases is that occupational tasks in the three incorporation cases are relatively low-risk, while occupational tasks in the three hybridisation cases are characterised by a higher fidelity level (see also Table 16 in Appendices chapter 3). As a consequence, the task arrangements within the incorporation cases are less complex: all students can perform tasks from day one, with limited instruction. The hybridisation cases require a more refined design in which students can perform both basic and complex tasks in a way that minimises the risk of compromising patients' health and safety (Oral Healthcare), the risk of technical problems with a website (ICT & Media), or the risk of potentially wrongful legal advice (Legal Consultancy).

Spatial and instrumental elements

There is no one-on-one relation between the design category and the physical location: both incorporation and hybridisation cases can be school-based, work-based, or a combination of both. Sometimes third locations are visited to meet with a client (Agriculture, Urban Studies) or as a field trip (ICT & Media). A difference between the incorporation and the hybridisation cases is, however, that in the incorporation cases no special physical elements are intentionally added to the learning environment; spaces and artefacts pertain to either the school or the work contexts. In contrast, the hybridisation cases spaces are purposefully furnished to look more like respectively an office (ICT & Media, Legal Advice) and an oral treatment practice (Oral Healthcare) than a school, while also providing spaces and instruments suited for instruction and teacher-consultation. Regarding the instrumental elements, in all six integrative cases, boundary objects are found that facilitate communication between school and work actors. These objects are instrumental to both school-purposes (e.g. grading) and work-related purposes (e.g. reporting on the work process): they serve to negotiate the tasks to be executed, to monitor students' development and the work progress, and to showcase the results (see also Table 17 in Appendices chapter 3).

Table 7

Designable elements of incorporation cases and of hybridisation cases

	Incorporation cases	Hybridisation cases
		
Rationale school–work connection	Incorporation: School to work or work to school	Hybridisation: School and work
	Incorporation of aspects from work into a school practice or of aspects from school into a work practice, without changing either practice	School–work connection: hybridisation of the two practices of school and work, leading to a new practice that is both school and work
Designable elements		
Epistemic elements		
- Task characteristics	Individual or collective, real-life, low-risk	Individual and collective, real-life, both low and high-risk tasks, including senior/managerial tasks
- Task arrangement	Differing, for instance, project-work (work to school) or basis workplace learning (school to work)	Highly differing arrangements characterised by some form of progress in terms of increasing difficulty or structured variety
Spatial and instrumental elements		

	Incorporation cases	Hybridisation cases
- Location	School, workplace	School, workplace
- Spaces	Regular school or workspaces. A specially furnished meeting 'lab' in the Urban Studies case No digital space or only school-related digital space	Specially furnished spaces in school (clinic, office) or at a workplace (neighbourhood office) Digital spaces with access to work- and school-related data
- Tools & artefacts	Artefacts that belong either to the school or the work context	Artefacts both from school and work as furnishings and as tools or instruments to support work- and school-related activities
Temporal elements		
- Timespan & intensity	Short periods within the educational programme Low time-intensity (hours per week)	Longer periods within the educational programme (on average) Both low and high time-intensity occur
- Time schedule	School schedule	Work schedule (shifts, office hours), combined with school elements (e.g. fixed breaks during the school day)
- Work pace	Regular work pace	Work pace is time-boxed or slowed down for instructional purposes
- Interruptions	No or only spontaneous interruption to consult with peers or coaches	Both planned and spontaneous interruptions to consult with peer or coaches
Social elements		
- Actors	Up to four different actors	Up to six different actors
- Roles	Actors fulfil a variety of roles	Actors fulfil a large variety of roles, frequent role changes
- Grouping	Grouping in dyads, triads, or project groups	Grouping in dyads or project groups, partially depending on work demands
- Division of labour	Task and project allocation by a teacher, task division by project group members	Task allocation and division of labour by teacher-supervisor and students in managerial roles

Temporal elements

The three incorporation cases have a shorter time span within the curriculum and lower intensity (in terms of hours per week) than the hybridisation cases. Furthermore, the hybridisation cases have different modalities, depending on the level of the students, for example, in their second-year students can work for 56 hours at the Legal Consultancy office, while in their third year they usually work there full-time for up to ten months. Although all cases have fixed weekdays in a weekly schedule, the nature of the schedule differs, not only between the two categories but also within the categories. For instance, while all three hybridisation cases follow a work-like schedule (office hours and shifts), the ICT & Media case also has collective (school)breaks. The work pace is regular in most cases and intentionally slower than the regular work pace (in professional settings) in two of the three hybridisation cases. Only in the Agriculture case time pressure is intentionally added to the design, by having project groups interact with different experts in fifteen-minute rounds. This is done to make the expert meetings more exciting for the students and to ensure that they interact with a large diversity of experts. Work process interruptions for instructional purposes are foreseen in all designs. In the incorporation cases, such interruptions do not have consequences for the work process. In the hybridisation cases, work interruption can be obtrusive when clients are present and have to wait as a consequence of the interruption. Nevertheless, frequent purposeful interruptions are an intentional part of the design to safeguard the correct execution of tasks or to engage in collective problem solving (see also Table 18 in Appendices chapter 3).

Social elements

All six cases have multiple actors fulfilling a variety of roles in the learning environment, but the role-diversity and role-complexity differ, as do some features related to grouping and division of labour. Students fulfil roles as peer-learners and as (junior) colleagues in all integrative designs. However, peer-coaching is most evident in the three hybridisation cases, where students are supported to work side-by-side or in an explicit junior-senior hierarchy. For instance, in the Oral Healthcare case and the Legal Consultancy case, it is part of the design that less experienced students observe and perform simple tasks as junior employees. These junior employees are introduced to the work by students in a managerial role. In all three hybridisation cases, students fulfil such managerial roles, being partly responsible for the organisational structure and daily functioning of the learning environment, for example, concerning the nature of the services and decisions about work templates.

Teachers have roles as coaches, assessors, and experts in all the studied cases. Within the three hybridisation cases, they concurrently fulfil a role as a senior colleague who can intervene in the work process, if the need emerges. In the Oral Healthcare case, for instance, a teacher-dental-hygienist or a teacher-dentist needs to be able to take over and finish a treatment after a complication has arisen. In the ICT & Media case, a teacher-senior colleague may perform tasks that are too complex for the students but needed to proceed with a clients'

assignment. In the Legal Consultancy case, a teacher-senior colleague may step in during a consult with a client, for example, when the student-junior colleague has difficulties handling clients' emotions. In the incorporation cases, teachers may be consulted on their expertise, but they do not intervene or participate in the work process as senior colleagues.

Work field professionals have varying roles in all cases, for instance, as workplace supervisor, senior colleague, expert, or client. In the work-based incorporation case (Sport & Recreation), supervisors are needed at work to give instruction about the tasks, while the school-based incorporation cases (Agriculture, Urban Studies) need workplace professionals to provide an assignment. The client role is similar in the three hybridisation cases, in which work field professionals are clients ordering specific products, like a website (ICT & Media). In two of the cases, citizens have the role of clients, and the work field is represented through partners in the chain, such as the patients' dentist (Oral Healthcare) and legal aid organisations (Legal Consultancy).

As to grouping and division of labour, in all cases, students are grouped in dyads, triads, or (project) groups with a teacher as coach (in the incorporation cases) or as workplace supervisor (in the hybridisation cases). Furthermore, all six designs have some kind of kick-off meeting at the start of a project or stand-up meeting at the beginning of a working day. These meetings are guided by a teacher-coach, student-project leader, or teacher-workplace supervisor. Teachers have a role in the division of labour in all learning environments, but in the hybridisation cases, they share part of these tasks with students in managerial roles.

An overall analysis of the social design of the six integrative cases shows that hybridisation cases are characterised by a larger amount and variety of actors involved (see also Table 19 in Appendices chapter 3). In all cases actors fulfil several roles, but within the hybridisation cases actors switch more frequently between roles. Also, students in these cases change roles both horizontally – focusing on a different task – and vertically – adopting a senior colleague role or one of the managerial roles (see also Table 20 in Appendices chapter 3).

3.5 Conclusions and discussion

The purpose of this research was to improve understanding of the designs of integrative learning environments at the school–work boundary. Six cases were selected to study manifestations of integrative learning environment designs and their designable elements, with specific attention to the differences and similarities between designs based on incorporation and designs based on hybridisation. Three of the selected learning environments were hypothesised as being manifestations of designs based on incorporation, three as manifestations of designs based on hybridisation. This initial categorisation was confirmed by the data: in the incorporation cases aspects of work were incorporated in school or aspects of school were incorporated in work; the three hybridisation cases were purposefully designed as in-between practices. The specific designable elements of these six manifestations were described with the use of a descriptive framework (Figure 6), largely based on the ACAD model

(Carvalho & Goodyear, 2018). Although the number of cases was limited, conclusions about the two categories of integrative designs and about the designable elements of these categories can be drawn.

Similarities between incorporation designs and hybridisation designs include the centrality of real-life work tasks, the use of boundary objects that facilitate communication between school and work, and the variety of roles that actors fulfil in a learning environment. Differences between incorporation designs or hybridisation designs can be identified across all of the designable elements and include a higher fidelity level of the occupational tasks, as they are more realistic and complex, and more evident use of peer-coaching, senior-junior roles, and role changes for actors in the hybridisation designs. Moreover, while teachers usually do not participate in the work process in the incorporation designs, they regularly have a role both as learning coach and as a senior colleague in the hybridisation designs, in which the division of labour may be a shared task between teachers and students in, for example, managerial roles.

The findings indicate interrelations between the designable elements. For instance, our findings suggest that learning environments with less elaborate epistemic designs (as found in the incorporation cases), with tasks that require less prior knowledge (epistemic), may be suitable at an early stage in an educational programme, and for a short period (temporal). Furthermore, since the tasks are more low-risk and can be performed relatively independently by learners (epistemic), fewer different actors and roles are needed within the learning environment (social), and few intentional interruptions appear to be required (temporal). In contrast, a more elaborated epistemic design (as found in the hybridisation cases) seems to correspond with more frequent work interruptions (temporal) to monitor a correct execution of the task or to offer additional instruction (social). This additional support is added to the design to prevent endangering patient safety or customer satisfaction (epistemic). A consequence can be that the teacher has an additional responsibility (social), namely quality assurance of the final product (see also Oonk et al., 2016). In fact, it is likely that the complex epistemic design of learning environments based on hybridisation generally corresponds with an elaborate role-design, since a wide variety of roles need to be fulfilled (social) to be within both the production scope and the learning scope of such a learning environment. This is in line with studies on hybrid learning environments, in which a range of roles is found, diversified in terms of function and in terms of seniority (Zitter & Hoeve, 2012).

The link between the epistemic and the physical elements seems to be determined mainly by the nature of the tasks. In the examined incorporation cases the tasks at hand required few specific physical affordances. However, relatively simple simulations in healthcare, which may be characterised as incorporation designs, require specifically equipped spaces and specific instruments for learners to execute the tasks (e.g. a urinary catheterisation procedure; Kneebone et al., 2005). Such suitable physical affordances may have a positive effect on learning opportunities of the learning environment, especially if they are accompanied by a slower work pace (Sheehan et al., 2017). This also illustrates the link between physical

elements and temporal elements, which in our study became visible in two cases in which we witnessed a slower work pace than the regular pace in a workplace (temporal) because learners needed time to develop the needed competences.

A link between the temporal and social designable elements that we encountered in our study regarded seniority and shared student-teacher control: in the three hybridisation cases, students would fulfil senior tasks after they had spent a minimum amount of time in the learning environment. Students with more experience, or otherwise acquired seniority, fulfilled tasks related to the design and management of the learning environment (social).

Limitations and suggestions for further research

Regarding the context of the study, a limitation of the presented research is that all studied cases were part of the Dutch education system. The transferability of the findings is enhanced by providing contextual information about the Dutch education system and detailed descriptions of the selected cases. Moreover, the universal nature of connectivity issues when educating or training for vocations leads us to assume that findings are transferable. Nonetheless, transfer of findings to other educational systems, such as Asian and African countries, will always require taking into account the "institutional provisions, infrastructure, and social sentiments" of those countries (Billett, 2011, p. ix).

A methodological limitation is that, although a systematic case study approach was used, site visits were relatively short and spread over a maximum of six months. A more longitudinal approach would have enriched understanding of how a design develops over the years and of which designable elements are more likely to be adjusted. Furthermore, a consequence of our focus on cases in secondary vocational and higher professional education is that potentially rich cases in other educational contexts were excluded. In addition, although several actors from the work context were interviewed, our study was largely informed by actors from the school context. Validation of the findings by actors from the work context is called for. In general, studies combining the school and the work perspective, could contribute to a common language and thus potentially to a stronger school–work connectivity (Wesselink et al., 2010a).

The scope of the present chapter was on generating design knowledge of learning environment designs as a product, while design as a process was not in focus. Nonetheless, insights into design categories and designable elements may be of added value to the design process, because reflection on, and decisions about, the product being designed impacts the design process and vice versa (Reymen et al., 2006). An interesting direction for further research would be to examine the characteristics of a design process with the involvement of actors from different contexts (school and work), as is often the case with learning designs at the school–work boundary. Such studies might also take into account the ongoing and increasingly collaborative nature of design processes (Buus & Georgsen, 2018; Muñoz-Cristóbal et al., 2018).

Implications

The presented insights into learning environment design at the school–work boundary extend current knowledge on the facilitation of work-related learning. Integrative designs seem to potentially compensate for some of the limitations of workplace learning mentioned in the introduction, like limited task-complexity and difficulties with work interruptions. An intentionally designed integrative learning environment can facilitate students to perform a large variety of tasks (from simple to complex, including managerial tasks), afford access to tools and expertise, and allow more time for the tasks. However, providing these settings does not guarantee that students will perceive them in the way they were intended: the function of a design is to make recommendations about tasks, spaces, artefacts, actors, and temporal elements that might be useful and about roles that should be adopted while recognising that learners may ignore these recommendations and not identify the affordances provided, or regard them in other ways than intended (Markauskaite & Goodyear, 2014). In fact, the emergent activity in the implemented curriculum is bound to deviate from the intended design (Zitter et al., 2016). How learners engage in the tasks and settings arranged for them will largely depend on their interests, capacities, and cognitive experience (Billett, 2014a).

Nevertheless, findings from other studies lead us to presume that careful attention to the design of learning environments can have a positive effect on the competencies that are developed (Oonk et al., 2017). Furthermore, specific design features of integrative designs appear to have a positive effect on learners' engagement and appreciation. For instance, a study in initial vocational education showed that learning environments that afford students to collaborate in life-like vocational activities with increasing complexity, lead to students perceiving themselves as learning in a more shared, meaningful, reflective, and transfer-oriented way than in more traditional learning programmes (Boersma et al., 2016). Students' appreciation has also been reported about hybrid learning environments that promote self-directed learning and working on real-life problems (Cremers et al., 2016). Similar findings have also been reported in a study conducted in an academic setting, where problem-based learning environments were valued by the students as powerful for enhancing learning (Dochy et al., 2005). However, although learning environment design seems to influence learners, further studies are needed for a deeper understanding of the relation between the design on the one hand and the learning processes generated by the design on the other hand (Thompson et al., 2013).

This present study contributes to such further studies by offering empirical support for the theoretical categorisation presented in the introduction between designs based on alignment, on incorporation, and on hybridisation, thus depicting that said categorisation serves to identify and characterise learning environments at the school–work boundary. Furthermore, the study provides additional foundations for the design of learning environments by presenting specific epistemic, spatial, instrumental, social, and temporal designable elements of each type of design. Thus, we have shown that our framework, based on the ACAD model

and extended with temporal elements, is useful as a descriptive framework for vocational learning environments and may serve as a basis for future learning environment research. Further operationalisation may be advisable in future studies, for instance by adding insights from more elaborate task-analysis methods (Jonassen, 2014; Van Merriënboer & Kester, 2008) and from recent scholarly work on epistemic artefacts (Markauskaite & Goodyear, 2017).

Practically, this study contributes to insights into integrative learning environments in vocational education and how they can be designed. It also sheds more light on possible variations in the design of learning environments, depending on the design rationale for the school–work connection. These findings may serve as a hold for educational designers when considering and discussing the possibilities for designing or adapting vocational curricula. By improving the school–work connection of learning environment designs and carefully selecting the designable elements, educators can contribute to better support for vocational students that strive to connect the two contexts of school and work. With the examples presented from the cases, designers can be more sensitive to the possibilities of adapting epistemic, spatial, instrumental, temporal, and social elements of integrative learning environments at the school–work boundary.

4

Multilevel design considerations for curricula at the school–work boundary[5]

[5] This chapter is based on: Bouw, E., Zitter, I., & De Bruijn, E. (2021). Multilevel design considerations for vocational curricula at the boundary of school and work. Journal of Curriculum Studies. Advance online publication.

Abstract

This study focuses on the school–work connection from the perspective of curriculum design. The aim was to uncover considerations underpinning the design of learning environments in vocational education. The research took place in the Netherlands. A focus group methodology was chosen to elicit designers' considerations, which generally remain largely implicit. These considerations concern the designable elements of learning environments: epistemic, spatial, temporal, and social elements. Design considerations were uncovered at each of the aggregation levels of a curriculum. At the macro-level, considerations referred to the connectivity between the contexts of school and work. Based on these considerations, different designs were chosen along the school–work continuum. At the meso-level, another continuum was found: the complexity in terms of practices involved in the learning environment. At the micro-level, concrete design considerations were revealed that designers take into account to strengthen the school–work connection. Thus, implicit design considerations at three levels were made explicit. Moreover, the need for alignment between the designable elements and the curriculum levels became more apparent, leading to a deeper understanding of curriculum design for vocational education. This paper adds understanding of ways to strengthen the school–work connection and design future-proof vocational curricula.

Keywords*:* educational development, curriculum design, vocational education, alignment, workplace learning

4.1 Introduction

Curriculum development or curriculum design is a multilevel and cyclic decision-making process, which involves a variety of stakeholders and multiple decisions on how to deliver the curriculum or the plan for learning (Huizinga et al., 2014; Thijs & Van den Akker, 2009; Van den Akker, 2003). A large part of this decision-making process is implicit (Kirschner et al., 2002). As a consequence, knowledge related to curriculum development is not easily accessible: educational designers' understanding remains implicit in the decisions they make and in the resulting educational designs (Edelson, 2002; Van den Akker, 2003).

When developing vocational curricula, designers strive to construct learning environments in which learners can develop the required qualifications for their (future) occupation. These designs generally include provisions in the context of school and provisions in the context of work (Billett, 2014c). Educational research on vocational education, that is, on education that prepares learners for occupational practice, suggests that a school context may be more suitable for students to learn certain types of formal and general knowledge, while a work context is more suitable to learn situated knowledge and skills (Billett, 2006; Schaap et al., 2012). A combination of both contexts is usually chosen. However, the quality of the connection between the school and work contexts remains problematic (De Bruijn et al., 2017b; Grollmann, 2018): when learners are active in two different contexts, they need to cross the boundaries between different social, cultural, and physical practices. While crossing those boundaries, learners may experience discontinuities, for instance, because prior knowledge turns out to be incompatible with the knowledge needed to perform tasks at the workplace (Lehtinen et al., 2014), or because learners experience the frequent changes in roles and perspectives as challenging (Akkerman & Bakker, 2011). Efforts to (re-) establish continuity in action or interaction across different practices are referred to as *boundary crossing*, which is typical of vocational curricula (Bakker & Akkerman, 2019). Thus, one of the kernel issues in the design of vocational curricula is to facilitate the integration of learning experiences across the contexts of school and work (Baartman et al., 2018; Choy et al., 2018a; Stenström & Tynjälä, 2009). Failing to address this issue means that learners will continue to experience problems crossing the boundaries and connecting the experiences arising in the various contexts.

In the last decade, several studies have addressed the issue of facilitating the school–work connection in vocational education. Research has focused, for instance, on specific connective training activities (Berner, 2010; Veillard, 2012) or strategies for supporting boundary crossing (Arts & Bronkhorst, 2020). From the perspective of partnerships, studies have shed more light on how school-industry partnerships can be regulated to promote connectivity (Flynn et al., 2016; Sappa & Aprea, 2014). At the level of learning environments, design principles have been advanced for specific manifestations, such as hybrid configurations: social practices at the interface of school and the workplace, built around ill-defined, authentic tasks (Cremers et al., 2016). However, more understanding of the design considerations is needed to support

reflection and decision-making during the design of learning environments at the boundary of school and work in vocational education.

The present study aims to uncover considerations underpinning the design of learning environments in vocational education, thus contributing to existing design knowledge for developing vocational curricula at the school–work boundary. The study uses a focus group methodology to understand both the explicit and implicit design considerations underpinning learning environment design in vocational education. This is done by exploring which considerations (dilemmas and choices) designers face when designing vocational learning environments. The specific context of the study is Dutch vocational education. The next sections explain the relevant theory for this study and place the study in an international perspective.

The central question of this study is: Which design considerations do educational designers take into account when designing learning environments at the boundary of school and work in vocational education?

4.2 Theory

Vocational education from an international perspective

Vocational education is organised and regulated differently across different countries (Billett, 2011; De Bruijn et al., 2017b). Differences are related to tradition and culture, government policy and regulation (e.g. national qualification frameworks, funding, etc.), and institutional factors. Depending on these factors, the "form and nature" of the vocational provisions varies: some countries mainly have school-based vocational programmes, while for other countries, (e.g. Germany and Switzerland), apprenticeships are more or less a "default option" (Billett, 2011, p. 34). Despite the international differences, vocational education worldwide intends to meet occupational-specific requirements and to equip learners for working life (Billett, 2011, 2015). For this purpose, a close relationship between educational institutions and (future) work practice is seen as vital (Guile & Unwin, 2019). However, this relationship also implies a fundamental tension between production and learning, that needs to be managed (De Bruijn et al., 2017b; Vaughan, 2018). Workplaces may have limited possibilities to afford learning activities (Billett, 2014c; Istance & Kools, 2013), and workplace demands can override pedagogical goals (Fjellström & Kristmansson, 2019). Facilitating connectivity between work-based and school-based provisions is seen as a way to work around such limitations (Griffiths & Guile 2003).

Connectivity at the school–work boundary

Connectivity refers to the creation of close connections between different contexts, that is, "bringing together things that have earlier been separated" (Stenström & Tynjälä, 2009, p. 12). Connective curriculum frameworks are based on strong school–work connectivity (Guile & Griffiths, 2001) and are designed to meet typical challenges of vocational education, regarding fragmentation of knowledge and experiences (Zitter & Hoeve, 2012) and the lack of alignment

between school-based activities and practice-based activities (Messmann & Mulder, 2015; Poortman et al., 2014). Connective frameworks aim to support learners to cross the boundaries between *school* and *work*, that is, to deal with socio-cultural differences and with the frequent changes of roles and perspectives (Schaap et al., 2012). Thus, connectivity can enable boundary crossing between school and work by different actors (Wesselink et al., 2010).

Connectivity is not easy to achieve: learners need to be supported with appropriate arrangements for integration (Choy et al., 2018a). The quest to design such arrangements has led to a variety of "fruitful alternatives" to workplace learning (Poortman et al., 2014), such as school-based vocational learning (Lindberg, 2003), work-integrated learning programmes (Veillard, 2012), or hybrid curricula (Zitter et al., 2016). Despite the variety of learning environments that connect the contexts of school and work, few studies have focused on their design (Wesselink & Zitter, 2017).

Although footholds have been presented about improving the connectivity between learning in school and in the workplace (Wesselink et al., 2010a), more understanding is still needed about design considerations of vocational curricula to support curriculum development and exploit the learning potential of the school–work boundary (Bakker & Akkerman, 2019).

Curriculum development in vocational education

Curriculum development implies taking into account the interest of all stakeholders involved (government, trade unions, social organisations, educational institutions, students, vocational teachers, curriculum designers), who may have different expectations of the curriculum (Thijs & Van den Akker, 2009) and different motives for engaging in curriculum design (Manwaring et al., 2020). This challenge of taking into account the interest of all stakeholders is especially evident in vocational education, where stakeholders are found to have different viewpoints (Sappa & Aprea, 2014; Tyson, 2016), and where stakeholders from the "world of work" have a considerable interest in the curricula that are designed to prepare and develop their (future) workforce (Choy, 2018).

Moreover, curriculum development implies searching for coherence between the different components of the curriculum. This coherence is difficult to achieve due to the mutual connection and dependency of the components, which has been visualized as a spider web (Thijs & Van den Akker, 2009). The spider web is useful to design learning environments in a single context, such as a classroom in a school context, but seems less suitable to deal with typical design issues of vocational education, concerning both contexts of school and work. Indeed, the curricular spider web does not focus on specific designable elements that may support the school–work connectivity, namely, the epistemic, spatial, instrumental, temporal, and social elements that shape the activities that emerge at the school–work boundary in vocational education (Bouw et al., 2020; Markauskaite & Goodyear, 2017; Zitter & Hoeve, 2012).

The relation between the design of learning environments and the emergent activity within the learning environment has been conceptualized in an Activity Centred Analysis and Design (ACAD) model that illustrates that activities may emerge as a consequence of the design (Carvalho & Goodyear, 2018). The ACAD model has been extended by Yeoman and Wilson (2019), who included three aggregation levels to the model (macro, meso, and micro) to highlight the challenge of connecting macro-level aspirations with the concrete design at the micro-level (Yeoman & Wilson, 2019). In the present study, we also adopt the distinction between the three aggregation levels, applying them specifically to a vocational context, in order to examine the design considerations regarding the school–work connection. Such considerations will need to regard choices about what elements of each of the contexts should be included. Thus, we will study the design considerations of educational designers in vocational education at macro, meso, and micro levels.

Three categories of learning environments at the school–work boundary

The present study builds on previous research on curriculum development, but focuses specifically on designable elements, and includes different types of learning environment designs at the school–work boundary. In previous scholarly work three categories of learning environment designs were identified at this boundary: (1) designs based on alignment between the two different contexts of school and work; (2) designs based on incorporation of elements from school into the work context or of elements from work into the school context; and (3) designs based on (partial) hybridisation of the two contexts (Bouw et al., 2019).

The three categories represent different ways to establish connectivity between the contexts of school and work. Several studies have focused on the first category of designs, that is, on designs based on school–work alignment, for instance, by presenting ways to improve alignment during apprenticeships or internships (Choy, 2018; Fjellström & Kristmansson, 2019; Messmann & Mulder, 2015; Poortman et al., 2014). Attention has also been paid to the more integrative categories of designs: studies have presented insights into designs based on incorporation, such as workplace simulations (Jossberger et al., 2015) and hands-on simulations (Khaled et al., 2016) and into designs based on hybridisation, for example, concerning the hybrid nature of vocational curricula (Zitter et al., 2016) and design principles for hybrid learning configurations (Cremers et al., 2016). Although these studies present relevant design frameworks, they do not uncover considerations of designers as such. The present study will explore these considerations to better understand the process of developing different types of learning environments in vocational education.

Design considerations

The present study combines two main research strands within educational design research: the technical strand, focusing on the design process, and the realist strand, focusing on design expertise (McKenney et al., 2015). Our research is not intended to provide prescriptive or normative guidelines for curriculum design. Instead, we intend to explore considerations underpinning the design of learning environments in vocational education. For this purpose

design knowledge needs to be elicited: we need to understand "what designers actually do, how they do it and why they do it" (McKenney et al., 2015, p. 188). Uncovering design knowledge, in general, is not an easy quest (Lawson, 2012). Design knowledge is largely implicit, grounded in experience and useful for practical (design) decisions; it is part of designers' "working knowledge" (Lehtinen et al., 2014). To make this design knowledge available to other designers, it has to be made explicit, objectified, validated, understood, and generalized (Aken & Reitsma, 2019). In educational contexts, it is important to make design knowledge available to support novice teachers and enhance their design expertise (Huizinga et al., 2014). The present study contributes to the understanding of educational design by exploring both explicit and implicit considerations of educational designers who design different types of learning environments at the school–work boundary in vocational education. This exploration was done in the context of Dutch vocational education.

Context of the study: Dutch vocational education

This study was done in the Netherlands. Dutch vocational education and training (VET) encompasses two educational levels qualifying students for occupational practice (Cedefop, 2016; De Bruijn et al., 2017b):

- Mbo (*middelbaar beroepsonderwijs*; senior secondary vocational education at VET schools or regional colleges), which corresponds with Levels 3 and 4 of the International Standard Classification of Education (ISCED) and Level 4 of the European Qualification Framework (EQF).
- Hbo (*hoger beroepsonderswijs*; higher, or tertiary, professional education at universities of applied sciences), which corresponds with ISCED Level 5 and EQF Levels 5 (for the short cycle programmes) and 6.

In the Dutch system, vocational education institutions and social partners cooperate to provide labour market-relevant education that prepares students for society and for further study (De Bruijn et al., 2017b). The curricula of Dutch vocational education include mandatory forms of workplace learning and other forms of work-related learning to support learners to acquire future-proof professional competences (Hoeve et al., 2019). Educational designers strive to establish connective relationships between workplace learning and learning in schools (Onstenk, 2017). In the Netherlands schools have relative freedom to design their curricula and designers, in turn, are given a high degree of autonomy to make design decisions about the learning environment (Pont et al., 2013; Thijs & Van den Akker, 2009). Though the present research is carried out in the context of Dutch vocational education, the results are expected to be relevant for all education in which connectivity between the contexts of school and work is an important issue.

4.3 Methods

To explore design considerations of learning environments in vocational education and to also make implicit design knowledge explicit, a focus group methodology was applied (Parker &

Tritter, 2006; Plummer-D'Amato, 2008a). By having participants explain dilemmas and choices regarding the design of learning environments familiar to them, we explored both the implicit and the explicit design considerations involved in the design process. This method has similarities with experimental vignette methodology (Aguinis & Bradley, 2014). However, we added realism to our approach by inviting participants to first describe a learning environment familiar to them according to a given format. This section explains our research method and the applied techniques to meet important criteria of qualitative research throughout all phases: credibility (plausibility), transferability (the degree to which findings can be transferred to other contexts), dependability (consistency), and confirmability (neutrality) (Anney, 2014).

Focus group design

A stepwise approach was applied to develop our focus group protocol. This was done to ensure credibility through structural coherence (i.e. a systematic and consistent approach). The stepwise process included an expert consultation round with expert designers, a pilot test, and an ethical assessment.

The expert consultation round was done as "peer examination" to further enhance the credibility of the focus groups (Anney, 2014). In this round, four expert designers were interviewed. Expert-designers with different backgrounds were approached through the network of the authors' research group: (1) a researcher-educational designer working at a university of applied sciences; (2) a Ph.D. in educational research with expertise in designing multi-stakeholder learning arrangements in vocational education; (3) a school principal of an institution for vocational education; (4) an independent educational designer who works with a large variety of organisations. All four experts have broad experience in collaborating with others during the design and study of learning environments and are thus used to explaining their considerations. Consequently, the expert consultation served as a starting point to elicit relevant design considerations and to develop the focus group protocol. An in-depth interview took place with each expert. During the interviews, insights from previous research were discussed and representations of learning environment designs were developed and tested. Reports of the interviews were member-checked (Birt et al., 2016), leading to minor adaptations of the reports. The expert consultation round resulted in a set of representations to be used during the focus group sessions.

The next step in the development of the focus group protocol was a pilot test with a group of researcher-practitioners who provided the research team with useful feedback, which led to adjustments to the focus group protocol. Next, the focus group protocol was submitted to an ethical committee who approved the protocol (data collection approach, consent forms, and procedures for data storage), thus confirming that our protocol was in accordance with the

prevailing standards regarding both how participants are informed and how research data are processed and stored[6].

Focus group participants

Purposeful sampling was used to enhance the transferability of the findings. This technique helps to focus on the most knowledgeable informants and provides greater in-depth findings than other sampling methods (Anney, 2014). Furthermore, purposeful sampling supports the collection of relevant and rich data concerning the research question (Plummer-D'Amato, 2008a). The sample needed to include practitioners and designers of vocational education with a minimum of five years of relevant experience in vocational education. Furthermore, practitioners from both school and work needed to be represented, as well as expert designers with a helicopter view of educational design. Moreover, we searched for a balanced selection for each focus group in terms of represented institutions and occupational domains.

The final sample included a variety of institutions and domains. During the selection, we kept in mind that groups should be homogenous enough for participants to feel comfortable expressing their views, and varied enough to allow for contrasting opinions (Krueger & Casey, 2000 as cited in Plummer-D'Amato, 2008a). Three participant groups were distinguished: (1) educational practitioners with design experience in vocational education; (2) expert designers with a solid background in both studying and designing learning environments; and (3) workplace practitioners with experience in designing vocational learning environments in a work context, in collaboration with educational partners. To counterbalance the effect of conformity (Plummer-D'Amato, 2008b), five focus groups were conducted. The group sizes varied between four and nine participants (Table 8).

[6] The ethical assessment was performed by the ethical committee of the Open University (OU) of The Netherlands.

Table 8

Focus group participants

Focus groups		Number of participants	Background of participants	Domains represented
EP focus groups	EP1	9	Educational practitioners (EP) in vocational education and training (mbo)	Built Environment, Business education, Healthcare, Facility Management, Marketing & Communication
	EP2a	7	Educational practitioners (EP) in higher professional education (hbo)	Healthcare, Technical education, Horticulture and Agribusiness, Pedagogy, ICT, Education
	EP2b	4		Healthcare, Social Work, Physiotherapy, Education
ED focus group	ED3	6	Expert designers (ED) in the broad field of vocational education	Built Environment, Business education, Healthcare, Facility Management, ICT Educational science as main research expertise
WP focus group	WP4	4	Workplace practitioners (WP) who design professional education in a work context, in collaboration with educational partners	Built Environment Healthcare, Maternity care, Facility Management

Focus group procedure

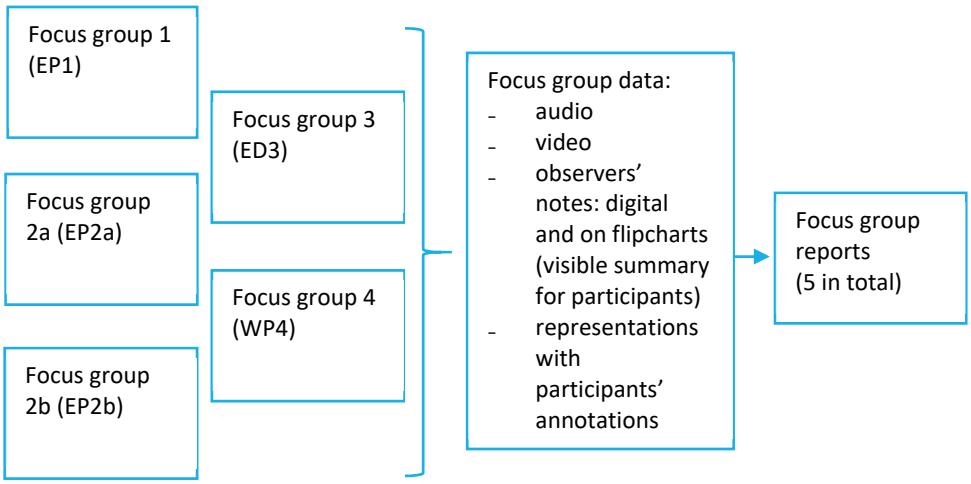
In line with the credibility criterion, a stepwise approach was used for data gathering: prior to each focus group meeting, participants were informed about the purpose and expectations of the meeting. At the beginning of each meeting, participants were reassured that there were no right or wrong answers, thus curtailing any concerns they might have about their knowledge of the topic of discussion (Plummer-D'Amato, 2008a). To minimize the effect of censoring, participants were informed about how the data would be used and about the procedures to maintain confidentiality and protect their identities. All focus groups followed the same protocol and started with a brief introduction and two 45-minute discussion rounds about design considerations of real-life learning environments. Representations were used to elicit

participants' views (Umoquit et al., 2011) and implicit design knowledge. During the focus group meetings, participants were invited to add annotations to the representations. In the expert designers focus group (ED3) the representations were enriched with data extracted from the previous focus groups, in analogy to the vignette-method (Hughes & Huby, 2004).

All focus groups were moderated by the first author of this paper, assisted by a well-briefed observer who took notes to aid analysis of the recordings, thus enhancing the confirmability and credibility of the focus group data (Plummer-D'Amato, 2008a). Both the moderator and the observer were trained in conducting focus groups, which contributed to a skilful organisation and moderation of the meetings. To further ensure credibility, the moderators' background was disclosed in each meeting and all meetings were recorded (audio and video). These measures help to ensure credibility because they increase transparency, minimize the risk of moderator bias (Plummer-D'Amato, 2008a) and allow for conclusions based on participants' original data (Anney, 2014). After each focus group meeting, the raw data (audio, video, notes, and representations) were converted into reports (Figure 7): recordings were processed together with the observers' notes (order of speakers and main themes and ideas). These notes were matched and complemented with the first authors' notes and transcriptions of participants' comments during the focus groups.

Figure 7

Data gathering and data processing



To further ensure dependability the reports were presented in accessible ways to the participants to encourage them to engage in member checking (Birt et al., 2016). This was done by using plain and concise language and by including relevant representations. The majority of

the participants engaged in member checking. Minor adjustments to the reports resulted from the member checks.

After member-checking and analysis of the individual focus groups, cross-focus group analysis started: all design considerations were clustered and condensed using a matrix display technique (Averill, 2002; Miles & Huberman, 1994), thus facilitating the display, interpretation, and discussion of the findings. The analysis matrix was based on the concepts presented in the theory section, namely, the designable elements (epistemic, set, temporal and social) and the distinction of three aggregation levels (Table 9).

Table 9

Analysis matrix

	EPISTEMIC	**SET**	**TEMPORAL**	**SOCIAL**
MACRO (strategic)				
MESO (tactical)				
MICRO (operational)				

To condense the design considerations, we used a method derived from Malterud's systematical text condensation method (Malterud, 2012). During this process, dependability and confirmability were safeguarded through repeated discussions between the first and the second author to identify tacit rules and check consistency between the raw data and the (preliminary) findings. The matrix and the preliminary findings were also discussed with the third author. During the third and last analysis round, the raw data of the focus groups was revisited, to look for examples and counter-examples of the key-considerations, leading to the findings reported in the next section.

4.4 Results

All focus group discussions revealed considerations at each of the aggregation levels of a curriculum design. Table 10 presents the central themes of the design considerations that emerged at each level and for each of the designable elements. These themes reveal the kernel issues of the focus group discussions about the strategic, tactical, and operational design considerations. The considerations per level are explained in the following paragraphs.

Table 10

Themes of the design considerations

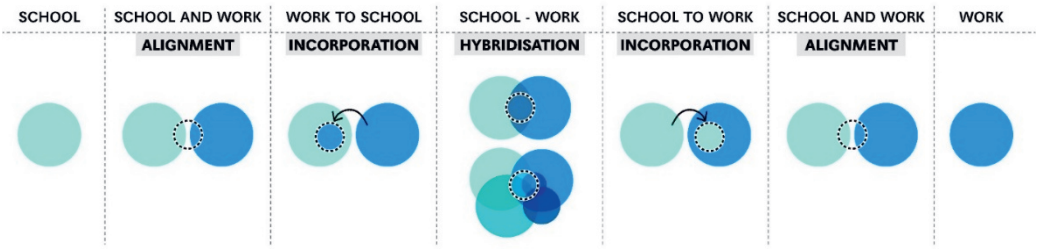
		Designable elements			
		Epistemic *What*	Set *Where,* *With what*	Temporal *When*	Social *Who*
Aggregation levels	MACRO Strategic	Objectives	Location	Time in context	Stakeholders
	MESO Tactical	Nature of practices	Spaces	Time in programme	Actors from practices
	MICRO Operational	Tasks	Artefacts	Time in interaction	Roles

Design considerations at the macro level

At the macro level, focus group discussions centred around the relationship between the objectives of the design, the stakeholders involved, and the level of connectivity between the contexts of school and work. The level of connectivity was discussed with the aid of a representation of the school–work continuum that emerged from the expert consultation preceding the focus group meetings (Figure 8). During the focus group discussions, this continuum appeared to correspond with key considerations at the macro level, namely: considerations about the objectives of the learning environment and considerations about the stakeholders of the learning environment.

Figure 8

Continuum of learning environment designs at the school–work boundary



Discussions between participants revealed that considerations about the stakeholders and their objectives influence the learning environment design. The design can be nearer to school as a context or nearer to work as a context. Which design is most fitting, was said to depend largely on whether stakeholders' objectives were learning, production, or both. If the main stakeholder is from the world of school and the main objective is learning, the design will display more characteristics that are typical for school as a context. School-based simulations, for example, were mentioned as designs that are suitable to provide continuity and avoid dependency on business fluctuations in work practice (e.g. in ICT, EP2a).

If the main stakeholder is from the world of work and the main objective is production, the design will show more features that are typical of work as a context. For instance, work-based learning environments can be characterised by a strong focus on work, especially in times of labour market shortages (e.g. in Healthcare, EP1). If, however, stakeholders from school and work are equally represented and the objectives of learning and production can be combined, without obstructing either, the design will have features of both school and work as a context. From the focus group discussions it became clear that in such a design, learners can contribute to reaching targets at the workplace, while also receiving guidance and support in a safe learning environment (e.g. in Social Work, EP2b).

Focus groups emphasized the dynamic nature of the learning environment design on the school–work continuum (Figure 2), indicating that when (re)considering the objectives and stakeholders' interests, the design may need to move to the left or to the right on the school–work continuum. This dynamic aspect was explained by a continuous search for balance between external demands (from the ministry of education, professional associations in the field, etc.) and the interests of local stakeholders. When educational interests prevail, designs may need to include more features of school as a context. When interests related to production prevail, the work context can become more pronounced and the learning scope may lose priority, which may lead to designs with more features of work as a context. Learning environments with the twofold scope of both contributing to students' learning and, for instance, contributing to regional development, would fit with a design based on hybridisation (ED3). Focus group data further revealed that designers also take into account learners' interests: educational programmes may provide different learning environments for different groups of learners, for example, a school-based curriculum for learners who prefer to be supported to learn in a familiar and safe learning environment, and a hybrid or work-based route for learners who prefer to learn in a learning environment that corresponds with or closely resembles their future workplace (EP1, EP2A, EP2B). Thus, designers take into account that learners may be attracted to a more incorporated or a more hybrid design, depending on their preferences: not all students thrive well in a fully work-based learning environment (e.g. in Healthcare, EP1).

A key consideration that emerged at the macro level regards the partnership between stakeholders from school and work (EP1, EP2a). Agreements between the stakeholders were

mentioned to secure scalability and durability of the design: can collaboration still be secured if the number of learners increases or decreases? Written agreements were sometimes chosen to safeguard the continuity of the learning environment (EP1, EP2a). Such agreements would preferably be based on a shared view between stakeholders of the professional field and the developments in the near-future (EP2a)

The abovementioned macro-epistemic and macro-social considerations about objectives and stakeholders have implications for the macro-set considerations (location) and macro-temporal considerations (time in context). When regional contribution is a desired feature of the learning environment, designers seem inclined to physically locate the learning environment close to regional stakeholders (macro-set) to facilitate frequent interactions between all partners involved (EP2a, ED3). Participants indicated that such macro-level agreements between stakeholders generally include agreements about time, for example, how much time of an educational programme is allocated to each of the contexts of school and work. Focus group discussions revealed that the time that learners are planned to spend in each context depends on educational standards, frameworks and guidelines, but is also influenced by the wishes and expectations of the stakeholders involved in the learning environment (EP1, EP2a, EP2b, ED3, WP4). These expectations may include, for instance, the possibility of adjusting the learning environment to the needs of the industry, such as seasonal work in agricultural contexts (EP2a) and special events in marketing and communication (EP1).

Design considerations at the meso level

Considerations at the meso-level relate to the tactical level and revolve around the following central themes: the amount and nature of the practices involved, the spaces selected for the learning environment, the timeframe of the learning environment within an educational programme, and which actors are involved from different educational programmes (i.e. school practices) and organisations (i.e. work practices).

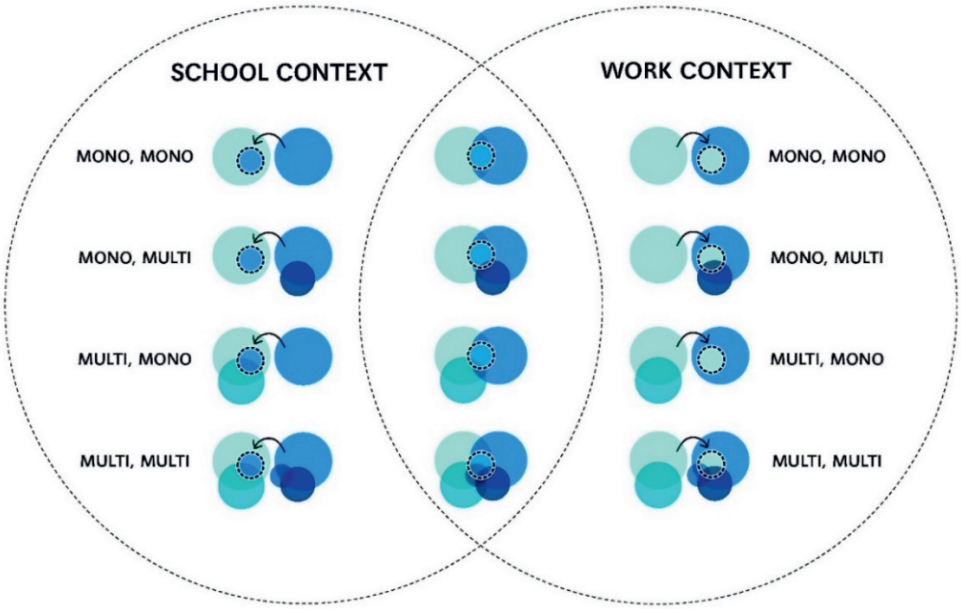
In the expert consultation preceding the focus groups, the school–work continuum was expanded with another dimension: the complexity of the configuration of practices involved. A two-dimensional typology resulted, based on a horizontal school–work dimension and a vertical dimension related to the complexity of the configuration (Figure 9). This typology was discussed in the focus groups.

In all focus groups, participants had experience designing learning environments involving practices from school and work, but the complexity of the resulting configurations differed from mono, mono (consisting of one school practice and one work practice), to multi, multi (involving multiple schools and multiple work practices). Meso-level considerations underpinning these choices relate to the nature of the practices needed for students to develop the relevant competencies (meso-epistemic) and the amount and type of actors that need to be present in the learning environment (meso-social): if contact with real customers, patients or pupils is essential for the profession, a real-life work practice will be part of the

learning environment (e.g. in Healthcare and in Education, EP2a). Such considerations are closely related to the macro-level objectives of the learning environment: if students only need to have a general idea of what a practice looks like, a mono learning environment may be sufficient; if students need to be fully immersed in an innovative setting, then a multi-type may be more suitable (EP2b). Sometimes designers choose a mono learning environment at the beginning of the educational programme and a more complex, multi learning environment in the third or fourth year of their programme (e.g. in Physiotherapy, EP2b). Educational practitioners tended to prefer a curriculum in which students are given the opportunity to participate in different (configurations of) practices in the course of their educational programme (EP1, EP2b).

Figure 9

Configurations of school and work practices



The type of configuration chosen has consequences for considerations about the set design: when multiple practices are involved, designers make tactical decisions about which (digital and analogue) spaces to use. Sometimes a lab is needed for learners to perform specific tests and designers look for the most suitable practice for lab-work (EP2a). However, not all domains turned out to have specific needs for physical spaces; in the ICT domain, the meso-set considerations are focused on digital spaces, since activities are more independent of the physical location (EP2a).

Regarding meso-temporal considerations, focus groups indicated to take into account the timeframe of the learning environment within the educational programme (i.e. the time in programme). From the real-life examples discussed, it appears that multi, multi configurations are more frequent in a late stage of an educational programme, to allow senior students to become involved with a diversity of practices. In contrast, in some educational programmes such configurations were intentionally placed in an early stage of the programme to have students engage with multiple professions from the start (EP2a).

Although the configurations in Figure 9 may be useful to determine the relationship between practices at an abstract level, they do not necessarily give an exact representation of real-life manifestations. Focus group discussions revealed that the overlap between the practices involved in real-life learning environments may differ from the diagrams above: several work practices may be connected to a school practice, without the work practices mutually overlapping (EP2a). Other work practices may be only loosely related, but still essential for the learning environment, for example, in the case of suppliers of materials in the built environment or facility services (EP1, WP4). Educational and workplace practitioners' focus groups (EP1, EP2a, EP2b, WP4) also pointed out that, depending on which practice initiates collaboration, practices may have a more central role in the configuration or a more peripheral role. School practices may be initiators of collaboration or become involved in existing structures (EP2a, WP4). Nonetheless, identification of the continua and reflection on the consequences of choices on both the school–work continuum and the complexity continuum were seen as relevant for choices about the configuration of school and work practices.

Design considerations at the micro-level

Important considerations at the micro-level relate to the operational level, that is, the concrete realization of the learning environment design in terms of tasks, artefacts, time in interaction, and roles. However, data from the focus group discussions indicate that decisions at this level depend to a large extend on decisions made at the strategic (macro) and tactical (meso) levels.

Regarding micro-epistemic considerations, focus group data reveal designers' ambitions to design tasks that correspond with learners' needs, taking into consideration the objectives of the stakeholders at the macro level and the nature of the practices at the meso level. Learners may be required to learn additional competences to meet the requirements agreed between the stakeholders involved, for example, to ensure safety and responsible use of materials at the workplace in the built environment (WP4). Sometimes the chosen work practice imposes limitations on the tasks learners can do, for instance at a residential facility for senior citizens students can only perform specific tasks and need to make sure that they do not cause any inconvenience for the residents (FG2b).

Focus groups discussed micro-set considerations about the artefacts: designers try to anticipate which artefacts are needed for learners to perform the selected tasks, taking into account the facilities of the spaces at the meso level. Simultaneously, focus groups expressed

trying to influence learners' behaviour (in line with the objectives at the macro level) by intentionally introducing professional artefacts. Such artefacts are intended to serve as a way to ensure that the "look and feel" of the learning environment closely corresponds with the profession, for example, professional chef clothing in the hospitality industry (EP2a). An artefact may also serve to support the integration of school-subjects and professional tasks, for instance, by having learners in the built environment contribute to building progress reports to activate their writing skills (EP1).

With regards to micro-social considerations, focus groups indicated searching for roles that correspond with the selected tasks. This level includes decisions about horizontal and vertical cooperation between actors, such as senior-junior links to learn from and with each other. Furthermore, designers consider possibilities for role-rotation, to have learners practise with different tasks and different degrees of responsibility. In several of the real-life learning environments discussed during the focus groups, learners are expected to fulfil roles as "chefs" or senior colleagues, for instance in facility services, where such roles are fulfilled across educational levels (EP1). Decisions also need to be made about the support learners need. While in some learning environments learners are closely supervised, in other learning environments they are allowed to operate independently, for example, when meeting a potential client for a business assignment (EP1). It is also important to decide which actors perform which roles: for instance, guidance may be done by workplace actors or actors from school (ED4). Concerning the more hybrid designs, it was mentioned that a multi-professional team is often called for to fulfil all the roles within the learning environment (EP1), and that sometimes additional training is needed for actors to fulfil the roles that are designed for them (EP2a). Lastly, designers also indicated that they regularly consider introducing rules of conduct, such as a dress code, to stimulate learners' professional behaviour within the learning environment.

Similar considerations are also made at the micro-temporal level. From focus group discussions it became clear that decisions about the time in interaction are largely based on considerations about what is customary in the relevant work practices. Consequently, designers try to implement certain relevant temporal elements, such as performing under time pressure (EP1). A recurring dilemma that was mentioned in the focus groups was whether learners' tasks could be scheduled according to a school-schedule or a work-schedule (EP1, EP 2a, EP2b, WP4).

4.5 Conclusions and discussion

Vocational curricula designs need to take into account the need of connecting school and work practices to facilitate learning across boundaries (Griffiths & Guile, 2003; Sappa et al., 2018; Unwin, 2009). More understanding is needed of learning environment design at the school–work boundary (Wesselink & Zitter, 2017). The present study helps our understanding by exploring design considerations of designers in vocational education. We did so through expert consultation and five focus groups in which explicit and implicit design considerations were

elicited. The focus in this study was on design considerations related to the school–work connection. Our findings show that considerations can be found at three levels (see Table 11).

Table 11

Design framework for learning environments at the school–work boundary

Alignment between designable elements

Alignment between design levels

	EPISTEMIC *What*	SET *Where, With what*	TEMPORAL *When*	SOCIAL *Who*
MACRO	Objectives	Location	Time in context	Stakeholders
	What are the objectives of the design?	Which locations are suitable? (school, work, third location)	How is the time divided between different contexts?	What kind of partnership should be established?
MESO	Nature of practices	Spaces	Time in programme	Actors from practices
	Which school and work practices need to be involved?	Which spaces are required?	What is the time frame within the educational programme?	Which actors from school and work need to be involved?
MICRO	Concrete tasks	Artefacts	Time in interaction	Roles
	What learning and working tasks are suitable?	Which resources are needed?	Which schedule and temporal aspects are feasible?	How can roles be divided and rotated between actors?

Table 11 may be seen as a variation of the earlier introduced curricular spider web model (Thijs & Van den Akker, 2009). The need for alignment between and within the various components corresponds with the concept of "constructive alignment": all components of a system should be aligned to each other (Biggs & Tang, 2007). However, the framework presented in our study extends the concept of alignment to include alignment between the designable elements and design levels that are particularly relevant for the context of vocational education, since they relate to the school–work connection. The framework invites designers to consider which

settings, practices, actors, tools etcetera should be included from each of the contexts of school and work. Thus, a contribution of this study is that it presents an additional understanding of constructing vocational curricula and of considerations that should be taken into account when designing cross-boundary learning environments (Zitter et al., 2016).

The presented framework (Table 11) can be categorised as a "learning design framework" that may serve both to analyse a design product and to further guide a design (Muñoz-Cristóbal et al., 2018). Our framework specifically supports the (re)design of learning environments at the school–work boundary. As such, it can be used alongside other tools with a reflective purpose, such as the instrument to analyse competence-based study programmes presented by Wesselink et al. (2010b), the overview of hierarchical categories of competence-based education (Koenen et al., 2015), and Bakker and Akkerman's boundary analysis (Bakker & Akkerman, 2019). These tools can help to identify possible areas of improvement concerning the stakeholders' ambitions, for example, to develop a more competence-based curriculum (Koenen et al., 2015), to make more effective use of the learning potential at the school–work boundary (Bakker & Akkerman, 2019) or to take into account the different conceptions of the stakeholders to support connectivity (Wesselink et al., 2010a). Our framework adds to these tools a set of specific design considerations that may support the (re)design. Next to epistemic and social elements presented in Wesselink et al's studies, such as agreements about the tasks, roles and responsibilities of the actors involved, our framework includes additional elements, namely, temporal and spatial elements. Moreover, our study adds understanding by distinguishing different aggregation levels of the design.

Nonetheless, further studies are needed to deepen the insights into the alignment of design considerations, as has been done, for example, regarding the alignment of the set design and the epistemic design (Van Merriënboer et al., 2017). Van Merriënboer et al.'s study describes a participatory design process that helps to realise physical spaces that support specific visions of learning and pedagogy. Similar studies examining alignment issues could focus, for example, on the interrelation between the set design and the social design (e.g. to develop an understanding of how actor-proximity may influence emergent learning activities) and between the social design and the epistemic design (e.g. focusing on the relation between grouping and knowledge acquisition).

Another potentially fruitful way forward is to investigate the relation between design characteristics and students' learning outcomes, as has been done for example in multidisciplinary student groups (Oonk et al., 2017). Furthermore, at the meso and macro design levels, current understanding of the dynamics of school–work partnerships could be investigated more profoundly, as has been done, amongst others, by Flynn et al. (2016).

From a practical perspective, the presented framework can guide educational practitioners and designers in their efforts to develop curricula that connect the school and work contexts. The representations of different learning environment types forwarded in this paper, together with

the design considerations, can be used in several stages of the designing process: (1) for aligning stakeholders' ambitions at the start of the design process; (2) for checking whether the progress is in line with the ambitions during the design process; and, (3) for evaluating the quality of the design when it is realised and in-action. As such, the presented insights can support practitioners and designers to make informed decisions on how to improve the connectivity between school and work.

Limitations

From a methodological point of view, the focus group approach of the present study was set up in line with key criteria of qualitative research (credibility, transferability, dependability, and confirmability; Anney, 2014). However, some of the common issues related to focus groups may still have occurred, because of the voluntary participation, or because of the focus groups' dynamics and moderation. Although only experienced practitioners and designers were selected, some differences in knowledge and experience were inevitable and may have led to participants not freely expressing all their considerations. Furthermore, despite the thorough preparation of the moderator and the observer, some participants may have refrained from expressing their opinion because they felt it to differ too much from those of other participants (Gawlik, 2017). To counterbalance these group effects, participants were approached individually for written member checks after the focus group sessions (Birt et al., 2016).

Regarding the transferability of the findings, input was generated from practitioners and designers in the context of Dutch vocational education. Although the school–work connection is relevant in many other educational systems, design considerations are bound to differ depending on the educational system in which the designers operate. For instance, the high degree of autonomy regarding curriculum design in the Netherlands may have consequences for designers' considerations (Thijs & Van den Akker, 2009). We have attempted to enhance transferability by explaining both the more universal elements of vocational education and by giving explicit information about the Dutch educational context. Nevertheless, additional understanding of the design issues in vocational education could be achieved through the exploration of design considerations of designers in other countries.

Conclusions

Designing future-proof vocational curricula that support learners to cross the school–work boundary is challenging. The multilevel design framework that we have presented may help to meet these challenges. The framework is specifically aimed at supporting the design of learning environments that connect the contexts of school and work. It is based on design considerations that generally remain largely implicit since they are part of the 'working knowledge' of the designers involved. By eliciting designers' design considerations, we have uncovered relevant considerations at three levels: macro, meso, and micro. These considerations regard the epistemic, set, temporal and social design of learning environments at the school–work boundary. At the macro-level, strategic design considerations come into play, dealing with overall, long-term and future-oriented issues, such as the formalisation of

the partnerships between different stakeholders. At the meso-level, the considerations are more oriented towards tactical decisions, for instance about the nature of the practices that need to be involved and about the timeframe that is available for the learning environments. At the micro-level, design considerations concern more concrete aspects, needed to actually realise the learning environment, for example, the concrete tasks that learners need to perform of the roles that they are expected to fulfil within the learning environment. The results suggest that design considerations at one of the design levels have implications for design decisions at the other levels. Alignment seems to be called for, both between and within the design levels and the epistemic, set, temporal and social design to meet the challenge of designing future-proof vocational curricula that support learners to connect what is learned in each of the contexts of school and work.

5

Exploring co-construction through the lens of vocational practice[7]

[7] This chapter is based on: Bouw, E., Zitter, I. & De Bruijn, E. (2021). Exploring co-construction of learning environments at the boundary of school and work through the lens of vocational practice. Vocations and Learning. Advance online publication.

Abstract

Educational institutions and vocational practices need to collaborate to design learning environments that meet current-day societal demands and support the development of learners' vocational competence. Integration of learning experiences across contexts can be facilitated by intentionally structured learning environments at the boundary of school and work. Such learning environments are co-constructed by educational institutions and vocational practices. However, co-construction is challenged by differences between the practices of school and work, which can lead to discontinuities across the school–work boundary. More understanding is needed about the nature of these discontinuities and about design considerations to counterbalance these discontinuities. Studies on the co-construction of learning environments are scarce, especially studies from the perspective of representatives of work practice. Therefore, the present study explores design considerations for co-construction through the lens of vocational practice. The study reveals a variety of discontinuities related to the designable elements of learning environments (i.e. epistemic, spatial, instrumental, temporal, and social elements). The findings help to improve understanding of design strategies for counterbalancing discontinuities at the interpersonal and institutional levels of the learning environment. The findings confirm that work practice has a different orientation than school practice since there is a stronger focus on productivity and on the quality of the services provided. However, various strategies for co-construction also seem to take into account the mutually beneficial learning potential of the school–work boundary.

Keywords School–work boundary, co-constructed learning environments, educational design, discontinuities, design considerations

5.1 Introduction

To meet current-day educational and societal demands, both educational institutions and vocational practices[8] are seeking to design and enact learning environments that combine the contexts of school and work. From the perspective of educational institutions, combining school-based learning with work-based learning has benefits for supporting learners' vocational competence development. Work-based learning, that is, learning that is based on real-life work experiences, exposes learners to production methods and work requirements of actual workplaces and is therefore considered as an effective way to develop vocational competence (Sweet, 2014). From the perspective of vocational practices, combined school- and work-based programmes can be interesting to reduce skills mismatches and provide hiring opportunities (Cedefop, 2020). Thus, such combinations have benefits for individuals, vocational practices, and society as a whole (Sweet, 2014) and continue to be promoted in vocational education and training policies, both in Europe (Cedefop, 2020) and worldwide (Bahl & Dietzen, 2019). Close collaboration between different stakeholders is seen as crucial to keep Vocational Education and Training (VET) relevant (Cedefop and ETF, 2020).

The present study focuses on the collaboration between school and work practices in terms of *co-construction*, that is, the process in which representatives of educational institutions and vocational practices work together to design and enact learning environments. Other studies have referred to this process as "collaborative design" (Akomaning et al., 2011) or "co-development" (Wesselink & Zitter, 2017), but in our view the term *co-construction* explicitly underlines the need for stakeholders to stay engaged during all phases of the design and enactment. However, the various stakeholders involved in the design process may have different expectations of the learning environment or curriculum (Thijs & Van den Akker, 2009). Especially in vocational education stakeholders are found to have different conceptions of learning and teaching across the practices of school and work, varying from more dualistic (viewing school and work as separate practices) to a more integrated perception of vocational teaching and learning (Sappa & Aprea, 2014; Tyson, 2016). Moreover, representatives of the two practices may have different motives for engaging in the design. Manwaring et al. (2020) illustrate that many "models of engagement" are possible for educators to engage with vocational practice, varying from one-off meetings, to high levels of engagement and time commitment (Manwaring et al., 2020). The present study focuses on the co-construction of vocational learning environments where actors from both school and work are highly engaged in the design and enactment of the learning environment.

Viewed through the lens of vocational practice, such high levels of engagement can be challenging. Workplaces may have limited possibilities to support learning activities (Billett, 2014a; Istance & Kools, 2013; Nyen & Tønder, 2018), and workplace demands tend to override

[8] The terms *vocational practice* and *work practice* are used as synonyms in this chapter, to refer to practices in both the private and public sector. The term includes the wide range from small- and medium-sized, to large(r) organisations and enterprises.

pedagogical goals (Fjellström & Kristmansson, 2019). Facilitating connectivity between work-based and school-based provisions is often chosen as a strategy to work around such limitations (Griffiths & Guile 2003). Facilitating connectivity means that things need to be brought together that have earlier been separated, which requires appropriate arrangements for integration (Bouw et al., 2019; Choy et al., 2018b; Stenström & Tynjälä, 2009). Viewed through the lens of educational practice, findings from recent studies suggest that frequent interaction with stakeholders from work practice during the design is crucial for connectivity (Hoeve et al., 2019). However, the interaction with these stakeholders is also perceived as challenging by educational practitioners, who need to develop new ways of working and be willing to "attune to the pace of the work process and environment" (Nieuwenhuis et al., 2019, p. 280). Several studies have focused on the efforts of educators in vocational education to facilitate learning at the school–work boundary (e.g. Berner, 2010; Mårtensson, 2020). Some studies have also taken a design perspective to examine the connectivity issue, highlighting the strategies that can be used by educators to design vocational curricula in close collaboration with vocational practices (Wesselink & Zitter, 2017). Research has also shown that design strategies can support the use of the learning potential at the boundaries between school and work in vocational education (Bakker & Akkerman, 2019). The present study aims to extend these insights by inquiring into design strategies through the lens of work practice.

More understanding is needed about design considerations through the lens of work practice to support initiatives of co-construction. Insights into design strategies of representatives of vocational practice may contribute to mutual understanding between school and work practices, which in turn may help to exploit the learning potential of the school–work boundaries. The present study focuses on the designable elements of co-constructed learning environments, exploring design considerations underpinning the co-construction with educational institutions (institutions for vocational education and training and for higher professional education). The next section elaborates on co-construction between the practices of school and work, on experienced discontinuities at the boundary of the two practices, and on the designable elements of co-constructed learning environments.

5.2 Theory

School–work connection and discontinuities

The connection between *school* and *work* is challenged by the differences between the practices. School and work are seen as social practices with distinct historical and cultural backgrounds and objects. Work practices are mainly driven by business demands and school practices are mainly driven by their educational purpose (Poortman et al., 2014; Schaap et al., 2012; Stenström & Tynjälä, 2009). Furthermore, school and work practices are bound by different governmental, legislative, cultural, and behavioural differences. For instance, school practices need to comply with government guidelines about the admittance and support of students; work practices need to comply with health and safety regulations (Flynn et al., 2016). The different intents, purposes and outcomes between school and work practices challenge

integrative opportunities for learning (Eames & Coll, 2010; Tynjälä, 2013). The sociocultural differences between the practices have been defined as "boundaries" (Akkerman & Bakker, 2011). These boundaries may affect communication and the progress of actions, thus leading to discontinuity.

The concept of discontinuity in learning across practices is used when an ongoing process is somehow hampered, which can lead to unfavourable consequences (Arts & Bronkhorst, 2020). The concept is used "when actions or interactions are not perceived as showing the desired progress or when they require substantial effort" (Bakker & Akkerman, 2019, p. 354). During co-construction, discontinuities may be experienced when trying to connect and integrate the experiences of school and work practices. For example, discontinuities may emerge when work supervisors do not agree with the school-requirements for workplace learning, because these requirements are not sufficiently attuned to the profession (Bakker & Akkerman, 2019). By studying emerging discontinuities, we might improve understanding of design considerations of representatives of vocational practices, when dealing with tensions at the school–work boundary.

Discontinuities between school and work practices have been approached at different levels. A frequently studied perspective is the individual or intrapersonal level, for instance about students who have difficulties connecting their workplace experiences to their vocational school (Tanggaard, 2007), or their (part-time) educational programme to their work life (Arts & Bronkhorst, 2020). Next to this intrapersonal level, discontinuities between the practices of school and work can also be studied at the interpersonal level, that is, between actors, or at the institutional level, that is, between institutions (Akkerman & Bruining, 2016; Bakker & Akkerman, 2019; Bronkhorst & Akkerman, 2016; Choy et al., 2018b; Grollmann, 2018). For instance, at the interpersonal level research helped to understand "boundary work" used by teachers during school-based vocational training to reaffirm the specificity of school practice or to reconstruct workplace experiences (Berner, 2010). Studies have also addressed the need to attune school and workplace supervision (Mikkonen et al., 2017). At the institutional level, studies have focused on the need for collaboration between schools and workplaces to reach better coherence between school and workplace learning (Aakernes, 2018), and on various forms of school–work collaboration, such as coop programmes (Coll et al., 2009).

However, most studies on discontinuities between school and work practices tend to take the learners' perspective or that of the educators from vocational institutions (Berner, 2010; Endedijk & Bronkhorst, 2014; Mårtensson, 2020; Nieuwenhuis et al., 2019; Rintala & Nokelainen, 2020). Little is known about school–work co-construction from the perspective of representatives of work practice that initiate or actively participate in the co-construction of learning environments. Considering the importance of co-construction for vocational education, it is crucial to increase understanding of the design considerations of all stakeholders, and thus also of the representatives of work practices who are strongly engaged in the co-construction.

Designable elements

In the present study, we explore the perspective of representatives of work practice on co-construction by eliciting their considerations about the school–work connection and about the designable elements of the learning environment. These elements influence the activities learners engage in (Bouw et al., 2019; Carvalho & Goodyear, 2018; Zitter et al., 2016). In the present study learning environments encompass four categories of designable elements:

1) Epistemic elements are all elements related to content and tasks. These elements are based on the vocational knowing (including skills and attitudes) that is seen as worthwhile in the relevant occupational domain and about how this knowing can best be presented and structured (Carvalho & Goodyear 2018).
2) Spatial and instrumental elements include all physical features, such as the location (school location, work location, or third location), spaces (analogue or digital), and artefacts needed to perform the relevant tasks (Bouw et al. 2019; Zitter & Hoeve 2012).
3) Social elements refer to which actors are active in a learning environment and the roles they fulfil. Grouping and division of labour are also part of the social elements of the learning environment, as are suggestions on how actors might interact (Carvalho & Goodyear 2018).
4) Temporal elements are included in this study to illuminate the importance of considering elements related to time. Designable temporal elements include timespan and intensity of the programme, nature of the time schedule, work pace (including amount of time pressure), and work interruptions to slow down, accelerate, or pause the work process for educational purposes (Bouw et al. 2019; Zitter & Hoeve 2012).

Inquiring into the designable elements of co-constructed learning environments contributes to an increased understanding of the design of vocational learning environments, particularly for the discontinuities encountered by work practice and how these might be counterbalanced. The study strives to answer the following two research questions:

- Which discontinuities are encountered in relation to the designable elements from the perspective of work practice when co-constructing learning environments at the boundary of school and work?
- Which strategies are applied to counterbalance the encountered discontinuities?

Context

The study was conducted in the context of Dutch vocational education, which encompasses two educational levels qualifying students for occupational practice (De Bruijn et al., 2017b; Smulders et al., 2019): senior secondary vocational education (EQF/ISCED 2–4) and higher, or tertiary, professional education (EQF/ISCED 5–7). In the Netherlands, these educational levels are enacted by institutions for vocational education and training (VET) and by universities of applied sciences (UAS). In the Netherlands vocational education is part of the public education system and educational institutions have a strong relationship with social partners, especially in senior secondary education (De Bruijn et al., 2017b). Government and social partners

cooperate to provide labour market-relevant vocational arrangements that also prepare students for participation in society and for further study. Mandatory forms of workplace learning are part of Dutch vocational curricula, intended to support learners to acquire future-proof vocational competence (Hoeve et al., 2019; Smulders et al., 2019). Thus, the collaboration between school and work is a core aspect of Dutch vocational education, both at the system level and at the level of concrete practices. The present study focuses on collaboration at the level of concrete practices, that is, at the institutional level of educational institutions (school practice) and vocational practices (work practice) and at the interpersonal level of the actors from both practices. Since many vocational education systems worldwide are somehow dependent on school–work collaboration, findings are expected to be relevant for researchers and practitioners (both from school and from work practices) in other countries.

5.3 Methods

An interview study was carried out to capture the perspective of representatives of work practice on co-construction. In-depth, semi-structured interviews were conducted with representatives of different occupational fields, who all have ample experience with co-constructing learning environments together with institutions for vocational education in the Netherlands. This approach was chosen to explore the discontinuities through the lens of work practice and to uncover the considerations on which representatives of work practice base their design decisions.

Sampling and data gathering

We purposively selected a specific sample of representatives of work practice, with enough "information power", that is, sufficiently large and varied to elucidate the aims of the study (Malterud et al., 2016) and to establish the basic elements for "meta themes", that is, overarching themes derived from the dataset (Guest et al., 2006; Hennink et al., 2017). The sample was selected on the basis of the following three selection criteria:

- Each participant is thoroughly familiar with co-constructing learning environments, due to their role in a profit or non-profit organisation. This role can be related to Human Resource Development (HRD), Human Resource Management (HRM), Learning & Development (L&D), or to the development of a corporate academy or training centre.
- Each participant has ample experience with co-constructing learning environments together with educational institutions.
- Together, participants represent a variety of vocational practices in different occupational fields and a variety of co-constructed learning environments.

Thus, next to the homogeneity in experience and background in co-constructing learning environments together with educational institutions, we also strived for diversity in terms of occupational fields and the nature of the co-construction. This was done to do justice to the differences in conceptions that representatives from different occupational fields may have

(Sappa & Aprea, 2014) and to safeguard rich data about co-construction. Each representative was or had been involved in the co-construction of multiple learning environments, leading to data being gathered on co-construction of a range of learning environment designs. Participants were selected from the extensive network of the authors' vocational research group with the help of key informants from different institutions, who brought the authors into contact with relevant participants. After potential participants indicated their interest, they were approached via e-mail by the first author with additional information about the study design and data processing and were asked to sign a consent form. After receiving their informed consent, participants were interviewed by the first author.

Individual in-depth, semi-structured interviews were conducted to gain relevant background information from the participants and to allow for a thorough understanding of the interviewees' thoughts about co-constructed learning environments. Interviews were conducted with the help of an interview guide (King, 2004). This interview guide consisted of four sections: (1) the interviewee's background (current and previous roles concerning the co-construction of learning environments), (2) co-constructed learning environments the interviewee is familiar with, (3) experiences during the design and enactment of these learning environments, and (4) design considerations about the epistemic, spatial, instrumental, temporal and social elements of these learning environments. Interview duration varied from 65 to 93 minutes, with an average duration of 78 minutes (Table 12). A total of 550 minutes of interviews was recorded and transcribed. Transcriptions were condensed into reports which were member-checked by all interviewees. A few remarks were added to the reports by interviewees. These remarks were included in the analysis of the data.

Table 12

Interviewees, occupational field, and duration of the interviews

	Interviewee's role and experience	Occupational field	Interview duration
Interview 1	Role: L&D specialist at a cleaning company Experience: co-constructing with different educational institutions (VET and UAS)	Facility services (cleaning)	68 min.
Interview 2	Role: Team leader at a neighbourhood farm, responsible for the L&D activities Experience: co-constructing with different educational institutions (VET)	Construction (built environment)	65 min.
Interview 3	Role: independent L&D specialist Experience: co-constructing with different vocational practices and educational institutions (VET and UAS)	Manufacturing (fashion and textiles)	89 min.
Interview 4	Role: Head of L&D of a large residential care centre Experience: co-constructing with different educational institutions (VET and UAS)	Healthcare (residential care)	93 min.
Interview 5	Role: Training manager at a private training centre for civil engineering education Experience: co-constructing with different civil engineering companies and educational institutions (VET and UAS)	Construction (civil engineering)	70 min.
Interview 6	Role: Operational manager at an electrical engineering company, responsible for L&D activities Experience: co-constructing with different companies and educational institutions (VET and UAS)	Engineering (electric engineering)	83 min.
Interview 7	Role: L&D specialist at a hospital training centre Experience: co-construction of an 'innovation centre' for the hospital with different educational institutions (VET and UAS)	Healthcare (hospital care)	82 min.

Data analysis

Thematic analysis was applied since this is seen as a suitable approach to analyse rich and meaningful data (King et al., 2017, p. 180). We used this method to identify, organise and interpret themes in the interview data. This means that the interviews were coded by the first author through deductive and inductive coding strategies (Miles & Huberman, 1994). We use *code* to refer to "comments linked to extracts of text, indicating material identified by the analyst as relevant to their research question" (King et al., 2017, p. 183). Consequently, the codes related to discontinuities at the school–work boundary (question 1) and to strategies to counterbalance these discontinuities (question 2). Next to the concept of discontinuity, coding was informed by the concepts presented in the theoretical framework: the designable elements of the co-constructed learning environment (epistemic, spatial, instrumental, temporal, and social), and the two levels at which counterbalancing strategies are examined in this study: the interpersonal level (between actors) and the institutional level (between institutions). Table 13 shows the deductive codes that were stipulated in advance and their description.

Table 13

Coding table

Codes		**Description**
Discontinuity		Instances in which an ongoing process within the co-constructed learning environment is hampered and/or actions and interactions require substantial effort, which can lead to unfavourable consequences
Strategy		A (design) intervention, approach, or method used to counterbalance (potential) unfavourable consequences of discontinuities
Designable elements		
	Epistemic	Discontinuities/strategies related to tasks within the learning environment or to the structuring of content or knowledge-oriented activities
	Spatial	Discontinuities/strategies related to the location of the learning environment and the nature of the chosen spaces (including digital spaces)
	Instrumental	Discontinuities/strategies related to tools and other artefacts of the learning environment
	Temporal	Discontinuities/strategies related to time, time span, schedules, work pace, and so forth

Codes		Description
	Social	Discontinuities/strategies regarding actors within the learning environment, including interactions, and social norms, rules of behaviour/divisions of labour
Levels		
	Institutional level	Strategies that relate to the *institutions* involved in the co-construction and how they collaborate
	Interpersonal level	Strategies that relate to the *actors* involved in the co-construction and how they collaborate

Thematic analysis of the interview data lead to themes based on the recurrent features in the accounts of the participants about the discontinuities that they had encountered while co-constructing learning environments and about the strategies they applied to counterbalance these discontinuities. To promote reflection and thus ensure the credibility of the findings, the first and second authors held data analysis sessions in which codes and quotes from the interviews were discussed (Aarsand & Aarsand, 2019). To prevent potential bias, themes were discussed with the third author, who acted as a "critical friend" during the study (Marshall & Rossman, 2014). The resulting themes are presented in the Findings section below. See the appendices for tables about the themes and quotes related to discontinuities and themes and quotes related to strategies (see Appendices chapter 5).

5.4 Results

Interview data report discontinuities related to all designable elements of the learning environment. Strategies used to counterbalance such discontinuities can be found both at the interpersonal and at the institutional level of the learning environment design. Table 14 summarises the themes that emerged from the interviews.

Discontinuities and strategies related to epistemic elements

Discontinuities related to the epistemic elements seem to emerge in the learning environment when actors from school and work practices have different views on, and knowledge of, the work tasks students need to do at the workplace. It appears that actors from school practice are not always informed about the nature of the work tasks in the occupational field: "Our regional trainer hears from students that the teacher does not know how to do it at all" (i1, discontinuity, epistemic). Discontinuities also appear to be related to the adaptability of the content of the learning programmes to the needs of work, that is, the relevancy of tasks and content. Expectations are not always met, and sometimes work practice seems to want (more) consultation about the tasks that school practice sets out for the learners:

> I understand that school wants them to do something, but sometimes they do not look at what they [the students] show in practice (…) So we should be consulted more often about these things, for example, what do we find useful in professional practice? (i7, discontinuity, epistemic)

Table 14

Themes resulting from the interviews

Designable elements	**Themes related to discontinuities**	**Themes related to counterbalancing strategies**	**Interpersonal level**	**Institutional level**
Epistemic	Relevancy of tasks and content Unseized potential	Structural/frequent interactions and proximity between actors	X	X
		Reciprocal exchange of expertise		X
Spatial & instrumental	Suitability of spaces Relevancy of tools and instruments	Purposeful selection of spaces and instruments	X	X
Temporal	Different schedules Different planning horizons Productivity	Agree upon actors' expected productivity	X	X
Social elements	Availability of actors Role performance Role conflicts	Involve other practices in the learning environment (Re)Designing roles		X

Moreover, it appears that not all learning potential is seized: interviewees (i5, i7) signal additional opportunities for students to benefit from the expertise that is available at the workplace

> We could work together every semester. That could be more fun and interesting for the mechanics teacher. But the higher education teachers seem to see this as a change, extra work. They would have to adapt the programme they have been running for 10 or 15 years to fit in, in this case, an aqueduct. That may be an extra effort for them, while they do not see the added value. (i5, discontinuity, epistemic)

In the co-constructed learning environments central to this study, schools are accountable for the content of the educational programme and the kinds of tasks learners engage in. As a consequence, the schools in question tend to adhere to the school-based training facilities for specific vocational training, even if this vocational training is also offered to employers in the workplace. Such a discontinuity is signalled at an innovation centre that is co-constructed between a hospital and several educational institutions:

> We offer workshops EBP [Evidence Based Practice] for our nurses. But the students say that they have EBP lessons at school at the same time, which are not as good (…). So 80% like the module better with us, those workshops, but they still have to follow the lessons at school, because of the school credits system. (i7, discontinuity, epistemic)

To counterbalance the epistemic discontinuities one of the strategies at the interpersonal level is to add structural interactions between actors to the design, to secure more mutual consultation: "And I have also proposed that, and we do now, to structurally organise a consultation moment every 14 days" (i2, counterbalancing-epistemic, interpersonal). Such frequent interactions between actors are seen as essential to attune the tasks learners should engage in. The strategy of organising frequent interactions is also reinforced by organising proximity between actors at a specific location, where actors can meet each other:

> On Wednesday they [the students and teachers] are at one of the residences. They are all there, so we [actors from work practice] also make sure that we work from that specific care location on that day, so we all see each other every week. (i4, counterbalancing-epistemic, interpersonal)

The frequent presence of educators from school at the workplace has the advantage that these educators gain more insights into which school-related tasks might be skipped, in favour of experiences at the workplace: "I notice that with [educational institution a] it is easier to skip things, because that teacher is here more often, while with [educational institution b] they [the students] always have to go to school, even if they already learned the same lesson here" (i7, counterbalancing-epistemic, interpersonal).

At the institutional level, interviews reveal attention to both the relevance of tasks and content and to avoiding a too-narrow focus on a single work practice. Interviewee 3 explains that having students rotate between different work settings helps to ensure a broad focus "not specific to one organisation or one vocational teacher" (i3, counterbalancing-epistemic, institutional). Students are afforded different work settings: "home care in [name of big town] is very different than home care in a small village (…) so they learn to work with customers from different backgrounds and with teams from different backgrounds" (i4, counterbalancing-epistemic, institutional).

Another strategy at the institutional level, intended to afford exchange of expertise, is to have teachers from the vocational institutions follow some of the same training as their (future)

employees: “What we started with, is to give VET teachers the basic vocational training (…) Then they noticed that their knowledge was outdated” (i1, counterbalancing-epistemic, institutional). Or by including reciprocal exchanges in the formal agreements about the co-construction:

> We have made agreements about that from the beginning, that our experts would be present in the schools more often and also that our “lector practitioners", caretakers with a master's degree, also work with us and also teach here, in practice. (i7, counterbalancing-epistemic, institutional)

Discontinuities and strategies related to spatial and instrumental elements

Related to spatial elements, the representatives of work practice seem to carefully consider the suitability of spaces for both work-related and school-related activities. Using spaces at the workplace for learning and instruction is seen by respondents as beneficial for vocational learning, but it also has a downside: such spaces do not always have the best facilities for school-related purposes. The hubbub of the workplace can make it hard for educators to give the needed instructions to the learners: “those multifunctional spaces that are also intended for residents are simply not always suitable for providing good training. For example, such a space is open, so you can hear rattling carts passing by on the way to the kitchen” (i4, discontinuity, spatial).

Likewise, the presence of multiple actors, both from school practice and work practice, at the same location can be a source of discontinuities: “And we don't have the right type of classroom (…). It is actually just like here (…), neighbourhood residents, volunteers, and children from school care walk around. And that is bothersome if you want to give a practical lesson” (i2, discontinuity, spatial). Such spatial discontinuities are encountered when the emergent activity in the learning environment does not match with the needs of the workplace, such as the need of patients for quiet spaces at a care centre:

> People with dementia benefit from a space that is quiet and predictable. How does that relate to a student’s learning process? We have somebody assisting with the meals, we have a qualified caretaker, and also a teacher coaching a student: how do we keep the place nice and quiet? (i4, discontinuity, spatial)

To counterbalance discontinuities related to the spatial elements of the design, a strategy at the institutional level is the purposeful selection of spaces and artefacts for specific tasks. For instance, a school-based space is selected for training specific nursing procedures: “I mean we also have nursing manikins, but they [the school] have a bit more volume (…). And they have all the materials that are cleaned properly and so yes, that was simply the best [option]” (i4, counterbalancing-spatial, institutional). Sometimes other locations are visited to afford students the opportunity to experience specific tasks or materials, for example, pouring concrete (civil engineering, i5) or cleaning specific floors (cleaning, i1).

Concerning the artefacts, interview data expose discontinuities related to tools and instruments being outdated when work practice is not sufficiently involved in the physical set up of the learning environment:

> You sometimes see that in retail: they build a shop in a school. Then they have an archaic cash register there. Or they [students] still have to check the stock using a pen and paper, which never happens in practice anymore. So as soon as they [the school] have actually linked that practice to it, it is immediately outdated. (i2, discontinuity, instrumental)

When work practice and school practice join forces to build a learning environment, such as a lab, they can take purposefully select tools and materials that are up-to-date: "We [the company] set up a lab together with a VET institution, not with the equipment that was left over from the company 20 years ago (….), but with the equipment that was current at the time" (i6, counterbalancing-instrumental, institutional).

Another strategy for the same purpose is to involve other practices in the learning environment. For example, company suppliers are involved in the learning environment to inform learners about state-of-the-art products, such as the newest cash register systems in retail (i3) or the most efficient cleaning tools in facility services (i1).

Discontinuities and strategies related to temporal elements

Concerning the temporal elements of the learning environment, discontinuities are reported that arise due to differences between the schedules of school and work practice. Representatives of work practice seem to expect flexibility in scheduling, but, as interviewee 2 states, the school schedule can be hard to deviate from: "It has to be done very quickly, but at fixed times. It has to be that Friday and that Wednesday and Tuesday, because it is scheduled on those days. I mean: there is no flexibility in the schedules." (i2, discontinuity, temporal)

Another discontinuity relates to the differences between the practices of school and work with respect to how far ahead activities are planned. Educational institutions seem to work with different planning horizons than work practice:

> They work per school period and then, really, two weeks before the next period starts, they request if our regional trainer can be made available for two half-days a week. We are used to planning and organising such things much longer ahead. (i1, discontinuity, temporal)

Besides the planning horizon, a discontinuity regarding the temporal elements has to do with the need for consultation about students' productivity. It happens that school decides to have students spend less time at work, without consulting the people from the vocational practice:

> That is really annoying for us because it means that they can work less in practice, they are less productive, and well, that must be budgeted differently. And since they inform us last minute, I cannot change the planning on time. (i4, discontinuity, temporal)

A strategy to counterbalance discontinuities related to time is to reach an agreement about when students can be expected to be productive. This is done at the institutional level through formal agreements, and at the interpersonal level by discussing mutual expectations. Interviewee 4 explains that at the care centre the students are not considered as part of the workforce during the first three months of their employment:

> They get their salary, but they don't have to be productive. We say this explicitly, and we also hear the workplace supervisors say this amongst them and to the students "take your time (…) just sit down, observe, register what happens, because now you have time for that; in a while, there will not be [enough time]". (i4, counterbalancing-temporal, institutional)

Discontinuities and strategies related to social elements

A discontinuity that emerges in relation to the social elements of the learning environment relates to the availability of actors to perform the needed roles in the learning environment. For instance, when there are no educators from school available to guide or monitor learners at work: "And we noticed that that group was too big, and we had to step in, while it should be the vocational teacher, who is prepared for this task. So then we no longer had a win-win situation" (i2, discontinuity, social). A similar discontinuity is signalled when actors from work cannot be assigned to guide learners, because this interferes too much with their regular tasks, such as care tasks in healthcare (i4).

Furthermore, interview data reveal that the connection between school practice and work practice sometimes depends on too few actors who fulfil a role as a broker, while other actors do not have a clear role in the learning environment or do not perform their role in line with the expectations from work practice:

> We have a number of contact persons within [name of educational institution], who are very positive and very enthusiastic, but the people behind them are sometimes sceptical, they wait and see. Some pioneers take a lot of effort and are very enthusiastic and think along very well (…), but then, when they have to pass it on to others, it becomes difficult. (i1, discontinuity, social)

The limited availability of actors and the need for actors to balance educational goals and business demands can lead to role conflicts. This is manifested, for instance, by the experience split between the role of workplace supervisor and the role of employee, in this case of caretaker:

> Workplace supervisors really experience that as a split. On the one hand, they really want to supervise the student, they want to take time for that, they think that the student deserves it and that they are training a good colleague for the future. But when there are sick people and there is no one attending to your patient, what then? (i4, discontinuity, social)

Role conflicts are also signalled concerning the role of learners. When school-related activities are concentrated on a "school day" at the workplace, this can lead to learners abandoning their professional roles and switching to their student role, which can trigger unwanted school-like behaviour:

> They really consider the school day as "school". And it is striking to see that people of our age – we do recruit people up to sixty in the programme – that they actually behave as students. They come in too late, they immediately start smoking again, they start doing all kinds of things on the edge of what is, and what is not acceptable, while you would not expect that. (i4, discontinuity, social)

To counterbalance discontinuities regarding role conflicts (social) and ensure that *learning* is not overruled by *working*, a strategy at the institutional level is to design new roles, such as work supervisors exempted from work duties: "So now we have also started working with fully exempted supervisors (…) We have recruited ten people for this, all of whose work consists of supervising in practice" (i4, counterbalancing-social, institutional).

Counterbalancing multiple discontinuities

A more encompassing strategy at the institutional level, which is aimed at counterbalancing multiple discontinuities, is to develop new practices that integrate aspects of both school and work practices. Different varieties are reported. One variety is to develop a flexible model of co-construction, that can be adapted to the needs of different educational institutions. This implies that the vocational practice can engage either in a basic model of engagement with a school, for instance, providing the workplace setting for workplace learning, or the vocational practice can participate more actively in the design and enactment of co-constructed learning environments and even take the lead in the organisation of the learning environment:

> We can do it in multiple ways: our regional trainer can give specific vocational training at the school, we can organise excursions, we can give guest lessons, we can take the lead during the ten weeks of basic vocational training, or not. In fact, these are all variants that we can be agreed upon per school, how we will organise it. (i1, counterbalancing multiple, institutional)

A variation to this strategy is to establish a new organisational unit in which work and school practices are more strongly connected. Such a unit can be part of a larger organisation, as is the case with the care centre (i4) and the hospital (i7), or a new organisation in itself, as is the case with the training centre for civil engineering (i5):

> But that carpenter who comes from there [public vocational educational institution], who is actually the residential carpenter, is totally different from the one they [civil engineering companies] ask for. So there was nothing, so then they [the companies] set up an academy to ensure that there was a skilled inflow [of industrial carpenters]. (i5, counterbalancing multiple, institutional)

Such an institutionalised practice can be formed with one school, to limit the amount of different educational institutions that actors from the vocational practice need to adapt to, or with several schools. Interviewee 4 explains why they chose the first option: “They [the supervisors] had to deal with all kinds of [school] systems. Well, that is not necessarily a guarantee for good guidance, so I wanted to bring more uniformity, and just do business with only one institution”. (i4, counterbalancing multiple, institutional)

In all three organisational units that integrate school and work practices, students-employees are employed by this unit until they finish their education. This entails that they are not pressured to be productive in the learning environment right from the start. Interviewee 7 explains the difference between students having an employment contract with the training unit versus being employed directly at one of the hospital wards:

> And that is the beauty of it, I think, that all students, whether they have a learning-employment contract or an internship agreement, that they have a contract with us [training unit], because then we do not have that hassle of students being put on the work schedule within two weeks. Because that used to be the way it was. (i7, counterbalancing-multiple, institutional)

Interviewee 4 also speaks about the advantages of employing the students: it allows them to monitor employees both in their roles of learner and of caretaker:

> The great thing is of this construction, is that we can intervene incredibly quickly if we notice that a student is not doing well (…) And yes, if the teacher says “gosh, that person stands out in the group, he does not seem very motivated”, then it is also very easy on our side to check how the student functions in practice. (i4, counterbalancing multiple, institutional).

The strategy of integrating the practices of school and work also aims at counterbalancing discontinuities by affording learners the opportunity to combine their learning and working tasks within the learning environment:

> Students are really stimulated to look at: I actually want to find out something, I have a patient and I run into something, I want to look it up in literature, then they also get time for it. They need to say how long they will be working on it, what they want to do, and how they will provide feedback to the other students in the afternoon, so that it becomes a learning moment for the group. And then we also look at: which patient

room were you linked to, what care were you giving, who will take over your care tasks when you are working on another learning task? (i7, counterbalancing multiple, institutional)

5.5 Conclusions and discussion

The purpose of the present interview study was to improve understanding of the co-construction of learning environments in vocational education through the lens of vocational practice. Interviews were held with representatives of vocational practices in different occupational fields in the Netherlands. From the findings, it appears that when co-constructing learning environments, discontinuities can be found relating to all designable elements: epistemic (nature and relevancy of tasks and content), spatial (suitability of spaces), instrumental (use of up-to-date tools and instruments), temporal (schedules, planning horizons and expected productivity) and social elements (availability of actors, role conflicts and role performance). Findings further show that these discontinuities are counterbalanced with purposeful strategies at the interpersonal and institutional levels of the design. Results suggest that at the interpersonal level frequent interactions and proximity can contribute to better attuning the school-related and work-related activities that emerge in the learning environment. At the institutional level, the formalisation of school–work agreements and the integration of the two practices into new organisational units seem to be helpful strategies to meet the demands of both school and work practices.

The signalled discontinuities and the strategies to counterbalance these discontinuities support the concept of *boundary crossing learning mechanisms* as developed by Akkerman and Bakker (Akkerman & Bakker, 2012; Bakker & Akkerman, 2019). These learning mechanisms are useful to understand how learning can be triggered at the school–work boundary. Findings confirm that it helps to demarcate the responsibilities of actors from the different practices and to use artefacts to explicate the agreements between the practices involved. Furthermore, the strategy of organising joint meetings for actors from school and work practices might indeed stimulate mutual reflection. The findings also substantiate that roles can be added or adapted to ensure that roles are complementary to one another. Lastly, findings verify the emergence of new practices that combine the affordances of school and work practices. Further empirical studies are needed to enrich understanding of the strategies adopted by school and work practices to make better use of these learning mechanisms and thus effectively mine the learning potential of learning environments at the school–work boundary.

The identified strategies in the present study to counterbalance discontinuities between the practices of school and work are similar to bridging strategies found in other studies. Relating to (dis)continuity between two work practices, a study in the context of product introduction showed that integration of product development and production can be enhanced by intrapersonal and interpersonal boundary crossing (Gustavsson & Säfsten, 2017). Our study further enriches these insights by taking a specific design perspective and by including the institutional level. Furthermore, the main strategy that we found at the institutional level is in

line with previous findings of establishing continuity between in-school and out-of-school contexts: one of the ways to establish continuity is by creating hybrid practices in which actors from both contexts interact (Bronkhorst & Akkerman, 2016).

The present study confirms that work practice has a different orientation than school practice, needing to take into account work productivity and the quality of the services provided. Nevertheless, it also shows that strategies employed by work practice can be simultaneously focused on the *learning* taking place. Findings include empirical data on co-construction that show that much attention is paid to the interplay between working and learning, for example, by protecting student-employees against high work pressure, affording them ample time to learn in different work settings, and by developing new roles for workplace actors, aimed at stimulating and monitoring learning activities at the workplace. This contrasts with some other studies about learning environments at the school–work boundary in which learners reported experiencing little interest from work practice in their work performance and employability (e.g. Strickland et al., 2001). In our study, several of the reported strategies are explicitly aimed at supporting learners to perform well both as students and (future) employees. This is particularly evident in learning environments in which students have an employment contract. The different status of the student-employees allows them to spend dedicated time to learning activities that are not directly linked to their work tasks, or even to the work practice they are currently functioning in. Students are thus trained to be able to perform in other practices as well. This broad approach to learning while working suggests that work-based training centres can be co-constructed in a way that meets both school and work demands.

In the present study, we examined the boundary between the social practices of school and work. However, a variety of distinct social practices exist *within* these practices and new boundaries can emerge. Any organisation can encompass different practices. A hospital, for instance, encompasses multiple wards that can each be seen as a separate social practice. Similarly, in civil engineering, each group of experts represents a different practice (construction, land development, hydraulic engineering, etc.). The differences between such practices may be experienced as boundaries that impact the activities in the learning environment. It would be interesting to further examine the discontinuities that are encountered at the boundaries of “practices within practices” and the efforts that are undertaken to bridge them. Moreover, new boundaries may also emerge when new practices are co-constructed at the boundary of school and work. A work-based training unit that employs student-employees can be viewed as a “school practice” within the vocational practice, when the orientation shifts more towards learning than towards working. It may be interesting to explore whether such a training centre is indeed experienced as “school” by the stakeholders involved.

A potential limitation of our study might be that its specific contextual and explorative nature may limit the applicability of the findings to other educational contexts. Differences between (educational systems of) countries make it difficult to simply apply findings from educational

research studies from one country to the other. Nonetheless, since vocational education worldwide is based on more or less the same educational purposes and since such education calls for engagement between partners to provide experiences across educational and practice settings (Billett, 2011), findings are expected to be of interest to an international audience of researchers and practitioners.

With regards to the methods, our study illustrates that the exploration of considerations of a small, but purposefully selected, sample of representatives with ample experience can help to uncover relevant overarching themes (King et al., 2017), that may be of interest to other researchers. Moreover, the sample that we selected was heterogeneous enough to allow for insights across occupational fields and types of learning environments and homogenous enough to explore the perspective of representatives of work practice on co-constructing learning environments. All representatives are or have been involved in the co-construction of multiple learning environments. With the relative heterogeneity, we wanted to do justice to the fact that in different occupational fields, different views of school–work connectivity may be in place, for example, in the field of business and administration actors may have a less integrated view of vocational learning and teaching across practices (Sappa & Aprea, 2014). Such different views may affect the way learning environments are co-constructed. However, although participants were active in different occupational fields, the sample was relatively homogenous in terms of participants' background: all participants shared a background in learning and development and/or had ample experience with designing for learning in vocational practices. In addition, our focused study objectives and a semi-structured interview approach allowed us to distinguish overarching themes across the interviews (Hennink et al., 2017). Nevertheless, additional qualitative and quantitative studies from both perspectives would be useful to validate and supplement the findings.

Notwithstanding the limitations above, the present study adds to the body of knowledge about co-constructing learning environments at the school–work boundary by explicitly exploring the perspective of representatives of work practice. Thus, the present study contributes to mutual understanding between the practices, which is needed to support initiatives of co-construction and mine the learning potential of the school–work boundary. The insights presented in this study may be useful both for researchers who want to gain a deeper understanding of co-constructing vocational learning environments and for practitioners and experts who continuously strive to improve such learning environments to meet the demands of current-day society.

6

Conclusions and general discussion

6.1 Conclusions

The central aim of this thesis was to increase understanding of designing vocational learning environments at the school–work boundary. Four studies were conducted, focusing on learning environment designs at the school–work boundary and on design considerations of the actors involved in their construction, both from the world of school and the world of work. This final chapter synthesizes and discusses the conceptual and practical implications of the answer to the central research question of this thesis and reflects on the methodological issues of the executed studies.

The central question of this study was: How are learning environments at the school–work boundary designed in vocational education? To answer this question we examined (1) characteristics of learning environments at the school–work boundary, (2) empirical manifestations, (3) design considerations underpinning curriculum (re)design in vocational education, and (4) experiences of representatives of work practice when co-constructing learning environments at the school–work boundary.

This research illustrates that designing vocational curricula is a complex process in which many considerations need to be regarded. The findings offer deeper insights into the potential affordances of specific designable elements and into ways to exploit the learning potential of the school–work boundary in vocational education. Our findings show that learning environments can be characterised on the basis of three design rationales concerning the school–work connection: (I) alignment; (II) incorporation; and (III) hybridisation. Furthermore, our research illustrates that designable elements of learning environments can be approached from different perspectives: epistemic, spatial (physical and digital), instrumental, temporal, and social, and that specific elements can be used to develop learning environments in line with a chosen design rationale.

Empirical evidence of a variety of integrative learning environments served to confirm that in Dutch vocational education two types of integrative designs can be found: designs based on incorporation and designs based on hybridisation. We identified similarities and differences between the two categories of designs. Similarities across the integrative designs include the centrality of real-life work tasks, the use of boundary objects that facilitate communication between school and work, and the variety of roles that actors fulfil in a learning environment. Differences between the two types of integrative designs include a higher fidelity level of the occupational tasks in hybridisation designs, as well as a more evident use of peer-coaching, senior-junior roles, and role changes for actors.

In relation to the design considerations of learning environments at the school–work boundary, our findings illuminate that designers in vocational education base their design decisions on (implicit) design considerations at the strategic, tactical, and operational levels. Moreover, it became evident that a design decision about one of the designable elements and levels has consequences for decisions about other designable elements and levels, which supports the

need for constructive alignment between and within the levels and designable elements of a learning environment.

Our research further deepens understanding of the nature of discontinuities across the school–work boundary when co-constructing learning environments, and the strategies that are used to counterbalance these discontinuities. This study uncovered themes about the discontinuities experienced by work practice, which can be related to the designable elements of learning environments. The findings reveal design strategies at the interpersonal and institutional levels of the learning environment, that serve to counterbalance occurring discontinuities. Our research seems to confirm that work practice has a different orientation than school practice, with a stronger focus on productivity and on the quality of the services provided, but that various strategies for co-construction also seem to take into account the mutually beneficial learning potential of the school–work boundary.

6.2 Theoretical contributions

Conceptually, our research adds to the understanding of designing learning environments for vocational education. The studies in this thesis show that combining a boundary-crossing approach (based on the conceptualisation of boundary-crossing as presented by Akkerman & Bakker, 2011) with an analysis and design model (based on the Activity Centred Analysis and Design, or ACAD-framework, presented by Goodyear & Carvalho, 2014), contributes to increased comprehension of learning environment design. The presented insights in this thesis form a multilevel design framework for curriculum design in vocational education. This framework consists of considerations at the strategic, tactic, and operational level about the designable elements of the learning environment. Our research adds understanding of both the design *process*, that is, (co)construction of learning environments, and of the designed *product*, that is, different categories of learning environment designs and their designable elements. In this section, we elaborate on three main contributions of our research: the design rationale of the school–work connection, the multilevel nature of design considerations, and the possibilities for scene-setting with specific designable elements.

The design rationale of the school–work connection

In this thesis we explored the design features of vocational learning environments using a boundary-crossing lens (Akkerman & Bakker, 2012), leading to a categorisation of learning environment designs at the school–work boundary based on their design rationale. With this categorisation, our study adds to a stronger, both conceptually and empirically grounded, understanding of vocational learning environments. The categorisation is based on a thorough literature review of relevant scholarly work and is supported by other studies on ways to establish continuity between different contexts, namely a study on the continuity between in-school and out-of-school contexts (Bronkhorst & Akkerman, 2016) and a study on the enactment of relationships between universities and the working world (Tynjälä, 2008). Both studies present a similar categorisation concerning the connectivity between in-school and out-of-school contexts. However, Bronkhorst and Akkerman's review excludes work as out-of-

school context and Tynjälä's study does not take an explicit design approach, focusing mainly on pedagogical approaches to connect learners' experiences in both worlds. Our focus is instead on the learning environment design. Nonetheless, the similarities in the findings substantiate a categorisation based on the distinction between considering two contexts as separate contexts that can be connected, versus a view that more strongly promotes integration of two contexts.

The categorisation of learning environments based on their underlying design rationale has been shown to serve as a basis to study different manifestations of vocational learning environments. Rintala and Nokelainen (2020), for instance, used our categorisation to discuss the design rationale behind learning environments in Finland. Their study illustrates how school and the workplace can be viewed as two separate learning environments. In the studied context, contact days at school were organised to connect the experiences at the workplace with what students had learned at school, but it seemed that it was mostly left to the learner to align the experiences in both practices. A rationale based on incorporation is seen by the authors as a potentially fruitful way forward to enhance the connectivity between education and work. Similar findings are reported in a study on the Icelandic dual VET system (Eiríksdóttir, 2020), where school and work are perceived by the actors involved as "two parallel parts rather than a single coherent program" (Eiríksdóttir, 2020, p.14). The author states that an optimal system would instead guarantee regular communication and collaboration and encompass clearly assigned roles and responsibilities, to support learners with the integration of the experiences in each context. These recommendations are in line with our findings related to integrative learning environment designs and to co-construction, which point to similar interventions as strategies to counterbalance discontinuities at the school–work boundary.

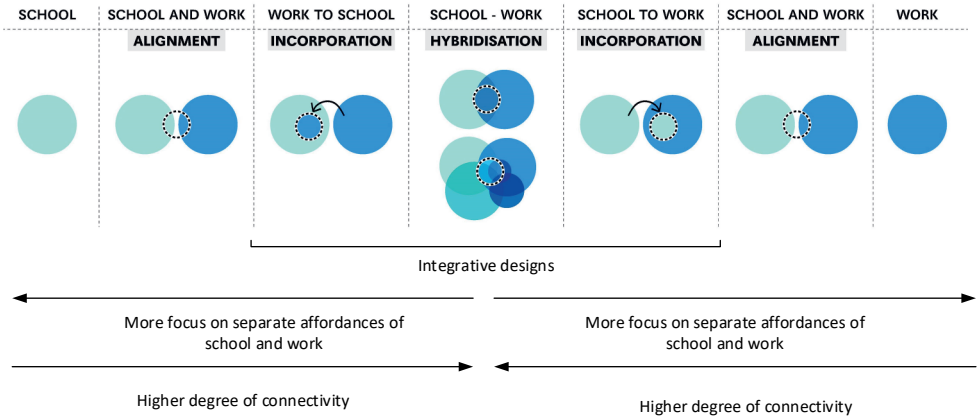
Another recent study, by Arts and Bronkhorst (2020), also refers to our categorisation and takes a boundary-crossing lens to study interventions in vocational education in part-time education. Creating a hybrid practice is presented in this study as one of the ways to support boundary-crossing, next to brokering, boundary objects, boundary interactions, and degrees of freedom (Arts & Bronkhorst, 2020). The authors focus on what they call "open-ended boundary-crossing support". Interestingly and in contrast to our study, Arts and Bronkhorst's study is not so much aimed at understanding the learning environment design as a whole, but focuses on learners' perception of concrete interventions, intended to support boundary-crossing. Nevertheless, their study seems to support the idea of deliberately choosing a specific design rationale for the construction of a learning environment at the school–work boundary, which is in line with our findings on the relevance of the design rationale of the school–work connection.

A kernel insight of our research is that the categorisation of learning environment based on their design rationale is useful to examine learning environments, even though the distinctions between the design categories are not clear-cut: the categorisation can be conceptualised as a

continuum of connectivity between school on the one side and work on the other side (see Figure 10).

Figure 10

The school work continuum: different degrees of connectivity



In vocational education learning environments will rarely be purely *school* or purely *work*. Most learning environments combine features of both worlds and this is done in different degrees of connectivity. Designs based on hybridisation can be seen as "lying in the middle" of the continuum since these designs combine objectives and characteristics from both ends of the spectrum. Contrary to the initial categorisation that emerged from the literature review, the continuum does not read from left to right as from low to high level of connectivity. Instead, school and work are represented as the ends of the continuum, to visualise the dynamics of learning environments: they can "move" more towards school or more towards work in terms of the rationale and matching designable features.

The continuum helps to visualise different degrees of connectivity. The designs based on alignment can be found at both ends of the continuum to make clear that a rationale based on alignment can be chosen with the aim to maximally exploit the affordances of both school as a separate practice, and of work as a separate practice. A learning environment based on such rationale may take school as a point of departure and opt for mainly school-based pathways with different degrees of work-based experiences (such as Dutch "BOL", the abbreviation of "beroepsopleidende leerweg"; Smulders et al. 2019) or work as a point of departure (such as dual programmes or Dutch "BBL", the abbreviation of "beroepsbegeleidende leerweg"), where students spend most of their time in an occupational setting, where they are also employed (Smulders et al., 2019). Such designs seem to fit when wishing to follow, for instance, Aarkrog's advice to regard school and the workplace as separate communities of practice, which each offer specific opportunities for learning (Aarkrog, 2005).

Institutions and universities for vocational education generally opt for a combination of learning environments in an educational programme. Sometimes relatively simple learning environments are developed at the start of the educational programme and more complex learning environments in the third or fourth year of programmes. Similar considerations can be found in recent scholarly work in the field of vocational education, where authors discuss curricula consisting of a variety of learning environments that are constructively aligned (Tynjälä et al., in press).

The school–work continuum presented in Figure 10 above is not the first continuum that is put forward to reflect upon vocational learning environments. Fuller and Unwin (2003) also presented a continuum related to vocational learning, specifically to learning opportunities at the workplace: they placed *restrictive learning* on one end of the continuum (narrow access to learning opportunities) and *expansive learning* on the other end of the continuum (ample access to learning opportunities in different practices, opportunities to cross the boundaries between these practices, support for the status as learners) (Fuller & Unwin, 2003). Fuller and Unwin's continuum may be suitable to assess the affordances of the workplace but seems to be rather normative. Our continuum, instead, is not meant as a normative guide, but as a conceptual lens that aims to capture the nature of the learning environment concerning the school–work connectivity. This lens can support educational researchers and educational designers to better understand the differences between the multiplicity of learning environments at the school–work boundary in vocational education and may help to configure curricula consisting of a variety of learning environments that are constructively aligned (Tynjälä et al., in press).

Multilevel design considerations

Previous research has provided principles for the design of vocational curricula. For instance, Cremers et al. (2016), presented principles underpinning the design of so-called "hybrid learning configurations": fostering authenticity, creating a learning community, utilizing diversity, inter-linking of working and learning, facilitating reflexivity, enabling organisation, and enabling ecology (Cremers et al., 2016). In a follow-up study (Cremers et al., 2017), these principles were tested by design teams: discussing the design principles was found to lead to an enhanced understanding of the learning environments involved, as well as to a shared image and inspiration for (re)design. However, some of the participants of this study indicated to prefer more direction as to *how* to design their hybrid learning configurations (Cremers, 2016, p. 118). It appears that the formulated principles mainly provided high-level conjectures, that is, a "theoretically principled idea of how to support some desired form of learning" (Sandoval, 2014, p. 22). Such conjectures still need to be articulated in concrete features of the design.

If we relate the design principles found in Cremer's study and Sandoval's definition of high-level conjectures to our study, it appears that the high-level conjectures correspond with our macro-level considerations, while what Sandoval refers to as "concrete embodiment"

corresponds with the designable elements at the meso and micro levels. Although Cremer's more abstract design principles may be helpful to discuss the *what* and the *why* of the learning environment design, our study adds to the why a focus on the design rationale concerning the school–work connection, and further adds specific and multilevel attention to *how* to realise a learning environment. If, for instance, a team of designers strives to "foster authenticity" and "interlink working and learning" (Cremers et al., 2016), our framework encourages designers to consider what this means for the tasks, the location, the artefacts, and so forth of the design. Our framework could also help to distinguish between the different levels of the design: what needs to be done at the macro/strategic level (e.g. structural agreements between stakeholders), at the meso/tactical level (e.g. searching for suitable spaces), and at the micro/operational level (e.g. setting concrete tasks for the learners).

Our study also serves to illustrate how a multilevel design framework can help to unravel the process of designing vocational learning environments. The multilevel approach to analysis and design of learning environments fits within a tradition of sociocultural research, focused on increasing understanding of the social reality at the different, mutually dependable, analytical levels (Layder, 2005). One might critique, however, the nature of the levels and the consistency of their use in this thesis. In the literature review, we used *macro* to refer to the level of a nation's educational system, in line with for example Van den Akker (2009) and Albashiry (2015). In our study on design considerations, we choose to instead use *macro* to refer to the strategic considerations regarding the school–work connection. These considerations depend on the "prerequisites" for cooperation, such as a legal framework, political intentions, and funding arrangements for vocational education, which can either hinder or enhance cooperation (Mulder, 2018). In line with Mulder (2018), we consider the meso and micro levels to be embedded in the macro level. The meso level, in our view, entails the tactical considerations about the practices and actors that need to be involved, the spaces, and the duration of the learning environment. The micro level in our framework is more specific and relates to operational considerations about concrete tasks, artefacts, temporal aspects of the interaction, and roles. This multilevel approach to the design of learning environments has led to additional understanding of the designable elements of learning environments.

Scene-setting with the epistemic, set, temporal and social design

Our research supports insights from previous scholarly work about the need for careful scene-setting and thorough preparation that is needed for invitational learning environments that are tailored to the stakeholder's needs (Billett, 2001), including both learners' needs and the needs of other stakeholders involved in the design. We adopted the Activity Centred Analysis and Design (ACAD) model, which distinguishes an epistemic design, a set design (including both spatial—physical and digital— and instrumental elements), and a social design (Carvalho & Goodyear, 2014), and added to this model a *temporal design*, to be able to explicitly address elements related to time (see also Zitter & Hoeve, 2012). Thus, we focused on the designable elements that shape the epistemic, physical/digital, temporal, and social setting in which activities emerge. These elements co-constitute a range of affordances for the learners

(Carvalho & Goodyear, 2014). We adopted the concept of *affordance* (Rietveld & Kiverstein, 2014) to indicate the latent potential of such designable elements to trigger learning. Moreover, based on the considerations of designers from vocational institutions, we enriched understanding of design for vocational education with a set of relevant design considerations at multiple levels. The overall design framework is intended to support the (re)design of learning environments, creating a suitable "scene" for the learners through careful attention to the epistemic design, the set design, the temporal design and the social design.

Epistemic design

Our findings seem to confirm findings from other scholars about supporting school–work connectivity through careful epistemic design. The considerations about real-life tasks match, for instance, with other researchers' recommendations to position the work context of the student as the starting point of the learning process (Arts & Bronkhorst, 2020; Zitter et al., 2016). Our findings also corroborate that designing suitable real-life tasks, with the right amount of complexity can be challenging (Kirschner & Van Merriënboer, 2008; Messmann & Mulder, 2015; Renta Davids et al., 2017; Veltman et al., 2019). Our study further adds to these insights a stronger focus on considerations about the selection of relevant practices from school and work.

Although the selection of relevant practices has been identified as a "key step in curriculum design" (Billett & Choy 2013), not much was known about relevant design considerations needed for this step. Our research adds comprehension of such design considerations, for instance, whether to include various schools (including perhaps both institutions for senior secondary education and universities of applied sciences), different business organisations (e.g. not only the patient, client, or problem owner, but also related businesses, such as suppliers of specific tools or products in the supply chain), or multiple professions in the design (e.g. by having learners collaborate in interprofessional teams to solve problems related to urban planning). Regarding this last aspect, our findings fit with studies about interprofessional education, particularly in healthcare, that underline the learning potential of combining different professions in the learning environment (Falk et al., 2013; Jacobsen et al., 2009; Nowak et al., 2016). The considerations regarding the exploitation of this potential largely coincide with the considerations that we found: in learning environments intended to support interprofessional learning, access to actors from different disciplines and professions is an important characteristic. An interprofessional learning environment for physiotherapy students, for example, may afford students access to nurses, doctors, physiotherapists, technicians, and other workers (Patton et al., 2013).

Our research further illuminates some of the recurring dilemmas that designers face when selecting suitable practices for collaboration. For instance, sometimes it is considered worthwhile to have learners participate in real-life practices, even when the possibilities to engage in relevant tasks are limited. In some real-life settings, learners are afforded limited possibilities to perform occupational tasks and need to avoid causing inconvenience for clients

or patients. Yet, such a setting can still be chosen to afford learners a setting in which they can become familiar with the "look and feel" of their future occupation.

Set design

Our study also illustrates that the "look and feel" of the vocation can be influenced by attending to the set design, that is, the physical and digital setting of the learning environment and the artefacts in these settings. Moreover, our studies confirm that careful attention seems to be paid to the selection of locations, spaces, and artefacts to influence learners' behaviour and support boundary-crossing. This matches with previous scholarly work about supporting boundary crossing (Arts & Bronkhorst, 2020). For instance, visits to other work settings' may be organised to afford learners the opportunity to work with less frequent cleaning machinery. Our findings also correspond with other insights into combining the advantages of school and work (Zitter et al., 2016), and into the influence of spaces and objects on the perceived affordances of a learning environment (Ellis & Goodyear, 2016; Young et al., 2019).

In line with these studies, our research highlights three ways in which artefacts may influence the activities within the learning environment. First, the fidelity of the learning environment can be increased by introducing professional artefacts, such as chefs' uniforms in the hospitality industry (Zitter et al., 2016). Second, artefacts can serve to contextualise school-based learning environments or support integration of school-subjects and professional tasks (see also Markauskaite & Goodyear, 2017), for example, by having learners in the domain of built environment contribute to building progress reports to activate their writing skills. Third, our findings substantiate that artefacts can function as boundary objects, supporting the connection between school and work practices and thus creating continuity for the learners. For instance, an oral healthcare plan can serve both to consult with the patient and the dentist and as monitoring tool for the educational programme. This last insight matches with other studies that advance the use of boundary objects (including e.g. digital applications and social media) to foster learning through boundary crossing (Akkerman & Bakker, 2011; Enochsson et al., 2020; Mårtensson, 2020; Veltman et al., 2019; Zitter et al., 2012).

Temporal design

Our research shows that temporal elements like timespan, time pressure, and schedules, can be purposefully designed. Influencing the temporal design is seen as useful to support specific tasks within the learning environment. For instance, by slowing down the work process learners can be allowed time to search for additional information, to ask for help, or to reflect upon how the task is being executed. These findings match with previous findings on the possibilities to either accelerate or slow down the work process (Zitter et al., 2016; Zitter & Hoeve, 2012). We also found that processes can be artificially "speeded up" for motivational purposes, for instance, to add excitement to the meetings between students and professionals.

Additionally, our findings add further insights into the multilevel nature of considerations regarding the temporal aspects of a learning environment. We uncovered, for instance,

considerations about stakeholders' interests concerning students' availability (or lack thereof) for seasonal work and special events, about the duration and sequence of learning environments within an educational programme, and about the time schedule within a learning environment. However, participants in our studies generally seemed less preoccupied with the temporal elements of the learning environment design than with other designable elements, such as tasks or roles. This is surprising, and may be due to participants feeling that they have less influence on these aspects due to the dependency on educational standards, frameworks, and guidelines. An alternative explanation might be that they have lesser expectations of the influence of temporal elements on the school–work connection. This would be in line with a recent study on perceptions of school–work integration, which found that the duration and sequencing of school- and work-based learning periods seemed to have a limited effect on perceived school–work integration (Eiríksdóttir, 2020).

Social design

First, a contribution of our research to knowledge about the social design, is that our findings show that the role-design can differ considerably between different learning environments: increasing levels of complexity were found. Especially learning environments based on hybridisation can include a large range of roles, diversified in terms of function and in terms of seniority, matching previous studies (Zitter & Hoeve, 2012). Our studies further enrich these insights by highlighting designers' considerations in this regard. Design considerations about the social design in vocational contexts seem to be largely based on the idea that specific vocational competences are best learned through contact with relevant target groups (e.g. customers or patients). This requires a social design that allows for safe interaction with such a target group. Furthermore, when learners work with real customers and patients, regular checks on the product and on the executions of the tasks may be needed, which may also imply higher coaching intensity (Oonk et al., 2016). The supervisor or coach may need to develop relevant expertise about how to guide students in these contexts to step in and help the learners when needed (Khaled et al., in press). Especially in designs based on hybridisation, it seems crucial to include actors in the learning environment who can take on the relevant professional role (e.g. an oral hygienist in the oral healthcare clinic).

A second contribution to the body of knowledge on the social design regards the insights into design considerations related to the formalisation of partnership agreements. These findings match with recent findings in the Norwegian context, that point to a need for closer, structural, and formalised cooperation between schools and workplaces to secure coherence between different parts of the educational programme (Aakernes, 2018). Our findings are also in line with previous scholarly work about multilevel boundary crossing (Akkerman & Bruining, 2016), about interactions between individuals from both practices (Berner, 2010; Mikkonen et al., 2017), and about collaborations at the institutional level (Aakernes, 2018; Coll et al., 2009; Flynn et al., 2016). It seems to matter who initiates the partnership and whether the focus of the learning environment lies more on learning or on working. However, we also concluded

that the interests of both school and work practices can be met simultaneously. Other scholars have found similar results, about new practices being developed that are recognised for learning as well as work (e.g. Choy et al., 2016).

A third contribution to the social design is that our research also substantiates findings on supporting the school–work connections through individuals fulfilling the role of brokers. Our literature review showed that educators can maintain membership in both school and work practices and support school–work connections in different types of learning environment designs. This fits with findings in recent scholarly work: brokers can support learners' boundary crossing by facilitating access to other stakeholders and by fostering learners' awareness of differences between practices (Veltman et al., 2019). Moreover, we found that brokers can strengthen collaborations between school and work practices. This matches with recent findings on brokers stimulating collaborations beyond the institutional boundaries (Oonk et al., 2020). However, our research showed that the school–work connection sometimes depends on too few actors fulfilling the role of a broker.

6.3 Reflection on the research approach

The findings presented in this thesis are encouraging in terms of characterising learning environments at the school–work boundary and of contributing to a deeper understanding of how these learning environments are designed. Our research design entailed that we used a stepwise approach to develop and validate a design framework for vocational education. Developing such frameworks is a crucial part of educational science. The presented design framework can be seen as an "ontological innovation" (Bannan, 2013): a categorisation emerged from the literature (chapter 2), which was validated through empirical research (chapters 3-5).

Throughout our research, we took care to purposefully select the literature to review, the cases to examine, and the participants for our focus groups and in-depth interviews. Such purposeful selection has the downside that data sources may have been excluded that could otherwise have further enriched our findings. For instance, concerning our literature review, our focus on English peer-reviewed literature and the use of English search terms entails that we may have missed studies from countries that use different terminology or that do not publish in English. However, the inclusion of studies from fifteen different countries and the richness of the data leads us to hypothesise that the categorisation that emerged from the international literature is relevant to analyse and describe learning environments in a large variety of countries.

Nonetheless, empirical validation with real-life learning environments only took place in the context of Dutch vocational education. This may limit the extent to which findings can be extrapolated to other countries since design considerations are likely to differ depending on the educational system in which the designers operate. For instance, the high degree of autonomy regarding curriculum design in the Netherlands (Thijs & Van den Akker, 2009) may

have consequences for designers' considerations. This high level of autonomy in the Netherlands contrasts with countries with a more centralized education system that allows minimal input from educators and institutions on the curriculum (Thijs & Van den Akker, 2009). Differences in the educational system are likely to impact the degree of autonomy at different levels of the design: while in the Netherlands educators may have a role both at the micro and at the meso levels of the design, including decisions at the tactical level, in many other countries their role might be limited to the micro-level, that is, the operational level of the design. We have enhanced the transferability of our findings by explaining both the more universal elements of vocational education and by giving explicit information about the Dutch educational context. Furthermore, our findings may also be partly independent of the specific educational context of the learning environments since they address the tension between the practices of school and work, which seems to be a universal feature of vocational education.

The purposeful sample of a variety of learning environments and of knowledgeable individuals from different occupational fields has helped us to reach conclusions across these fields (including for instance healthcare, built environment, and hospitality). However, it may be seen as a limitation that we did not zoom into particular design issues for each of the occupational fields, for example, issues related specifically to dental hygiene or to urban studies. Although on the one hand this abstraction may have the downside of providing few details on how to design learning environments in a specific occupational context, on the other hand, such an abstraction can also be seen as an advantage, since it allows practitioners to translate them to their specific context. Thus, the level of abstraction that we used to analyse learning environments designs implies that our findings are partly independent of the specific occupational field.

A kernel methodical challenge of our empirical research was to grasp design knowledge that is not easily accessible since it mostly remains implicit in the decisions that designers make and in the resulting educational designs (Edelson, 2002; Kirschner et al., 2002; Van den Akker, 2003). In response to this challenge, we chose an interpretive approach, which is seen as a suitable approach to grasp the subjective world of individuals "from within" (Cohen et al., 2011, p. 17) and to elicit perceptions and considerations that generally remain unarticulated and implicit (Cassell et al., 2014). However, although we have indeed managed to observe a large variety of design features and to elicit a range of design considerations of a purposefully selected group of participants, it is hard to determine whether we have been able to observe and elicit *all* relevant features and considerations. First, we cannot be certain that all relevant considerations were explicated by the people we interviewed. Some of the interviewees may have refrained from expressing their ideas due to group effects, social desirability responses, or feelings of uncertainty (Gawlik, 2017; Plummer-D'Amato, 2008b). Second, it may be that the considerations we were able to elicit are not representative of the average designer in Dutch vocational education. For instance, we may have attracted relatively more participants with an innovation-oriented stance. Third, the number of cases and participants was limited, which

may have negatively impacted the trustworthiness of the findings. To counterbalance such potential limitations, and in line with other interpretive studies in educational education (e.g. Coll et al., 2009), we took care to meet the quality criteria of credibility, transferability, dependability, and confirmability (Anney, 2014; Schwandt et al., 2007). For instance, we approached experts of designing for vocational education at several stages of our research, including the first stages of the research design (Stasik & Gendzwill, 2017). Other measures included peer-debriefing, data-triangulation, member checking, and the use of data gathering and analysis protocols.

In sum, we think that our research approach was fitting for the aim of the present study, namely to increase understanding of learning environment design in vocational education. We have succeeded in counterbalancing most of the potential threats to the trustworthiness of our research and in eliciting the most compelling features and considerations about designing learning environments at the school–work boundary. This is supported by the observation that our findings show consistency throughout several studies (i.e. the findings of the case study and interview studies match with findings from the literature review), and also seem to both be in line with, and to further extend the findings from other researchers in the context of vocational education (as discussed in 6.2).

6.4 Future studies

In line with the limitations that we highlighted above, our findings may be developed by further research. Comparative studies on learning environment designs in different occupational domains and in different countries, for instance, would allow for a deeper understanding of the influence of the context on the design. Ideally, such further studies would include stakeholders from a wider array of occupational fields, to improve understanding of the similarities and differences across these fields. Indeed, previous studies suggest that stakeholders from different occupational fields may have different perceptions of the school–work connectivity (e.g. Sappa & Aprea, 2014). Thus, it could be hypothesised that stakeholders from different occupational fields also have different perceptions of the *rationale* underpinning learning environment designs. Such different perceptions can be expected to influence how stakeholders act and which decisions they make regarding the design. Further insights into such mechanisms in different occupational fields would be useful to further inform the co-construction efforts.

Additionally, future studies could expand the insights presented in this thesis into school–work partnerships and co-construction of different types of learning environments. For instance, longitudinal studies could help to gain further understanding of how school–work partnerships develop over time and of the implications of this development for the co-construction process. Such longitudinal studies could build on the “transformation process” presented by Flynn et al. (2016). The authors found that applying boundary-crossing mechanisms can be helpful to co-produce industry-based curricula and they mapped a five-step transformation process from employing boundary-crossing mechanisms to fully co-producing industry-based curricula.

However, in its presented form Flynn et al.'s transformation process does not seem to take into account that different design solutions may result from long-term school–work cooperation. Adaptation and elaboration of the nature of the transformation process and of different forms of partnerships seem to be needed to thoroughly understand new forms of partnerships that go beyond "vendor-client relationships" between educational institutions and workplaces (Choy et al., 2016). Such future studies could also deepen insights into the dynamics of "extended teams" in vocational education. In extended teams, actors from school and actors from work are jointly responsible for the quality of education. Such teams seem to hold potential both for strengthening the school–work connection and for individual professional growth of the team members (Mazereeuw et al., 2016), but more knowledge is needed about how this potential can be best exploited for designers to make informed decisions about the learning environment design.

More knowledge is also needed about the inclusion of a wider array of practices in the learning environment configuration, besides *school* and *work*. Indeed, increasingly complex learning environment configurations seem to be needed for vocational education to meet current-day and future societal and environmental challenges. For instance, many learning environment configurations now include practice-based research. Nieuwenhuis et al. (2019) suggest a "triple helix model" consisting of education, innovation of practice, and practice-based research to design "learn-work environments" in which students from different educational programmes can do apprenticeships and/or their practice-based research. Another curriculum model that fits with the mission of including research practice in the vocational curricula is Fung's "connected curriculum model" (Fung, 2016), which also aims at affording learners active participation in research and inquiry. Other scholars seem to prefer a "quadruple helix model", adding a fourth stakeholder group, such as intermediate organisations as enablers of educational innovation, the users of the design (Arnkil et al., 2010), or the "wider community" (Kolehmainen et al., 2016). The insights presented in this thesis may be elaborated to more explicitly address the implications for the social design of including such different practices in different stages of the development and enactment of the curriculum.

Future studies may also be able to shed more light on the affordances of the set design of the learning environment. Access to specific spaces or tools may be considered as affordances since such access might incite learners to engage in activities that can trigger learning. In our thesis, we have provided a range of examples in this regard and we have explicated relevant design considerations. However, more studies are needed to deepen understanding of the relations between the affordances of the designable elements, the emerging activities within a learning environment, and the learning outcomes that result from these activities. For instance, current-day vocational education would welcome additional knowledge of how specific applications may support the school–work connection. Considering recent developments related to the COVID-19 crisis and the European Commissions' vision for high-quality, inclusive, and accessible digital education in Europe (European Commission, 2020),

more research on the specific affordances of the technological aspects of the learning environment is called for, to support decisions about the set design.

6.5 Practical implications

The presented insights provide a multilevel design framework to support design considerations for vocational curricula. This framework can be used by stakeholders engaged in the co-construction of vocational education to discuss and reflect on the design of learning environments. Our framework can help create a shared understanding for the (re)design of learning environments at different levels and in different phases of the design process.

The findings of our research have implications for policymakers and designers of vocational education who try to meet challenges related to curriculum design and development, such as contributing to regional development and innovation. These kinds of challenges require a balanced focus and consistency in the design of learning environments. The presented insights can support such a balanced focus, encouraging stakeholders to carefully consider the design rationale of a learning environment, the designable elements of the learning environment, and how these designable elements may best be aligned. For instance, to meet the aforementioned need for vocational education to contribute to regional development, a design based on hybridisation may be fitting, with an epistemic design that includes dealing with wicked problems (Veltman et al., 2019), and dealing with boundaries (Oonk et al., 2016).

At the strategic level, our design framework may support policy development and accountability by facilitating discussions on the ambitions concerning the school–work connection, and on ways to better meet such ambitions. Additionally, the presented design considerations can be used to evaluate learning environments (or a configuration of different, interrelated learning environments) and to support dialogue between educational management, designers, and learners in the learning environment, thus contributing to the constructive alignment of different learning environments in an educational programme (Tynjälä et al., in press). At the tactical level, the framework encourages considerations about the actors involved in the enactment of the learning environment, and what they may need to fulfil the roles that they are expected to fulfil. It may be needed, for instance, to organise support for the educators involved in the enactment. It is known that simply providing a thought-through design with a range of potential affordances for the educator, does not mean that educators will identify and use them in the way the designers have intended (Billett, 2001). Realising the full potential of a learning environment requires preparing and supporting educators to adapt their practices to leverage the opportunities provided (Young et al., 2019). Especially concerning the increased role diversity, tactical interventions seem to be called for to support educators for their new roles (Oonk et al., 2020). One such new role may be the role of a broker. Our research corroborates the importance and challenges of this role, illuminating potential threats for the sustainability of the learning environment when the school–work connection depends too much on but a few individuals that cross the school–work boundaries. Our framework can help to pinpoint such “weak spots” in the learning environment and to

develop strategies to compensate for them. At the operational level, the framework can help design teams to explicitly exchange ideas on different characteristics of the learning environment design and to carefully consider which specific designable elements (such as concrete tasks and artefacts) best fit with the decisions that are made at the other two levels, thus contributing to the coherence between the different levels of the design.

Our findings throughout this thesis underline that curriculum design in vocational education is a complex and multi-layered process. As a consequence, people engaged in the design process need to have an understanding of curriculum design for vocational education. The present thesis adds to such an understanding. We hope that our research will contribute to future-proof curriculum design and that the presented insights might be further developed by researchers and practitioners engaged in the study and design of vocational education, thus supporting the continuous improvement of learning environments at the school–work boundary.

Samenvatting
(Summary in Dutch)

Dit proefschrift, met de titel *Ontwerpen van leeromgevingen op de grens van school en werk*, beschrijft een promotieonderzoek naar hoe leeromgevingen op de grens van school en werk in het beroepsonderwijs worden vormgegeven. Het proefschrift begint met een algemene inleiding op het onderwerp en op het belang van het onderzoek, alsook een theoretische inkadering van het onderzoek (hoofdstuk 1).

Aanleiding voor het onderzoek is dat het beroepsonderwijs onder druk staat om onderwijs te ontwerpen dat voldoet aan veranderende maatschappelijke eisen. Deze eisen hebben te maken met de snelle technologische en maatschappelijke veranderingen en met verwachtingen van het onderwijs als onderdeel van een groter "ecosysteem", waarin steeds meer wordt samengewerkt met andere organisaties (OECD, 2019). Deze eisen en verwachtingen hebben invloed op de verbinding tussen *school* en *werk*. Dit zij twee aparte systemen, met ieder een eigen logica: de logica van leren en de logica van werken (De Bruijn et al., 2017b; De Bruijn & Westerhuis, 2016; Nieuwenhuis & Van Woerkom, 2007). Spanningen tussen deze systemen zijn inherent aan het beroepsonderwijs. Deze spanningen maken het uitdagend om leeromgevingen te ontwerpen die helpen om de twee werelden van school en werk met elkaar te verbinden (Wesselink & Zitter, 2017). Een optimaal curriculumontwerp kan bijdragen aan die verbinding en aan een betere ondersteuning van lerenden bij het omgaan met sociaal-culturele verschillen en met de frequente wisselingen van rollen en perspectieven op de grens van school en werk (Cremers et al., 2014; Veillard, 2012; Wesselink et al., 2010).

Om grip te krijgen op het ontwerpen van leeromgevingen op de grens van school en werk, gebruiken we in dit proefschrift een *boundary crossing*-lens. Deze lens houdt in dat de sociaal-culturele verschillen tussen school en werk die tot spanningen (of *discontinuïteiten*) leiden, worden opgevat als grenzen, en dat de school-werk transities worden opgevat als het overgaan van grenzen, als boundary crossing dus (Akkerman & Bakker, 2011; Bakker & Akkerman, 2014; Tuomi-Grohn et al., 2003). Het concept past bij een participatieve benadering van leren, waarbij lerenden door actief deel te nemen in een praktijk, geleidelijk ingroeien in die praktijk. Boundary crossing tussen praktijken kan bijdragen aan het leren doordat de vertrouwde ervaringen in de ene praktijk worden uitgedaagd door de ervaringen in de andere praktijk: lerenden worden gestimuleerd om ervaringen in verschillende praktijken met elkaar in verband te brengen en om te reflecteren over de overeenkomsten en verschillen tussen die praktijken (De Bruijn & Leeman, 2011; Schaap et al., 2012). In het beroepsonderwijs worden verschillende leeromgevingen ontworpen om boundary crossing van lerenden te faciliteren.

Een *leeromgeving* is de sociaal-culturele, fysieke en sociale omgeving waarin mensen kunnen leren (Goodyear, 2001). *Leren* zelf kan niet worden ontworpen, maar elementen van de situatie waarin wordt geleerd, kunnen wel worden ontworpen (Goodyear & Carvalho, 2014). Wij onderzoeken in dit proefschrift die elementen van leeromgevingen die doelgericht kunnen worden ontworpen. Deze zogenaamde *ontwerpbare elementen* (Ellis & Goodyear, 2016; Ellström et al., 2008; Zitter et al., 2012) zijn bedoeld om het leren te faciliteren. Wij gaan ervan uit dat taken, ruimtes, hulpmiddelen, actoren enzovoort, lerenden kunnen aanzetten tot

(leer)activiteiten. Een leeromgeving kan activiteiten ontlokken door een bepaalde fysieke vormgeving, bijvoorbeeld door de plek waar studenten werken aan opdrachten vanuit het bedrijfsleven in te richten als een kantoortuin. Activiteiten kunnen ook ontlokt worden door specifieke taken, bijvoorbeeld door studenten juridisch advies te laten geven aan burgers in een buurthuis, waardoor zij naar verwachting hun professionele rol als juridisch adviseur serieuzer gaan vervullen. Activiteiten worden daarbij gezien als *emergent* (Goodyear et al., 2014), dat wil zeggen dat activiteiten ontstaan in de situatie en niet van te voren heel precies kunnen worden bedacht en voorspeld. Deze activiteiten zijn wel epistemisch, fysiek/digitaal en sociaal gesitueerd. Dit betekent dat het ontstaan van activiteiten wordt bevorderd door inhoudelijke, fysieke en digitale kenmerken van de leeromgeving en door het sociale ontwerp van de leeromgeving (zoals de verdeling van rollen en verantwoordelijkheden tussen actoren van school en werk). Gezien het belang van kenmerken die te maken hebben met tijd, zoals moment in het opleidingsprogramma, duur, tijdsdruk enzovoort (Engeström, 2001; Zitter & Hoeve, 2012), nemen we ook de temporele elementen mee in de analyse.

Het onderzoek dat in dit proefschrift wordt beschreven is gericht op leeromgevingen op de grens van school en werk, dat wil zeggen leeromgevingen die op een of andere wijze de verbinding maken tussen de schoolcontext en de werkcontext. Daarbij onderzoeken wij zowel het ontwerp van de leeromgeving—het ontwerpproduct— als de afwegingen die nodig zijn om leeromgevingen te ontwerpen —het ontwerpproces (McKenney et al., 2015). Een groot deel van die afwegingen is impliciet (Kirschner et al., 2002). In tegenstelling tot het ontwerpen in andere disciplines, zoals technische disciplines, is het bij het ontwerpen van onderwijs namelijk niet gebruikelijk om alle stappen te expliciteren en systematisch vast te leggen (Edelson, 2002). De consequentie voor ons onderzoek is dat deels een *retrospectieve analyse* nodig is: door het gerealiseerde ontwerp te bestuderen (het product), krijgen we ook meer grip op het ontwerpproces (Edelson, 2002; Van den Akker, 2003). Bij dit onderzoek analyseren we de kenmerken van verschillende typen leeromgevingen zoals die voorkomen in het beroepsonderwijs. We analyseren dan het geïmplementeerde curriculum (*implemented curriculum*) met het doel om het ontwerp en het ontwerpproces beter te begrijpen en zo een concreter beeld te krijgen van het ontworpen curriculum, ook wel het bedoelde curriculum (*intended curriculum*) (Van den Akker, 2003). Om het ontwerpproces beter te begrijpen, onderzoeken we vervolgens de grotendeels impliciete ontwerpafwegingen die zijn gemaakt om de leeromgeving vorm te geven.

Kennis over het ontwerpen van leeromgevingen is schaars, zeker in het beroepsonderwijs. Hoewel sommige recente onderzoeken inzichten hebben opgeleverd over ontwerpprincipes voor een specifieke leeromgevingen (bijv. Cremers et al., 2016; Khaled et al., 2015; Veltman et al., 2019), is er weinig kennis over kenmerken en afwegingen die relevant zijn bij het ontwerpen van verschillende typen leeromgevingen op de grens van school en werk. De bestaande onderzoeken zijn bovendien moeilijk met elkaar in verband te brengen, omdat er een veelvoud aan termen wordt gebruikt om te verwijzen naar die verschillende typen

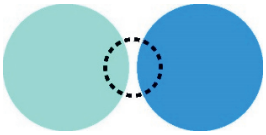
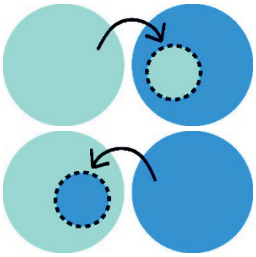
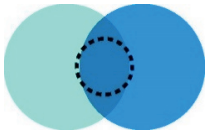
leeromgevingen. Dit vormt een belemmering bij het duiden en onderzoeken van leeromgevingen. Het is namelijk lastig om onderzoek te doen naar verschillen en overeenkomsten tussen leeromgevingen als er weinig kaders zijn voor het duiden, analyseren, beschrijven en ontwerpen van die leeromgevingen. Daarnaast is er in de huidige literatuur weinig bekend over co-constructie van leeromgevingen. Met co-constructie bedoelen we het gezamenlijk vormgeven, waarbij diverse belanghebbenden een rol hebben. Hoewel we weten dat het bij gezamenlijk ontwerpen belangrijk is dat alle belanghebbenden hun verwachtingen verhelderen (Voogt et al., 2019), wordt dit ook bemoeilijkt door het gebrek aan een gemeenschappelijke taal en een gedeeld beeld van verschillende typen leeromgevingen en hun specifieke kenmerken. Aangezien van onderwijsinstellingen in toenemende mate wordt verwacht dat ze buiten de eigen grenzen kijken en deel uitmaken van grotere “ecosystemen” (OECD, 2019), is meer kennis nodig over het gezamenlijk ontwerpen van leeromgevingen op de grens van school en werk.

De centrale vraag van dit onderzoek is: “Hoe worden leeromgevingen op de school-werkgrens in het beroepsonderwijs ontworpen?”. Om antwoord te vinden op de centrale onderzoeksvraag zijn vier deelstudies uitgevoerd. De eerste twee deelstudies richten zich op kenmerken van leeromgevingen vanuit de literatuur (deelstudie 1, hoofdstuk 2) en vanuit de onderwijspraktijk (deelstudie 2, hoofdstuk 3). De andere twee deelstudies richten zich op de ontwerpafwegingen (deelstudie 3, hoofdstuk 4) en op ontwerpstrategieën die worden gebruikt bij de co-constructie van leeromgevingen (deelstudie 4, hoofdstuk 5). Bij deze laatste twee studies is ontwerpkennis geëxpliciteerd van diverse experts die nauw betrokken zijn bij het ontwerpen van leeromgevingen, zowel vanuit het beroepsonderwijs (mbo en hbo), als vanuit de beroepspraktijk.

Hoofdstuk 2, *Kenmerken van leeromgevingen op de grens van school en werk* beantwoordt de eerste deelvraag: “Wat zijn de ontwerpkenmerken van leeromgevingen op de grens van school en werk in het beroepsonderwijs?” Het hoofdstuk bevat de resultaten van een systematisch literatuuronderzoek naar verschillende typen leeromgevingen op de grens van school en werk. Uit de literatuur kwamen drie categorieën leeromgevingen naar voren: ontwerpen gebaseerd op afstemming, ontwerpen gebaseerd op incorporatie en ontwerpen gebaseerd op hybridisering van de contexten van school en werk (zie Figuur 11).

Figuur 11

Drie ontwerp categorieën van leeromgevingen

Ontwerpen gebaseerd op afstemming	Ontwerpen gebaseerd op incorporatie	Ontwerpen gebaseerd op hybridisering
		

Bij *leeromgevingen gebaseerd op afstemming* bewegen lerenden heen en weer tussen de afzonderlijke contexten van school en werk. Gerichte (groeps)interventies zoals stagevoorbereiding, terugkomdagen en begeleidingsgesprekken zorgen voor de afstemming tussen de contexten. Bij l*eeromgevingen gebaseerd op incorporatie* wordt een deel van de schoolcontext geïncorporeerd in de werkcontext of andersom, een deel van de werkcontext wordt geïncorporeerd binnen de schoolcontext. Op school kunnen studenten bijvoorbeeld aspecten van het beroep oefenen in een meer gesimuleerde setting of in een meer geconstrueerde setting leren omgaan met echte klanten. Op het werk kunnen studenten *just-in-time* theorieonderwijs volgen of begeleid oefenen met beroepshandelingen. Bij *leeromgevingen gebaseerd op hybridisering* komen delen van de contexten van school en werk zodanig samen dat er een nieuwe praktijk ontstaat, met kenmerken van zowel school als de beroepspraktijk. Schoolgerichte en werkgerichte taken wisselen elkaar af en studenten krijgen te maken met alle verschillende aspecten van het werk. De drie categorieën worden uitgewerkt op basis van specifieke ontwerpbare elementen. Deze ontwerpbare elementen helpen om onderscheid te maken tussen leeromgevingen en om beslissingen te begrijpen die tijdens het ontwerp van het curriculum worden gemaakt. We concludeerden dat empirisch onderzoek nodig was om de gevonden inzichten verder te ontwikkelen. Daarom hebben we in deelstudie 2 (hoofdstuk 3) onderzoek gedaan naar de kenmerken van die leeromgevingen in de onderwijspraktijk.

In **hoofdstuk 3**, *Ontwerpbare elementen van integratieve leeromgevingen*, wordt de tweede deelvraag beantwoord: “Welke leeromgevingen zijn te onderscheiden in het beroepsonderwijs en wat zijn de specifieke ontwerpbare elementen van deze leeromgevingen?” Middels empirisch onderzoek zijn real life leeromgevingen onderzocht in het middelbaar beroepsonderwijs (mbo) en in het hoger beroepsonderwijs (hbo). We hebben zogenaamde

integratieve leeromgevingen uitgezocht, die kenmerken van school en werk integreren. Het doel van deze deelstudie was om manifestaties van twee categorieën van integratieve leeromgevingen te onderzoeken: ontwerpen gebaseerd op incorporatie en ontwerpen gebaseerd op hybridisering. Een meervoudige casestudie op basis van drie mbo- en drie hbo-cases leidde tot meer kennis over de ontwerpbare elementen van beide categorieën (zie Figuur 12).

Figuur 12

De zes cases van de casestudie

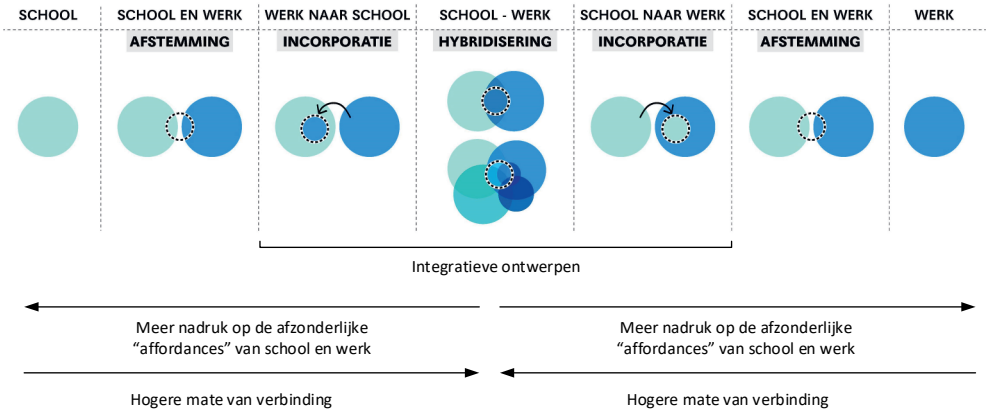
Dit leverde nieuwe inzichten op over de epistemische, ruimtelijke, instrumentele, temporele en sociale elementen van de cases. We hebben overeenkomsten en verschillen tussen de twee categorieën kunnen identificeren. Overeenkomsten zijn onder meer de centrale rol van echte beroepstaken (bijvoorbeeld het uitwerken van een advies voor echte burgers of bedrijven), het gebruik van grensobjecten die de communicatie tussen school en werk vergemakkelijken (zoals een mondzorgplan bij de mondzorgkliniek), en de verscheidenheid aan rollen die actoren in de leeromgeving kunnen vervullen (bijvoorbeeld verschillende rollen binnen een projectgroep). Verschillen zijn onder meer een hogere complexiteit van de beroepstaken in ontwerpen gebaseerd op hybridisering en een duidelijker gebruik van peer-coaching, senior- en juniorrollen en rolwisselingen. Deze deelstudie heeft inzichten opgeleverd over specifieke kenmerken van integratieve leeromgevingen en de verbanden tussen verschillende ontwerpbare elementen. Deze inzichten dragen bij aan een beter begrip van leeromgevingen die zijn ontworpen om de contexten van school en werk te verbinden. We kwamen tot de conclusie dat meer kennis nodig was over de afwegingen van de mensen die betrokken zijn bij het ontwerpen van leeromgevingen, om beter zicht te krijgen op de benodigde ontwerpkennis om leeromgevingen op de grens van school en werk vorm te geven. Onze derde deelstudie (hoofdstuk 4) richtte zich daarom op die ontwerpafwegingen.

Hoofdstuk 4, *Multilevel ontwerpafwegingen voor leeromgevingen op de grens van school en werk,* beantwoordt de volgende deelvraag: “Welke ontwerpafwegingen worden toegepast bij

het (her)ontwerpen van leeromgevingen op de grens van school en werk?" Doel was om ontwerpafwegingen aan het licht te brengen voor het ontwerpen van leeromgevingen in het beroepsonderwijs. Door middel van focusgroepen is met deze deelstudie impliciete ontwerpkennis van ontwerpers van beroepsonderwijs ontlokt. Deze kennis gaat over de ontwerpbare elementen van beroepsgerichte leeromgevingen, dat wil zeggen de epistemische, ruimtelijke (fysiek en digitaal), temporele en sociale elementen van de leeromgeving, die doelgericht kunnen worden ontworpen. We vonden afwegingen op elk van de niveaus van een curriculumontwerp: macro, meso en micro. Op macroniveau kwamen strategische afwegingen naar voren over de verbinding tussen school en werk. Op basis van deze afwegingen kunnen verschillende ontwerpen worden gekozen langs een continuüm tussen de twee contexten. Dat wil zeggen dat de contexten van school en van werk in meer of mindere mate met elkaar kunnen zijn verbonden (zie Figuur 13). Op mesoniveau vonden we tactische afwegingen, waarbij een tweede continuüm relevant bleek te zijn: de complexiteit in termen van praktijken die worden betrokken bij de leeromgeving. Leeromgevingen kunnen op deze schaal variëren van eenvoudig (één schoolpraktijk en één werkpraktijk) tot complex (meerdere schoolpraktijken en meerdere werkpraktijken). Op microniveau kwamen concrete operationele afwegingen naar voren waar ontwerpers rekening mee houden om de school-werkverbinding te versterken, zoals het gebruik van professionele werkkleding. Ook werd de noodzaak van coherentie tussen de ontwerpbare elementen op alle drie de niveaus duidelijk: de taken die lerenden op microniveau krijgen toegewezen moeten bijvoorbeeld overeenkomen met de strategie die op macroniveau is afgesproken. De resultaten van deze deelstudie dragen bij aan begrip over manieren om de verbinding tussen school en werk te verbeteren en om toekomstbestendige curricula voor beroepsonderwijs te ontwerpen.

Figuur 13

Het school-werk continuüm: mate van verbinding



In **hoofdstuk 5**, *Verkennen van co-constructie door de lens van de beroepspraktijk* worden de volgende vragen beantwoord: "Welke discontinuïteiten worden door de werkpraktijk ervaren

bij de co-constructie van leeromgevingen op de grens van school en werk, en welke strategieën worden toegepast om deze discontinuïteiten te compenseren?" Centraal staan de uitdagingen van de school-werksamenwerking, die in deze deelstudie zijn onderzocht vanuit het perspectief van de beroepspraktijk. Om helderheid te krijgen over die uitdagingen, hielden we diepte-interviews met vertegenwoordigers uit de beroepspraktijk. Uit die interviews kwam een verscheidenheid aan discontinuïteiten en ontwerpstrategieën naar voren die te maken hebben met de ontwerpbare elementen van een leeromgeving. Met de toegepaste ontwerpstrategieën wordt beoogd de continuïteit in acties en interacties te borgen. Zo zorgt structurele interactie en nabijheid van de actoren van school en werk ervoor dat de inhoud en de taken van de leeromgeving passen bij de eisen vanuit school en vanuit werk. Wederzijdse uitwisseling van expertise tussen actoren van beide contexten zorgt ervoor dat wat lerenden aangeboden krijgen actueel is en aansluit bij wat er speelt in de praktijk. Daarnaast blijkt uit de data dat ruimtes en instrumenten doelgericht worden geselecteerd, dat er duidelijke afspraken worden gemaakt over de inzetbaarheid en productiviteit van lerenden en over het faciliteren van *just-in-time* leren. Verder wordt gekeken naar welke extra praktijken bij de leeromgeving moeten worden betrokken, zoals bijvoorbeeld leveranciers van specifiek gereedschap of ander materiaal, zodat de lerenden met die artefacten in aanraking kunnen komen. Tenslotte kwamen ook ontwerpstrategieën naar voren die te maken hebben met het (her)ontwerpen van specifieke rollen, zoals zogenoemde "leermeesters" op verpleeglocaties, die zijn vrijgesteld van ander werk, zodat zij zicht volledig kunnen richten op het begeleiden van studenten. De resultaten laten zien dat de werkpraktijk een andere focus heeft dan de schoolpraktijk, met meer nadruk op productiviteit en op de kwaliteit van de geleverde diensten, maar dat diverse strategieën voor co-constructie ook specifiek gericht lijken te zijn op het leren.

In **hoofdstuk 6** gaan we in op de sterktes en zwaktes van het onderzoek, worden conclusies getrokken over de bijdrage van ons onderzoek aan de wetenschap en aan de praktijk van het beroepsonderwijs, en doen we suggesties voor vervolgonderzoek.

Sterktes en zwaktes van het onderzoek

De *bijdrage aan de wetenschap* van onze categorisering van leeromgevingen op basis van hun onderliggende ontwerp-rationale blijkt onder meer uit het feit dat deze categorisering wordt toegepast in ander onderzoek. Rintala en Nokelainen (2020), bijvoorbeeld, gebruikten onze categorisering om de ontwerp-rationale van leeromgevingen in Finland te analyseren. In hun publicatie beschrijven ze een op afstemming gebaseerde leeromgeving waarin school en werk worden beschouwd als twee aparte settingen. Contactdagen op school zijn er om de ervaringen op de werkplek te verbinden met het geleerde op school, maar studenten moeten grotendeels zelf de verbinding leggen tussen de ervaringen. Een op incorporatie gericht ontwerp zou volgens de auteurs de school-werkverbinding kunnen verbeteren. In een andere recente studie wordt naar onze categorisering verwezen bij het introduceren van een ontwerp gebaseerd op hybridisering om boundary crossing te ondersteunen (Arts & Bronkhorst, 2020).

De door ons gepresenteerde categorisering lijkt bij dit soort onderzoeken goed te kunnen worden gebruikt om kenmerken van de leeromgeving die wordt onderzocht te duiden.

Een andere bijdrage van ons onderzoek is het inzicht dat leeromgevingen in het beroepsonderwijs zelden puur *school* of puur *werk* lijken te zijn. De meeste leeromgevingen combineren elementen uit beide werelden en dit gebeurt in verschillende mate van verbinding. Ontwerpen gebaseerd op hybridisering kunnen worden gezien als “in het midden” van het continuüm (zie Figuur 13), aangezien deze ontwerpen doelstellingen en kenmerken van beide uiteinden van het spectrum combineren.

In tegenstelling tot de aanvankelijke categorisering die uit het literatuuronderzoek naar voren kwam, leest het continuüm niet van links naar rechts (van een lage naar een hoge mate van verbinding). In plaats daarvan worden school en werk voorgesteld als uiteinden van een continuüm, om de dynamiek van leeromgevingen zichtbaar te maken: leeromgevingen kunnen meer naar school of meer naar werk bewegen in termen van rationale en ontwerpbare elementen. Het continuüm helpt om die verschillende mate van verbinding te visualiseren.

Onze studie laat ook zien hoe een gelaagd ontwerpraamwerk kan helpen bij het ontrafelen van het ontwerpproces. De gelaagde benadering past binnen een traditie van sociaal-cultureel onderzoek, gericht op het vergroten van het begrip van de sociale werkelijkheid op verschillende, onderling afhankelijke, aggregatieniveaus. Deze benadering heeft geleid tot een beter begrip van de ontwerpbare elementen van leeromgevingen. Ons onderzoek ondersteunt daarmee inzichten uit eerder wetenschappelijk werk over de noodzaak van een zorgvuldige vormgeving en grondige voorbereiding die nodig zijn om leeromgevingen af te stemmen op de behoeften van verschillende belanghebbenden (Billett, 2001). Onze resultaten bevestigen inzichten uit eerder onderzoek over het verbinden van school en werk door een zorgvuldig inhoudelijk ontwerp, met nadrukkelijke aandacht voor de complexiteit van taken (Kirschner & Van Merriënboer, 2008; Messmann & Mulder, 2015; Renta Davids et al., 2017; Veltman et al., 2019).

De resultaten van ons onderzoek bevestigen daarnaast dat de “look and feel” van de leeromgeving kan worden beïnvloed door fysieke en digitale elementen. Ons onderzoek onthult afwegingen over de locaties, ruimtes en artefacten om de activiteiten van lerenden te beïnvloeden en boundary-crossing te ondersteunen. Onze resultaten sluiten aan bij eerdere onderzoeken over het combineren van elementen van school en werk en over de invloed van ruimtes en objecten op hoe de leeromgeving wordt ervaren. Zo lieten andere onderzoeken al zien dat boundary-crossing wordt bevorderd door bijvoorbeeld excursies (Arts & Bronkhorst, 2020), door de fysieke vormgeving van de leeromgeving (Ellis & Goodyear, 2016; Young et al. , 2019), en door het combineren van kenmerken van school en werk in hybride curricula (Zitter et al., 2016). Artefacten kunnen daarbij worden ingezet om de ervaren authenticiteit van de leeromgeving te versterken (Zitter et al., 2016), om de integratie van schoolvakken en beroepstaken te ondersteunen (Markauskaite & Goodyear, 2017), en om als grensobject de

verbinding tussen school en werk vergemakkelijken (Akkerman & Bakker, 2011; Enochsson et al., 2020; Mårtensson, 2020; Veltman et al., 2019; Zitter et al., 2012). Toekomstig onderzoek zou meer licht werpen op de *affordances* van de leeromgeving, bijvoorbeeld over hoe specifieke ICT-toepassingen de verbinding tussen school en werk kunnen ondersteunen. Gezien de recente COVID-19-crisis en de visie van de Europese Commissie voor hoogwaardig, inclusief en toegankelijk digitaal onderwijs in Europa (Europese Commissie, 2020), is meer onderzoek nodig naar de affordances van digitale elementen om gefundeerde beslissingen te nemen over de vormgeving van de (digitale) leeromgeving.

Een methodologische uitdaging van ons onderzoek was om grip te krijgen op ontwerpkennis die niet gemakkelijk toegankelijk is, omdat deze kennis voor een groot deel impliciet blijft in de beslissingen die ontwerpers nemen en in de resulterende ontwerpen. Om deze reden hebben we een interpretatieve benadering gekozen voor onze empirische studies. Deze benadering wordt gezien als geschikt om de subjectieve wereld van individuen “van binnenuit” te begrijpen en om afwegingen te laten expliciteren, die over het algemeen onuitgesproken en impliciet blijven (Cassell et al., 2014; Cohen et al., 2011). Hoewel we er inderdaad in zijn geslaagd om een grote verscheidenheid aan ontwerpafwegingen expliciet te maken, kunnen we niet uitsluiten dat sommige geïnterviewden zijn beïnvloed door groepseffecten, of sociaal wenselijke antwoorden hebben gegeven (Gawlik, 2017; Plummer-D’Amato, 2008b). Om deze potentiële zwaktes van het onderzoek te compenseren, hebben we in verschillende fases van het onderzoek experts betrokken en gebruik gemaakt van technieken als peer-debriefing, data-triangulatie, en memberchecks. Daarnaast hebben we steeds gewerkt met uitgebreide protocollen voor dataverzameling en analyse.

Een andere mogelijke zwakte van het onderzoek is dat de data voor ons onderzoek grotendeels in de context van het beroepsonderwijs in Nederland zijn verzameld (op het literatuuronderzoek na) en dat het aantal cases en deelnemers in ons onderzoek beperkt was. Dit kan van invloed zijn op de betrouwbaarheid van de resultaten. Wij denken echter dat de resultaten ook voor veel andere landen relevant zijn, aangezien deze voor een groot deel gaan over de deels universele spanning tussen school en werk. Bovendien zijn we bij de selectie van cases en deelnemers steeds doelgericht te werk gegaan: we hebben steeds twee onderwijsniveaus betrokken (mbo en hbo) en een verscheidenheid aan werkvelden. De resultaten zullen daardoor naar verwachting relevant zijn voor diverse contexten. Desondanks zou het zinvol zijn om vergelijkende onderzoeken te doen waarin wordt gekeken naar het ontwerpen van leeromgevingen in verschillende landen, in verschillende beroepsdomeinen en op verschillende niveaus. Dit zou bijdragen aan beter inzicht in de overeenkomsten en verschillen tussen de contexten.

Vervolgonderzoek zou ook kunnen dienen ter uitbreiding van de inzichten over verschillende categorieën van leeromgevingen en hun implicaties voor school-werkpartnerschappen. Longitudinaal onderzoek zou bijvoorbeeld kunnen helpen om de dynamiek van het ontwerpproces beter te begrijpen. Het gaat dan om hoe de school-werkverbinding zich in de

loop van de tijd ontwikkelt en wat dit betekent voor de soorten leeromgevingen die gezamenlijk worden geconstrueerd. Kennis over nieuwe samenwerkingsvormen lijkt ook nodig vanwege de toenemende druk op het beroepsonderwijs om bij te dragen aan de hedendaagse maatschappelijke en klimatologische uitdagingen. Hierdoor is het vaak nodig om aanvullende praktijken te betrekken, behalve *school* en *werk*, zoals bijvoorbeeld de onderzoekspraktijk (zie o.a. Nieuwenhuis et al., 2019 over praktijkgericht onderzoek).

Praktische implicaties

De inzichten in dit proefschrift vormen een gelaagd ontwerpraamwerk dat het vormgeven van beroepsopleidingen kan ondersteunen. Dit raamwerk kan worden gebruikt door belanghebbenden die betrokken zijn bij de co-constructie van beroepsonderwijs. Zij kunnen op basis van het raamwerk het ontwerp van toekomstige leeromgevingen bespreken en reflecteren op reeds gerealiseerde leeromgevingen en hoe deze eventueel te verbeteren. Ons raamwerk kan helpen om een gedeeld beeld te creëren in verschillende fasen van het ontwerpproces en op verschillende niveaus:

- Op macro/strategisch niveau kunnen beleidsmakers en ontwerpers van beroepsonderwijs de resultaten gebruiken om in te spelen op hedendaagse verwachtingen over het onderwijs, bijvoorbeeld dat beroepsonderwijs bijdraagt aan regionale ontwikkeling en innovatie. Dit soort uitdagingen vereisen een evenwichtige focus en consistentie bij het ontwerp van leeromgevingen. De uitkomsten van het onderzoek moedigen partijen aan om op meerdere niveaus na te denken over de ontwerp-rationale van een leeromgeving, de ontwerpbare elementen van de leeromgeving, en hoe deze ontwerpbare elementen op elkaar kunnen worden afgestemd.
- Op meso/tactisch niveau betekent dit dat er nagedacht wordt over wie er betrokken moeten worden bij de leeromgeving en over wat die actoren nodig hebben om hun rollen te vervullen.
- Op micro/operationeel niveau kan het raamwerk ontwerpteams helpen om expliciet ideeën uit te wisselen over verschillende kenmerken van de leeromgevingen en af te wegen welke specifieke ontwerpbare elementen (zoals concrete taken en artefacten) passen bij beslissingen die op de andere twee niveaus worden genomen. Dit draagt bij aan de consistentie tussen de verschillende niveaus van het ontwerp.

De resultaten in dit proefschrift onderstrepen dat het ontwerpen van curricula in het beroepsonderwijs een complex en gelaagd proces is. Het is daarom belangrijk dat mensen die betrokken zijn bij het ontwerpproces houvast hebben. Het huidige proefschrift draagt bij aan die houvast. Wij hopen dat de inzichten die wij hebben gepresenteerd verder worden ontwikkeld door zowel onderzoekers als *practitioners* in het beroepsonderwijs, zodat lerenden steeds beter ondersteund kunnen worden bij het boundary crossen tussen school en werk.

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Appendices

Table 15

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 & 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, Ten Dam, Wardekker, & Volman (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, Wals, Wesselink, & Mulder (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

	Short citation	Country (ISO code)	Field	Research design	Central concept or learning environment	Design category
7	Falk, Hult, Hammar, Hopwood, & Dahlgren (2013)	SE	Healthcare	Survey design based in a single institution with 454 students from different disciplines.	Interprofessional training ward	3
8	Farnsworth & 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, Pillay & Watters (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 & Singh (2009)	AU	n/a	Case study methodology with 21 educational leaders.	'Contextualised learning' and boundary crossing among	2

	Short citation	Country (ISO code)	Field	Research design	Central concept or learning environment	Design category
					education, training and work systems	
13	Harris, Willis, Simons, & Collins (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, Fink, Marcussen, Larsen, & BæK Hansen (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

	Short citation	Country (ISO code)	Field	Research design	Central concept or learning environment	Design category
18	Kessels & 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
20	Lippke & Wegener (2014)	DK	Technology, Healthcare	Qualitative design based on two ethnographic field studies.	Boundary-pushing in school-based setting	2
21	Lynch, Ash, & Chadwick (2010)	UK	Healthcare	Analysis of student perspectives and opinions based on surveys completed by 257 dental students.	Outreach teaching unit	3
22	Makovec-Radovan & 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, Burke, & O'Sullivan (2010)	IE	Healthcare	Survey-study with questionnaires completed by 142 dental graduates .	Vocational dental training	1-3
24	Messmann & Mulder (2015)	DE	Technology	Survey with questionnaires completed by 70 apprentices.	School–work alignment	1

	Short citation	Country (ISO code)	Field	Research design	Central concept or learning environment	Design category
25	Nowak, Klimke-Jung, Schäfer, & Reif (2016)	DE	Healthcare	Qualitative analysis of process data and learning results of 164 students from different professional programmes.	Interprofessional training programme	2
26	Onstenk & 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, Higgs, & Smith (2013)	AU	Healthcare	Exploration of learning theories underpinning physiotherapy clinical education	Clinical learning experiences in physiotherapy	3
28	Pineda-Herrero, Quesada-Pallarès, Espona-Barcons, & Mas-Torelló (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, Reenalda, Nijhof, & Nieuwenhuis (2014)	NL	Healthcare, Agriculture, Business, Technology, Society	Qualitative multiple case study with seven cases.	Workplace learning in dual training programmes	1

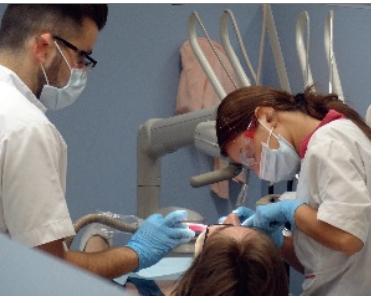
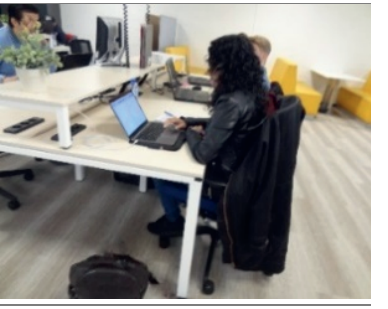
	Short citation	Country (ISO code)	Field	Research design	Central concept or learning environment	Design category
			& Human behaviour, Education, Language & Culture.			
30	Sappa & Aprea (2014)	CH	Industry, Business & Administration	Phenomenogra-phic study with a total of 26 vocational school teachers, company trainers and apprentices.	Conceptions of learning and teaching across different learning sites	1-3
31	Schaap, Baartman, & De Bruijn (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 & 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 programme at three sites: school, training centre and worksite.	1-3
34	Tennant & 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

	Short citation	Country (ISO code)	Field	Research design	Central concept or learning environment	Design category
36	Van Schaik, Van Oers, & Terwel (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, Tynjälä, & Eteläpelto (2014)	FI	Social services & Healthcare, Technology & Transport	Internet questionnaire, completed by 1603 final-year vocational students.	Workplace learning	1
39	Watts & 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, Hoeve & De Bruijn (2016)	NL	Hospitality	In-depth descriptive, embedded, single-case study of a distinctive curriculum innovation.	Hybrid VET-curriculum / educational innovation project	3

Table 16

Epistemic elements

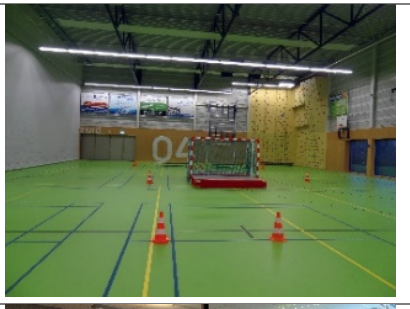
Design category	Case	Task characteristics and task arrangement	
Incorporation	Sport & Recreation	Characteristics: individual, low-risk tasks related to day-to-day operation of a sport and leisure centre, for example, preparing sandwiches Arrangement: different tasks in various work settings	
	Agriculture	Characteristics: collective, low-risk problem-solving tasks related to dairy cow management, for example, grass pasture issues Arrangement: project tasks in one time project	

Design category	Case	Task characteristics and task arrangement	
	Urban Studies	Characteristics: collective, low-risk problem-solving tasks to solve issues surrounding urbanisation and planning, for example, how to increase experienced safety in a neighbourhood Arrangement: different tasks in four projects	
Hybridisation	Oral Healthcare	Characteristics: wide range of individual and collective tasks, varying from relatively simple tasks (e.g. advise about oral care) to high-risk tasks (e.g. caries treatment) All tasks are related to preventive oral care Tasks include senior/managerial tasks Arrangement: core tasks in varied degrees of difficulty over a two year period	
	ICT & Media	Characteristics: wide range of individual and collective, medium-risk tasks, related to the production of ICT and media applications Tasks include project tasks and senior/managerial tasks Arrangement: a variety of project tasks over a three year period	

Design category	Case	Task characteristics and task arrangement	
	Legal Consultancy	Characteristics: individual and collective, ranging from relatively simple (e.g. administrative tasks) to medium-risk All tasks are related to legal advice to clients Tasks include senior/managerial tasks Arrangement: different arrangements, depending on the duration of the stay in the learning environment	

Table 17

Spatial and instrumental elements

Design category	Case	Spatial and instrumental elements		
		Location & Spaces		Tools & artefacts
Incorporation	Sport & Recreation	Location: a range of work-locations Spaces: workspaces (e.g. office, cafeteria) and sporting facilities (e.g. swimming pool) No digital space		Work-artefacts like sporting equipment, cleaning tools and so forth No specific school-artefacts Main boundary object: qualification file
	Agriculture	Location: different school-locations (at secondary and higher professional institutions) and one-time visit to work location (client's farm) Spaces: classrooms with school furniture Digital space to hand-in assignment		School-artefacts like classroom facilities No specific work-artefacts Main boundary object: clients' assignments and final report

Design category	Case		Spatial and instrumental elements	
	Urban Studies	Location: school and occasionally a work location (visit to clients' company) Spaces: specially furnished 'lab' where meetings can be held; regular classrooms and workspaces for students Digital space with project information		Mainly school-artefacts Some work artefacts in 'lab', for example, meeting room facilities Professional software Main boundary objects: client quotation and final report
Hybridisation	Oral Healthcare	Location: school Spaces: specially furnished clinic with adjoining functional spaces for work tasks (e.g. radiology) and small classrooms for meetings and clinical lessons Digital space with client information and knowledge database		Work artefacts, for example, clinical instruments and patient questionnaires School artefacts, (e.g. digital handbook and students' portfolio) Main boundary object: client files

Design category	Case	Spatial and instrumental elements		
	ICT & Media	Location: school and occasional fieldtrips to for example, an IT fair Spaces: school-department furnished as an office, with some meeting spaces to meet clients and a separate classroom for instruction Digital space with all work-formats		Work and school artefacts, for example, software applications and work templates Main boundary object: client quotation and produced products
	Legal Consultancy	Location: school and several work-locations Spaces: school-department furnished as an office Offices in several neighbourhoods where consultation hours are held Digital spaces to monitor work process and download work formats		Work and school artefacts are found at all locations, for example, office equipment, digital portfolio and legal reference tools Main boundary object: written legal advice for the client

Table 18

Temporal elements

Design category	Case	Temporal elements			
		Timespan & intensity	Time schedule	Work pace	Work process interruptions
Incorporation	Sport & Recreation	In first year One year Half-day per week	Fixed weekday Daily schedule based on regular working hours, aligned with the work-location Collective student breaks at set times	Regular work pace of a workplace	Possible, but rare
	Agriculture	In third year One year Half-day per week	Fixed weekday to facilitate project group meetings and coach-consultation Project group decides on duration of meetings and breaks	Regular work pace of the school Time pressure added during expert-consultation round halfway the project	Spontaneous interruptions to consult with peers or coaches
	Urban Studies	In second year One year Two days per week	Fixed weekdays to facilitate project group meetings and coach-consultation	Regular work pace of the school	Spontaneous interruptions to consult with peers or coaches

Design category	Case	Temporal elements			
			Project group decides on duration of meetings and breaks		
Hybridisation	Oral Healthcare	In second year Two and a half years Two to four half-day shifts	Fixed weekdays Daily schedule similar to work-shifts in external oral healthcare practices	Slower work pace than in regular oral healthcare practices in terms of patients per shift	Planned interruptions to monitor progress Spontaneous interruptions to consult with peers or coaches
	ICT & Media	From 2nd year Two years Three to four days per week	Fixed weekdays Daily schedule based on office hours Collective breaks at set times	Work pace based on time-boxed four-week periods	Spontaneous interruptions to consult with peers or coaches
	Legal Consultancy	In second, third or fourth year From 56 hours to one year From a few hours per week to fulltime	Fixed weekdays Daily schedule based on office hours and fixed consultation hours in the neighbourhoods Team-agreements about for example, telephone manning and breaks	Work pace slower than in regular legal consultancy firms	Planned interruptions to monitor progress Spontaneous interruptions to consult with peers or coaches

Table 19

Social elements (1)

Design category	Case	Actors	Roles
Incorporation	Sport & Recreation	Teachers	Coach, assessor, coordinator, expert
		Students	Assistant, junior colleague, (peer-) learner
		Work field professionals (bar staff, cleaning staff, sport instructors)	Workplace supervisor, sr. colleague
		Citizens	Client of a sport & leisure centre
	Agriculture	Teachers (3 institutions)	Coach, assessor, expert
		Students (2 levels)	Project member, project leader, (peer-) learner
		Work field professionals (farmers, agricultural entrepreneurs)	External coordinator, client / problem owner, expert
	Urban Studies	Teachers	Coach, assessor, coordinator, expert
		Students	Project member, project leader, (peer-) learner
		Work field professionals (urban development stakeholders)	Client / problem owner of an urban development issue
		Occasionally: citizens	Research participants
Hybridisation	Oral Healthcare	Teachers	Coach, assessor, coordinator, expert, workplace supervisor, sr. colleague, coordinator, oral hygienist, dentist, radiologist
		Students	Oral hygienist, co-hygienist, colleague (jr. and sr.), (peer-) learner, patient, (peer-) coach, managerial roles
		Sterilisation assistants	Coach, colleague, workplace supervisor

Design category	Case	Actors	Roles
		Work field professionals (dentist)	Patients' dentist (external), with whom the students-oral hygienists have to consult
		Receptionist	Colleague
		Citizens	Oral healthcare patient
	ICT & Media	Teachers	Coach, assessor, coordinator, expert, workplace supervisor, sr. colleague
		Students	Project member, colleague (jr. and sr.), project leader, (peer-) learner, managerial roles
		Floor manager	Coach, coordinator
		Work field professionals (entrepreneurs)	Client / Problem owner, expert
	Legal Consultancy	Teachers	Coach, assessor, coordinator, expert, workplace supervisor, sr. colleague
		Students (from several programmes)	Legal advisor, colleague (jr. and sr.), volunteer, (peer-) learner, expert, managerial roles, (peer-) coach
		Work field professionals (legal aid and social work organisations, law firms, housing corporations)	Client / Problem owner, chain partner, expert
		Citizens	Clients seeking legal advice

Table 20

Social elements (2)

Design category	Case	Grouping	Division of labour
Incorporation	Sport & Recreation	Dyads or triads, supervised by workplace supervisor c. 12 students per teacher-coach	Task allocation and division by teacher, in consultation with workplace supervisor No changes in horizontal/vertical role of students
	Agriculture	Project groups with 1 higher professional education student and 3-4 secondary vocational education students 8-15 students per coach	Project-allocation by teachers Task division by students in project group Fixed horizontal and vertical roles in project group, with higher professional education student as project leader
	Urban Studies	Project groups of 4 to 5 students from different disciplines 16-20 students per teacher-coach	Project-allocation by teachers Task division by students in project-group meetings led by student-project leader Change of horizontal and vertical roles of students through different projects
Hybridisation	Oral Healthcare	Dyads c. 12 students per teacher-coach	Patient-allocation by experienced students in managerial roles, supported by teacher-supervisor Task-division during start-up meetings, led by teacher-supervisor or student-coach Horizontal and vertical role changes of students
	ICT & Media	Project groups of 4 to 5 students c. 6 teams (30 students) per teacher-coach	Project-allocation by students in managerial roles, supported by teacher-supervisor Task-division by students

Design category	Case	Grouping	Division of labour
			Horizontal and vertical role changes of students
	Legal Consultancy	Students work both alone, in dyads and as a team c. 10 students per teacher-coach	Task- and client-allocation discussed in team-meetings with students and teacher- supervisor Task-division by student and teacher-supervisor Horizontal and vertical role changes of students

Table 21 *Themes and quotes related to discontinuities*

Designable elements	Themes	References	Sources	I1	I2	I3	I4	I5	I6	I7	Quotes used in the manuscript
Epistemic	Relevancy of work tasks and content	7	3	X	X					**X**	I understand that school wants them to do something, but sometimes they do not look at wat they [the students] show in practice (…) So we should be consulted more often about these things, for example, what do we find useful in professional practice? **(i7)**
	Unseized potential	4	2					**X**		X	We could work together every semester. That could be more fun and interesting for the mechanics teacher. But the higher education teachers seem to see this as a change, extra work. They would have to adapt the programme they have been running for 10 or 15 years to fit in, in this case, an aqueduct. That may be an extra effort for them, while they don't see the added value. **(i5)**

Designable elements	Themes	References	Sources	I1	I2	I3	I4	I5	I6	I7	Quotes used in the manuscript
Spatial & instrumental	Suitability of spaces	6	3		**X**		X	X			And we don't have the right type of classroom (…). It is actually just like here (…), neighbourhood residents, volunteers and children from school care walk around. And that is bothersome if you want to give a practical lesson. **(i2)**
	Relevancy of tools and instruments	3	3			**X**	X			X	You sometimes see that in retail: they build a shop in a school. Then they have an archaic cash register there. Or they [students] still have to check the stock using a pen and paper, which never happens in practice anymore. So as soon as they [the school] have actually linked that practice to it, it is immediately outdated. **(i3)**

Designable elements	Themes	References	Sources	I1	I2	I3	I4	I5	I6	I7	Quotes used in the manuscript
Temporal	Different schedules	2	2			**X**			X		It has to be done very quickly, but at fixed times. It has to be that Friday and that Wednesday and Tuesday, because it is scheduled on those days. I mean: there's no flexibility in the schedules. **(i3)**
	Different planning horizons	4	3	**X**		X	X				They work per school period and then, really, two weeks before the next period starts, they request if our regional trainer can be made available for two half-days a week. We are used to planning and organizing such things much longer ahead. **(i1)**
	Productivity	5	4	X	X		**X**			X	That is really annoying for us because it means that they can work less in practice, they are less productive, and well, that must be budgeted differently. And since they inform us last minute, I cannot change the planning on time. **(i4)**

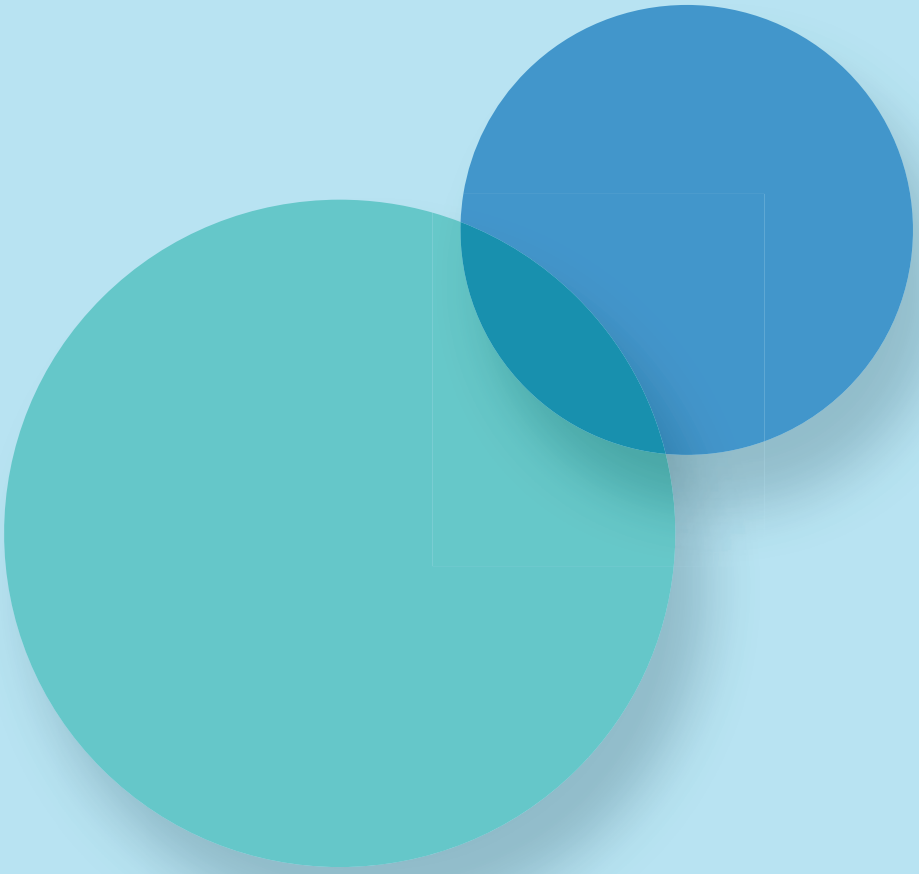
Designable elements	Themes	References	Sources	I1	I2	I3	I4	I5	I6	I7	Quotes used in the manuscript
Social elements	Availability of actors	4	3		**X**		X			X	And we noticed that that group was too big, and we had to step in, while it should be the vocational teacher, who is prepared for this task... So then we no longer had a win-win situation. **(i2)**
	Role performance	3	2	**X**		X					We have a number of contact persons within [name of educational institution], who are very positive and very enthusiastic, but the people behind them are sometimes sceptical, they wait and see. There are pioneers who take a lot of effort and are very enthusiastic and think along very well (…), but then, when they have to pass it on to others, it becomes difficult. **(i1)**
	Role conflicts	3	2				**X**			X	Workplace supervisors really experience that as a split. On the one hand they really want to supervise the student, they want to take time for that, they think that the student deserves it and that they are training a good colleague for the future. But when there are sick people and there is no one attending to your patient, what then? **(i4)**

Table 22 *Themes and quotes related to strategies*

Designable elements	Themes	References	Sources	I1	I2	I3	I4	I5	I6	I7	Quotes used in the manuscript
Epistemic	Structural interactions and proximity between actors	15	4	X	**X**		X			X	And I have also proposed that, and we do now, to structurally organise a consultation moment every 14 days. **(i2)**
	Reciprocal exchange of expertise	14	6	**X**		X	X	X	X	X	What we started with, is to give VET teachers the basic vocational training (…) Then they noticed that their knowledge was outdated. **(i1)**
	Affording different work settings	10	4	X		X	**X**			X	home care in [name of big town] is very different than homecare in a small village (…) so they learn to work with customers from different backgrounds and with teams from different backgrounds. **(i4)**
Spatial & instrumen-tal	Purposeful selection of spaces and artefacts	19	7	X	X	X	X	X	**X**	X	We [the company] set up a lab together with a VET institution, not with the equipment that was left over from the company 20 years ago (….), but with the equipment that was current at the time. **(i6)**

Designable elements	Themes	References	Sources	I1	I2	I3	I4	I5	I6	I7	Quotes used in the manuscript
Temporal	Agree upon actors' expected productivity	6	3				**X**	X		X	They get their salary, but they don't have to be productive. We say this explicitly, and we also hear the workplace supervisors say this amongst them and to the students "take your time (..) just sit down, observe, register what happens, because now you have time for that; in a while there will not be [enough time]. **(i4)**
Social elements	Involve other practices in the learning environment	12	5	X	**X**	X	X	X			And we now have a contractor there. So the contractor supervises, he takes control together with the school and we watch. And that is our win-win situation. And of course I am responsible for the financial part and whether it all goes as agreed. **(i2)**
	(Re)Designing roles	24	5		X		**X**	X	X	X	So now we have also started working with fully exempted supervisors (…) We have recruited ten people for this, all of whose work consists of supervising in practice. **(i4)**

Designable elements	Themes	References	Sources	I1	I2	I3	I4	I5	I6	I7	Quotes used in the manuscript
Multiple	Integrating the practices	15	5	X			X	X	X	**X**	And that is the beauty of it, I think, that all students, whether they have a learning-employment contract or an internship agreement, that they have a contract with us [training unit], because then we do not have that hassle of students being put on the work schedule within two weeks. Because that used to be the way it was. **(i7)**



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