Competency-oriented secondary VET

- Effects on competencies, further education and labor market[1]-

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Inhoud

1. Introduction

Preparing youngsters for continuing educational careers, for the labor market as well as life-long learning are central objectives of the Dutch secondary VET system. Firms expect more than just graduates with a strong base of vocational competencies. According to Allen and van der Velden (2012) the world of work is changing with an ICT revolution that triggered related changes on the demand side of the labor market such as globalization, flexibilization and polarization of the job structure. Competencies requirements are changing along these trends and have strong impact on what educational systems need to provide to youngsters. In line with that, Sternberg (2003) proposes that the future needs a "generation of experts, whose expertise will extend well beyond technical knowledge".

Traditional learning environments in which students are passively fed knowledge by teachers are more and more replaced by activating learning environments placing the student at the center of the learning process. The former learning environments are no longer seen sufficient to train students in the broad range of both vocational and generic competencies required to start on the labor market and to successfully keep up with changes in competency requirements through life-long learning. Whereas in the Dutch higher vocational education these latter types of learning environments were introduced generally in the nineties, the concept of competency and the discussion on the learning environment has made a strong entrance at the beginning of the new millennium in the Dutch secondary VET. Competency-oriented education (COE) is required in Dutch secondary VET since 2012 for all study programs. Students that started a non-COE study program naturally could finish this program after 2012. In eight years before, since 2004, COE has seen a phased entry and both competency-oriented education and classical learning education (so called end-term qualification education) were provided simultaneously. The main objective of this change of the learning environment is to allow youngsters more effectively to acquire the competencies required to start their future career.

In a COE training course the desired results are described in a number of competencies in a document, the so called "qualification dossier". In the Netherlands, a competency is defined as a work-based combination of knowledge, skills and behavior. For example, COE assumes that a starting trade professional has acquired certain competencies, including the skills of planning and collaboration. Thus, students learn how to communicate better and how to work in cooperation with each other. The competencies a student must acquire in order to graduate are defined in a *qualification dossier*, compiled in close consultation with the trade industry. Each training programme has such a *qualification dossier*.

For each training course it is known which competencies a student supposed to have gained after completing the study. Schools use the qualification dossier for the development of competency-orientation education. The dossier however does not describe *how* the VET College, or the training course, should arrange this, or implement COE. It does not describe how COE should take its form. Hence: the 65 VET colleges each offer training courses, within their own unique context, and even though the dossiers can be equal, the way the COE is formed and implemented is not necessarily similar. For instance; the study program "Furniture making" in VET college X can differ from a similar program in VET college Y; the outcome (students trained in particular competencies) however should be similar.

Research (Huisman, 2010; Van der Meijden et al. 2009, Van der Meijden et al. 2013) suggests that training programs / VET schools, vary on several characteristics of COE such as flexibility, the emphasis put on independence of the students, orientation on and collaboration with (work) practice, orientation on study routes *after* secondary VET, orientation on general skills, orientation on (technical) expertise, orientation on social skills and attitude.

The phased entrance of COE in the VET system allows us to analyze the effect of this change on different outcomes. We do so by analyzing a unique dataset, the VET-survey of the Netherlands. This annual large scale survey among graduates of the secondary VET system in the Netherlands provides detailed information on a broad scale of competencies acquired in education, information on further career steps within the first 1.5 years after receiving the VET degree, be it in further education or on the labor market. By analyzing these unique data, we will be able to contribute to the literature in different ways. First of all, analyzing competency outcomes of VET students, both in terms of vocational competencies as well as different types of generic competencies, we contribute to the research on how competencies outcomes are linked to learning environments. Second, we analyze to what extent VET graduates make successful transitions into further education[2] or the labor market. The comparison between COE programs and non-COE programs that are otherwise identical, contributes to the literature analyzing the factors determining a successful transition from school to school/work. In our paper, we will first analyze the effects of COE as a comprehensive learning environment on the above mentioned outcomes, secondly we analyze the effects of particular characteristics of COE study programs (measured in 2011) on the above mentioned outcomes.

The paper is organized as follows. In Section 2, we briefly provide some background information on the Dutch secondary VET system. Next, we discuss literature on competency-based VET, on the relation between the learning environment and competency outcomes of students as well as literature on the transition to the labor market and the importance of a good start on the labor market. Section 3 introduces the data and the operationalization of the instruments. In Sections 4 and 5, we discuss the empirical approach and the results of the multilevel analyses; first (Section 4), relations between COE as a learning environment and outcomes, secondly (Section 5), relations between different characteristics of the implemented COE and competency outcomes.

[2] In recent years, approximately 50% of the Dutch VET graduates continued their educational career either within the secondary VET system itself or, in case of graduation from the highest secondary VET level, into the Higher Vocational Education system.

Finally, Section 6 provides a rounding up and discussion of the outcomes.

2. Theory

2.1 Dutch secondary VET

The Dutch educational system (see Figure 1) is highly stratified from secondary education onwards, and this also applies to secondary vocational education. Each VET study programme can be followed in two different learning pathways, literally called the 'vocationally educating learning pathway' (*beroepsopleidende leerweg, or BOL*) and the 'vocationally guiding learning pathway' (*beroepsbegeleidende leerweg, or BBL)*. Study programmes in the vocationally educating learning pathway (BOL) are school-based and practical training take up between 20% and 60% of the course. Study programmes in the vocationally guiding learning pathway (BBL) are work-based; practical training takes up more than 60% of the course. Before they start their study programme, first-year pupils of the work-based track are fully responsible to find an apprenticeship, for which they have to apply. In principle all VET study programmes should be offered in both pathways (though in practice this is not always the case), and both pathways are (supposed to be) completely equal with regard to labor market opportunities and qualifications. VET study programmes can be followed at four different qualification levels, varying from ISCED level 3C-short (level 1 programs), up to ISCED level 3A (level 4 school-based track) and ISCED level (level 4 work-based track). Finally, VET study programmes can be categorized into five SECTORs: Behavior & Society, Health & Wellbeing, Technology, Economics, and Agriculture and the natural environment (also called 'green education')[3].

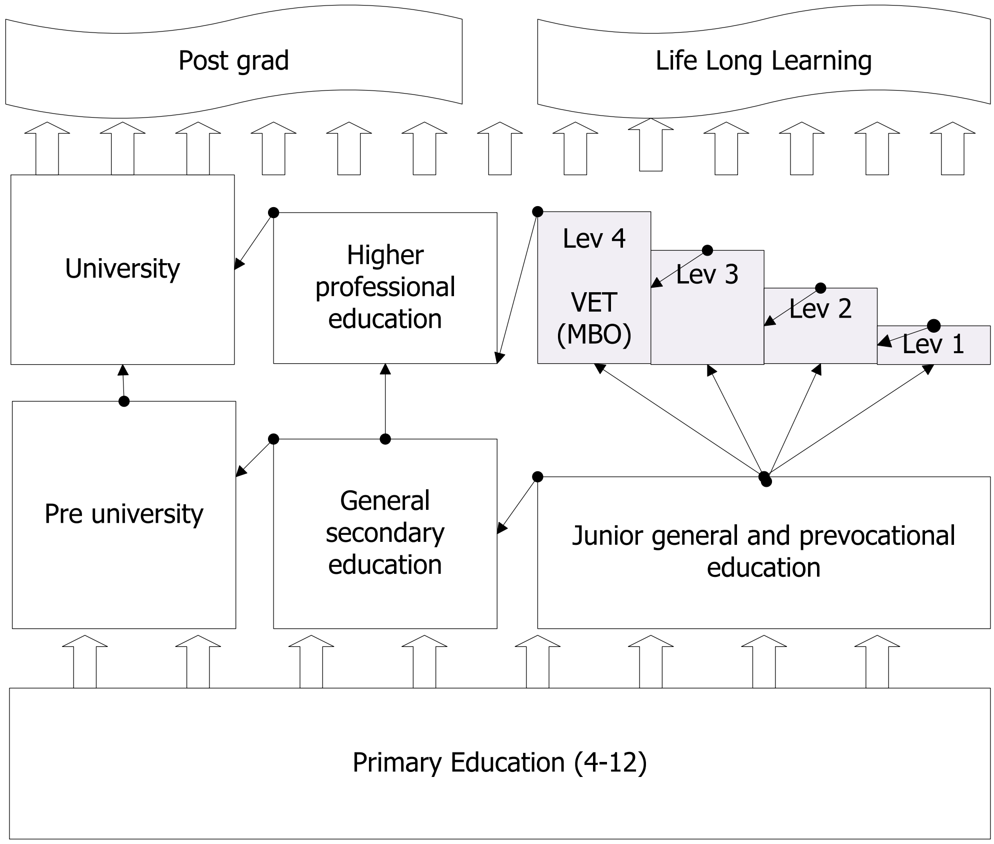
VET study programmes in level 1, the lowest level within VET, take approximately 0.5-1 year and are accessible without a previous degree from Preparatory Secondary Vocational Education (PVSE: 4 year training after primary education) and do not provide a so-called 'starting qualification' for the labor market, meaning that graduates from VET level 1 study programmes are defined as early school-leavers if they do not continue in education after graduation. Entrance into SVE study programmes in levels 2-4 (duration of which is two to four years) are restricted to people with at least a degree from PVSE or a VET level 1 degree.

After graduation from secondary VET, youngsters can either continue their education or enter the labor market. Currently, approximately half of the VET graduates continue education (either within secondary VET or, in case they graduated from a level 4

[3] The secondary VET sector in the Netherlands consists of 65 VET colleges comprising multidisciplinary VET colleges, agricultural VET colleges and specialised vocational colleges. All VET colleges have a strong regional orientation and function. Around 500.000 students are enrolled in a study programme offered in the secondary VET sector.

programme, they continue their study within the higher vocational education system) and half of the graduates enter the labor market.

Figure 1: Schematic overview of the Dutch educational system



2.2 Competency-outcome of VET

Didactic methods and the learning environment provided in secondary VET need to be in line with the two possible career paths (further education or entrance to the labor market) and provide the VET students with the competencies necessary to successful make these transitions.

The concept of competency[4] has made a strong entrance at the millennium into the Dutch VET system, both at level of policy-making and the level of educational practice (Biemans et al., 2005). COE is since 2012 in Dutch secondary VET required for all programs youngsters can start with. In the years before, COE has seen a phased entry and both COE and the classical-learning qualification education were provided simultaneously. COE is based on definitions of tasks graduates are expected to fulfil in the labor market and related work processes. For each working process specific competencies students need to acquire are set.

[4] Despite the pragmatic approach taken in most (economic) literature, we follow Weinert (2001), Rychen and Salganik (2003) and Meng (2006) and distinguish between the term competency and the term skill. The term 'competency' will be reserved for a group of skills, referring to a single underlying dimension and forming the condition to fulfil complex and varying tasks inside and outside the working sphere.

The introduction of COE reshaped secondary VET education in the Netherlands (see van der Meijden et al., 2014). Schools and training programs experimented with implementation of COE. This happened in different manners.

Analyses of 69 case studies of training programs and their implementation of COE suggested a variation in implementation methods and objectives (Huisman, 2010). Case studies varied in focus, distinct groups of case studies focused on the implementation on the professional discipline, others on the general development of students. The study unveiled the existence of a wide range of implementation methods and objectives amongst the VET training programs.

Humburg and van der Velden (2013) provide a thorough review on trends and related skills of relevance for youngsters entering the labor market[5].They argue that to prosper in a knowledge driven society, youngsters entering the labor market need to be equipped with a mix of skills covering *professional expertise*, *flexibility*, *innovation and knowledge management, mobilization of human resources*, *international orientation* and *entrepreneurship*.

At the center they see *professional expertise* that entails a specific body of knowledge (the knowledge and skills needed to solve occupation-specific problems), the ability to apply expert thinking and a set of generic skills such as analytical thinking, reflectiveness or the ability to see limitations. For secondary VET, given that study programs evolve around the preparation for a particular (set of) job(s), professional expertise in this sense is without doubt the core competency to be achieved by students. The role and value professional expertise plays during the transition from VET to the labor market may differ slightly between countries along the institutional rules of access to skilled workers' positions (see e.g. Meng, 2006). In countries (such as the Netherlands or Germany) with an Occupational Labor Market (OLM) setting the linkage between vocational competencies acquired in education and required in starter jobs is stronger than in countries (such as the United Kingdom) with an Internal Labor Market (ILM) (see e.g. Eyraud, Marsden and Sylvester, 1990 or Gangl, 2000). Professional expertise is not only of relevance for the VET graduates entering the labor market but also for those continuing their educational career. Research in the Netherlands (see e.g. Meng and Sijbers, forthcoming) shows that there is a strong link between the type of vocational competencies acquired in the programme graduated from and the type of vocational competencies to be acquired in the follow-up study. Hence, graduates continuing to study are able to build upon the vocational competencies acquired.

[5] Although the review is targeted towards graduates of higher education, the trends presented and the related skills demands are also of relevance for graduates from secondary VET.

Flexibility in the Netherlands has increased sharply in the last decade (see Chaklova et al, 2015) with currently around 70% of employees aged 15-25 holding a flexible contract[6]. Humburg and van der Velden (2013) also stated the increasing uncertainty and flexibility as one of the core trends on the labor market. They relate that trend to skills youngsters need to acquire in education to be prepared for employers increasingly demanding flexibility, such as the ability to (rapidly) acquire new knowledge, the ability to deal with changes and uncertainty and employability skills. These types of skills relate back to the earlier cited work of Sternberg (2003) but also to Bowden and Marton (1998) stating "*If you do not know what the future situation will be, then teach students some fundamental skills which they can apply to any situation*". Generally generic competencies are seen as complements and not as substitutes of vocational competencies. Allen and van der Velden (2012), citing the words of the German psychologist Weinert state that "*Over the last decades, the cognitive sciences have convincingly demonstrated that context-specific skills and knowledge play a crucial role in solving difficult tasks. Generally, key competencies cannot adequately compensate for a lack of content-oriented competencies*" (Weinert, 2001:53). Meng (2006) also shows that vocational competencies and generic competencies have both their distinct role in the transition to the labor market and need to be acquired alongside in education. The implementation of COE in secondary VET in the Netherlands intends to achieve indeed this symbiotic process. According to van den Berg and de Bruijn (2009), the implementation of COE can be classified along the three categories 'the what', 'the how' and the 'intended effects'. The 'what' is central to our line of discussion indicating that the implementation of competency-oriented VET aims at promoting both professional competencies as well as competencies for career development through lifelong learning. Whereas the first is in line with our earlier discussion of professional expertise and vocational competencies in specific, the second is strongly related to the uncertainty and flexibility graduates of VET are confronted with not only at the beginning of their working career but throughout their whole working career. In that sense, the implementation of competency-oriented VET in the Netherlands is in line with the broader discussion of the effects activating learning environments can have on competencies outcomes of students. Ample research shows that a well-designed activating learning environment in which the student is an active discoverer directly involved in the learning process rather than being fed passively by a teacher can trigger a symbiotic process from which both, the acquisition of vocational as well as generic competencies, can benefit (see e.g. Meng, 2006 Vaatstra and de Vries, 2007). The question of 'how' COE is formed in order to work towards the objectives as described under 'what' can only be answered within the specific context of individual training courses. We will explore the relationship between choices made in COE training courses and the outcome.

[6] Chaklova et al. (2015) define a flexible contract as e.g. a fixed-term contract (with or without possible extension), a 0 hours contract or employees contracted through temporary agencies.

2.3 Transition to the labor market

We restrict this study to the transition from secondary VET to work and focus on a short working life period of a maximum of 1.5 years. Although we will have to neglect certain aspects, such as the obsolescence of competencies, the impact of dropping out of the labor market for a certain period, and factors influencing the long-term employability of VET graduates, Meng (2006) showed that this focus allows addressing particular aspects related to the outcome of VET more coherently. First, the period after receiving the degree is the time with the strongest link between competencies acquired in VET and competencies required in the workplace. Hence, finding a job that matches the competencies invested in during the VET program is a crucial cornerstone in the transition to the labor market. With the accumulation of labor market experience, the weight attached to the initial educational career will fade out. The match between what education provides and what jobs require has received strong interest in research in the last decades. It is generally measured along two lines. One measuring the level of degree/competencies required in a job relative to the level of degree/competencies acquired in education, referred to as vertical match or as level underemployment. The other line measuring the field of study/type of vocational competencies required in the job relative to the field of study/type of vocational competencies acquired in education, referred to as horizontal match or content underemployment (see e.g. Meng, 2006; Falcke, Meng and Nollen, 2015, Levels, van der Velden, di Stasio, 2014, Green, 2013, Quintini, 2011, Verbruggen et al, 2015). Mismatches along one or both lines can trigger costly adjustments in form of additional training to compensate for skill deficiencies, in particularly at the beginning of the working career (see e.g. Barron, Black and Loewenstein, 1989; van Smoorenburg and van der Velden, 2000; Wolbers, 2003). Being level underemployed has also frequently been related to lower objective (e.g. lower salary) and subjective (e.g. lower job satisfaction) career success as well as to poorer psychological and physical health (see Burris, 1983; Hartog, 2000; Maynard & Feldman, 2011; McKee-Ryan & Harvey, 2011; Thomson, Shea, Sikora, Perrewe & Ferris, 2013; Tsang and Levin, 1985). Lower job satisfaction yields an increased probability of job switches (see e.g. Allen and van der Velden, 2001; Wolbers, 2003) triggering costs both on the employee's as well as on the employer's side. Next, suboptimal matches may limit graduates to keep abreast of developments with respect to the core competencies in which they invested during VET and may have long-term effects for the employees working career by limiting a person's further human capital development (De Grip et al., 2008; Baert et al., 2012). These lock-in effects might negatively influence future pay or future job satisfaction (see Verbruggen et al. 2015).

3. Data and measurement

3.1. Data

3.1.1. General Impact

To analyze the general impact of the implementation of competency-based education, we use a combination of two distinct datasets for our analyses. A first important source of information concerns the registered information about the VET programme. VET programs are registered in the Netherlands centrally with a unique identification number (CREBO). On the basis of the identification number, it can be established if a programme works according to the ‘classical learning qualification’ or a ‘competency-oriented dossier’. We use the information of the degree registration for our analyses. Generally speaking, it is possible that a VET school changes the programme from a ‘classical-learning qualification programme’ to a ‘competency-oriented programme’ while students are in the midst of the programme. In that case, the unique identification number of the programme changes and students formally graduate from a different programme than the one they started with. The data used for our analyses does not allow identifying such changes. However, given that the degree awarded to the student needs to be in compliance with either the classical learning qualifications or the competency-oriented programme qualifications, a possible change of the programme in the midst of a youngsters study needs to go in line with changes in the manner the degree is awarded and hence should not influence our analyses.

The second dataset we use is the survey among graduates from secondary vocational education (VET-survey) carried out annually by the Research Centre for Education and the Labor market of Maastricht University. This survey is designed to provide valid and reliable estimates of the transition from secondary vocational education to both continuous education and the labor market. For that purpose, graduates of VET are surveyed approximately 1.5 years after receiving the diploma. The data analyzed in this paper relate to the surveys that took place in the period 2007-2015. The annual samples contain approximately 5.000 cases with the exception of the samples in 2013 and 2015 that contain each around 30.000 cases. Reason for the diverging samples in these two years is that in 2013 and 2015 instead of a random sample a full population survey has been carried out.

Combining the register data with the information on the type of study programme (competency-based or not) with the data of the VET survey, provides the unique opportunity to analyses the outcome of the change to competency-based education on both, labor market outcomes as well as success in further education.

3.1.1 Differences in implementation

To analyse the impact of differences in the implementation of COE on competency outcomes, we add the outcomes of the CGO-monitor to our analyses. At the end of the schoolyear 2010-2011 a nationwide research was conducted into competency based education in Dutch VET, the so called “CGO monitor”. A part of this research was a questionnaire; send to all contact persons of training courses in all Dutch VET institutions. The aim of this questionnaire was to measure several objectives of competency based education, as formulated by the ministry of Education, such as satisfaction of teachers and students, study success. The questionnaire also comprised a large number of questions with which we can determine how each training course was arranged along aspects such as the ability of teachers for the tasks at hand, the focus on student's independence, the focus on generic and/or vocational competencies or the incorporation of practice in the study program.

The data used were collected early 2011 in the vocational education learning pathway. In the schoolyear 2010-2011 237 dossiers (with a unique CREBO number) existed. The number of School-Program combinations varied, but was estimated at around 7.000. 2117 individual persons could be identified as a 'contact person' for a School-Program combinations, and were send the questionnaire. 1012 people responded. These people represent 752 School-Program combinations. The questionnaire used in de *CGO monitor* consists of 127 items[7]. A number of items were identified to represent those elements of the study programme that can cause variation in particular items in data from the VET survey. We were able to construct comprehensive scales, based on a number of items[8]:

1. Degree of activities/expertise by professionals in study program (*9 Items*: Cronbach alpha: 0.87)
2. Activities directed towards vocational route[9] (*3 Items*: Cronbach alpha: 0.66)
3. Average number of hours for vocational theories in study (*4 Items*: Cronbach alpha: 0.90)
4. Average number of hours for vocational skills in study (*4 items*: Cronbach alpha: 0.88)
5. Average number of hours for generic skills in study (*4 Items*: Cronbach alpha: 0.88)
6. Proximity of practice in study program (*3 Items*: Cronbach alpha: 0.59)
7. Extent to which students have to gather knowledge on their own (*3 Items*: Cronbach alpha: 0.60)

The data of the CGO monitor were matched to the data of the VET surveys 2012-2015. The respondents of these VET surveys studied in 2010-2011 in one of the School-Program combinations[10].

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[7] Not all respondents answered on all items. A multiple imputation procedure in SPSS was followed to estimate values for missing cells that were used for the scales.

[8] See Appendix 1 for detailed information.

[9] 'Vocational route' refers to the route students after primary school can take to prepare for the labour market: the route through junior general and prevocational education, secondary vocational education and higher professional education. Opposed to the 'vocational route' students can take the 'general or academic route', via pre university and university to labour market. Cross routes are allowed and take place, but the bulk of students follow a specific route after primary education. See figure 1.

We were able to match 9.126 respondents of the VET surveys with 735 School-Program combinations . An average of 23 VET survey respondents per School-Program (min 1 max 259). Doing so we created a dataset consisting of independent variables (scales based on CGO monitor, as described above) and outcome variables (scales based on VET survey).

3.2 Data selection

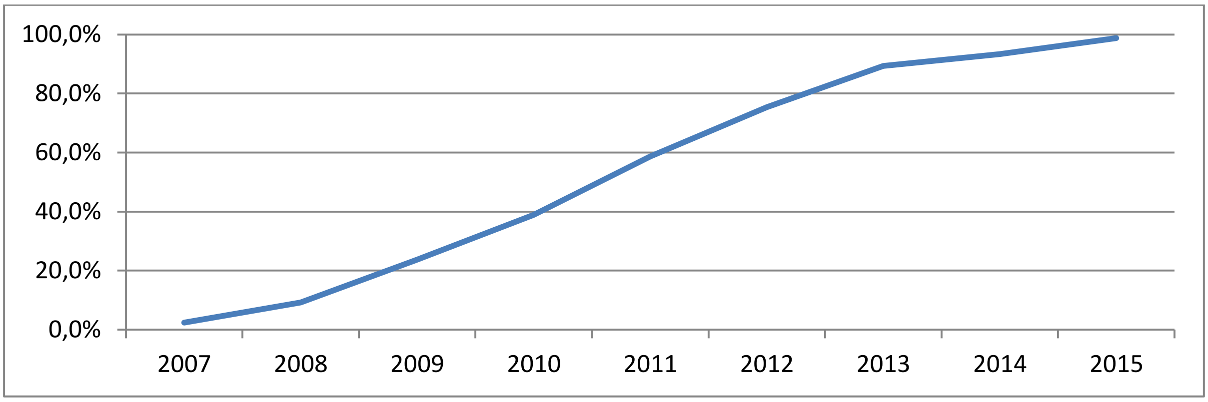
To prepare the data for our analyses, we have made a number of selections. First, in the VET survey data, we only selected graduates that at time of survey were younger than 31. By doing so, we neglect the outcomes of those participants in secondary VET who generally are trained while already having a history of working experience. Secondly, we focus our analyses on those youngsters that have received a degree from the VET level 2, 3 or 4. We leave the graduates from the shortest VET programmes (Level 1 programmes) out of the analyses. Level 1 programs do not formally provide a starting qualification for the labor market. The working sample finally consists of 86.044 graduates from the Dutch secondary VET system. 66% of the respondents are part of the labor force at time of the survey. 50% of the respondents started after the graduation with another study programme, either within the secondary VET system on a higher level or, in case of the graduates from the VET level 4, within the higher vocational education system (HBO). There is some overlap between the two groups as those who continue to study within the apprenticeship system or in a dual programme at the higher vocational education are in our analyses counted as both, member of the labor force as well as student.

Figure 2 shows the distribution of respondents according to the question if they graduated from a competency-oriented programme or a classical learning programme[11]. The share of respondents from competency-oriented programs continuously increases from less than 3% in 2007 to 99% in the 2015 survey. Overall, 58% of all the respondents graduated from a competency-oriented programme.

[10] An assumption is made: the implementation approach of the training course does not vary drastically between the moment of measurement (early 2011) and later years.

[11] All descriptive figures provided in Paragraph 3 are based on the weighted data, taking into account possible response differences between level of VET degree, field of study or region.

Figure 2: Share of respondents from competency-oriented programs



Source: VET-survey, 2007-2015, ROA.

3.3 Measurements

Below, we discuss the measurements of the variables we use in detail. An overview of descriptive statistics of all the dependent variables in our models is given in Table 1.

As discussed in Section 2, a change towards a competency-oriented programme is expected to yield both effects on the probability of youngsters to continue successfully in education as well as on the success during the labor market entrance.

Further education

With respect to further education, we analyze two dependent variables. First, we analyze the probability that the graduate directly after receiving his or her degree from the VET continues with another education programme. This is a 0/1 dummy variable with 1 if the respondent indicated that he continued to study and 0 otherwise. 42,2% (57,8%) of the respondents from a classical learning qualification programme (competency-oriented programme) continued to study. Secondly, we analyze for those who continued to study the answer on the question 'are you still following this program' (1.5 years after starting the follow-up study). We combine the answers 'yes' and 'no, I already graduated from it' together in '1' in a dummy for 'successful in further study'. The answer 'no' is then coded as 0. The share of respondents that are successful in their further study is strikingly comparable between the classical learning qualification programs and the competency-oriented qualification programs (89.3%, respectively, 90.0%).

Table 1: Descriptive statistics

	Classical learning qualification	Competency-oriented qualification

% of respondents	42.2%	57.8%
Further education		
% that continues to study	43.9%	52.5%
% successful in further study	89.3%	90.0%
Labor market		
% Unemployed	3.4%	7.9%
% Vertical mismatch	74.2%	70.2%
% Horizontal match	73.3%	69.8%
% Generic domain	23.8%	26.7%
Competencies(5-point scale)		
Discipline-specific competencies	3.9	3.9
Basic generic competencies	3.8	3.8
Advanced generic competencies	3.9	3.9

Source: VET-survey, 2007-2015, ROA.

Labor market

With respect to the success on the labor market, we analyze both the possibility to find a job as well as the match between the job and the education followed.

The unemployment is measured according to the international definition of unemployment. Respondents not working for at least 1 hour a week and at the same time looking for work, are considered as unemployed (dummy=1). Respondents working for at least 1 hour a week are considered as working labor force (dummy=0). In both cases, respondents who indicate that there main occupation is 'student' are left out. 3.4% of the graduates from classical learning qualification programs and 7.9% of the graduates from competency-oriented qualification programs are unemployed. Given that the share of graduates from competency-oriented qualification programs increases in the period under consideration, the higher unemployment rate among graduates from these programs might in fact reflect the worsening of the Dutch labor market in the period 2009-2014.

The match between the job and the education followed is measured according to two questions in the VET survey.

First, the respondents were asked to indicate the level of degree required by the employer for the job they were hired. Based on this question, a dummy variable has been constructed which is 0 in case the respondent indicates that the level of degree required is lower than the level of degree graduated from and 1 otherwise. Note that by doing so, we ignore a situation in which graduates might be undereducated. 74.2% (classical learning qualification) and 70.2% (competency-oriented qualification) of the working graduates have a vertical match.

Second, the respondents were asked to indicate which field of study was required by the employer for the job they were hired. Respondents were given 4 answer categories 'my own field', 'my own or a related field', 'another field of study' or 'no particular field'. In line with earlier research (see for instances Falcke, Meng and Nollen, 2016 or Verbruggen et al., 2015), we first created a dummy variable 'horizontal match that is 1 if one of the first two answer categories is given and 0 otherwise. Given that this first definition of the horizontal match includes as horizontal mismatch both jobs for which another field of study and hence another type of vocational competencies were required and jobs for which no particular field of study was required and hence in particular generic competencies might be of value, we also analyze a second dummy: 'Generic domain' that is 1 if 'no particular field is required' and 0 otherwise. Table 1 shows that 73.3% (classical learning qualification) and 69.8% (competency-oriented qualification) of the working respondents have a horizontal match. The shares of graduates working in the 'generic domain' indicate that a 'horizontal mismatch' is closely in line with working in the 'generic domain'.

Competencies

Section 2 introduced different types of competencies that are of relevance for both, a successful continuation of the education career, as well as a successful transition to the labor market. The VET survey measures different items using a self-reporting approach starting at the 2011 survey[12]. Respondents belonging to the working labor force were asked to indicate on a 5-point Likert scale their own level for a total of 19 items. On the basis of both factor- as well as hierarchical cluster analyses, three clusters of competencies have been constructed with strong internal consistency:

1. *Vocational knowledge (Cronbach alpha: 0.67)*
    a. *Vocational knowledge of the own field of study*
    b. *Ability to apply knowledge and theories in practice*
2. *Basic Generic competencies (Cronbach alpha: 0.72)*
    a. *Written skills*
    b. *Oral skills*
3. *Advanced Generic competencies (Cronbach alpha: 0.80)*
    a. *Insight into ICT*
    b. *Ability to transfer knowledge*
    c. *Planning, coordinating, organizing*
    d. *Problem solving skills*

[12] The questionnaires in the earlier surveys measured the competency items in a different way not allowing to analyze the question for the surveys 2007-2010.

e. Ability to work in team / to work together

We use the average score on a particular cluster item as dependent variable. This allows us to measure a possible effect of the introduction of competency-oriented qualification programs on the level and type of competencies graduates entering the labor market possess.

4. General impact of implementation

4.1 Method and model

We now turn to exploring whether various outcomes of vocational education are associated with characteristics of educational programs and individuals. We are most interested in identifying the effect of changes in the way in which vocational tracks are organized to enable a learning environment (competency-based learning vs. classical learning) on various outcomes:

- The probability of continuing study after getting a diploma
- For those who continue studying, the probability of being successful in further education
- The probability of entering the labor market after getting a diploma
- For those who enter the labor market, the probability of finding a job within two years
- For those who find work, the probabilities that the job is at the right level, in the right field, or in a general field
- For those who find work, the extent to which they have the skills to do their job.

The hierarchical structure of the data implies that we can use multilevel models to construct accurate standard errors (Snijders and Bosker 2012, pp. 178-179). We estimate four-level random intercept models, in which schools form the highest level. Educational programs are nested in schools, and exit cohorts are nested in programs. Individuals are then nested in exit cohorts. We control for exit cohorts by adding dummy variables for year of graduation in the fixed part of the multilevel equation. The effect of the learning environment is modeled with a fixed slope dummy variable.

Possibilities for a (quasi-)experimental design are limited, but by structuring and analyzing the data like this, we can isolate the effects of changing the learning environment from time-invariant school characteristics, time-invariant general characteristics of vocational educational programs, and observable time-invariant differences related to individuals, as well as all time-varying characteristics of schools, programs and pupils not related to changes in the learning environment. Our design gives the interpretation of the dummy for learning environments a causal flavor under the following assumptions[13]:

[13] Both assumptions are plausible. Pupils in the Netherlands choose a secondary VET programme generally based on their interest in a particular field without taking didactical methods used in a programme into account. Moreover, geographical mobility of pupils entering a VET programme is limited. Finally, in the period under consideration, no other large scale changes have taken place in the secondary VET system in the Netherlands. Certainly not coinciding one-to-one with the phased implementation of competency-based education in different schools and within schools in different programs.

- Pupils did not select into (or out of) vocational educational programs because they are competency based, and
- The changes of learning environments do not structurally coincide with other changes that affect the outcomes we study.

We analyzed the data with the statistical software packages xtmelogit to estimate models with binary dependent variables and xtmixed to estimate models with continuous dependent variables (Statacorp, 2014).

4.2 Results

Table 2 presents the outcomes with respect to the question if graduates continue their education on a higher level and, given that they continue their education, how successful they are in the further education after 1.5 years. The results show that graduates from competency-based education more likely continue their education, be it on a higher secondary VET level or within the higher vocational education system. In that way, the introduction of the competency-based education method seems to have achieved an important outcome as a degree from a higher level generally increases the labor market chances. However, measured after 1.5 years inside the further education, we do not see an increased probability of graduates from competency-based education to be successful in the sense of not-having dropped out until then. Our measurement of being successful in further education is certainly limited. We measure success just 1.5 year into the further education and hence do not measure the probability of receiving a final degree nor do we measure the level of competencies acquired in further education.

Table 2: (Success in) further education (standard errors in brackets)

	Continue to study	**Success further education**
Fixed parameters		
Constant	0.887***	3.040***
	(0.0859)	(0.183)
Characteristics of VET		
School-based (versus work-based)	0.622***	-0.304**
	(0.0343)	(0.0929)
VET level 2 (level 3 = reference)	0.289***	0.134
	(0.0422)	(0.0879)
VET level 4 (level 3 = reference)	0.725***	-0.696***
	(0.0342)	(0.0684)
Characteristics of cohort in educational program		
Competency-based (vs. classical learning)	**0.253*** **	**0.0331**
	(0.0287)	**(0.0543)**
Characteristics of individuals		
Age	-0.258***	-0.0501***

	(0.00635)	(0.0139)
Female (male = reference)	-0.312***	-0.186***
	(0.0254)	(0.0462)
Western immigrant (Dutch native = reference)	0.0888	-0.132
	(0.0506)	(0.101)
Non-Western immigrant (Dutch native = reference)	0.562***	-0.0653
	(0.0375)	(0.0662)
Average grade	0.0608***	0.155***
	(0.00996)	(0.0207)
Graduation cohort 2008	0.289***	-0.0434
	(0.0366)	(0.0747)
Graduation cohort 2009	0.237***	-0.145
	(0.0425)	(0.0833)
Graduation cohort 2010	0.282***	0.116
	(0.0421)	(0.0888)
Graduation cohort 2011	0.220***	-0.0866
	(0.0402)	(0.0797)
Graduation cohort 2012	0.116**	-0.267**
	(0.0431)	(0.0820)
Graduation cohort 2013	0.0335	-0.0896
	(0.0387)	(0.0794)
Graduation cohort 2014	0.0278	-0.255**
	(0.0431)	(0.0829)
Variance components		
School	-1.277***	-15.73
	(0.127)	(399735.9)
Education program within school	-0.579***	-1.392***
	(0.0342)	(0.232)
Graduation cohort within education program	-1.646***	-8.977
	(0.195)	(1695.3)
Individual within graduation cohort	n/a	n/a
N	46851	22865

Source: VET-survey 2007-2015. */**/*** significant on a 10%/5%/1% level.

Instead of continuing one's educational career, graduates from secondary VET levels 2 to 4 also possess formally a starting qualification to enter the labor market. Table 3 provides the outcomes of our labor market analyses. To start with, we estimate the probability to belong to the labor force 1.5 year after graduation. Not surprisingly, the findings generally mirror our analyses on the probability to continue education[14] indicating that graduates from COE programs less likely enter the labor force. Model 2 ('working') estimates the probability that

[14] The results are not precise the other side of the coin as a) graduates not continuing to study might belong to the labor force or not (NEETS) and b) as graduates continue to study in either the work-based secondary VET system or in the dual Higher Vocational Education System both are categorized as in further education as well as on the labor market.

graduates who enter the labor force find paid work. The result is negative for the competency-based education programs. Graduates from this type of education programs entering the labor market are less likely find paid work and hence are more likely unemployed than graduates from programs with a classical learning environment. Note that this result is obtained after controlling for graduation year, so that this effect is independent of changes in the annual general labor market conditions. Finally, in our first set of models considering the labor market entrance, we focus in the last three models on the selection of graduates with paid work. First, we analyze the probability of a vertical match and a horizontal match. We find a slight negative effect (significant only at the 10% level) of COE on the probability to have a horizontal match but no impact on the probability to have a vertical match. Given that a horizontal mismatch according to our typology generally means working in the generic domain[15], it is not surprising that we also find a positive coefficient of graduation from a competency-based program on the probability to work in the generic domain. However, this effect is small and only significant at the 10% level.

So far our results seem to suggest a positive effect of the implementation of competency-based educational programs in the Dutch secondary VET system on continuation to further education, but a negative effect on finding a job. We find no effect on the chance of obtaining a vertical match and slight negative effects on having a horizontal match. This seems to indicate that competency-based education has not improved the transition to the labor market (and even decreased the chance of getting a job), although there is some indication of a positive effect on finding a job in the generic domain.

[15] The generic domain is the domain for which according to the respondent no specific educational program prepares best.

Table 3: Labor market entrance (standard errors in brackets)

	Entering labour market	**Working**	**Vertical match**	**Horizontal match**	**Generic domain**
Fixed parameters					
Constant	1.137***	12.32***	-0.177	1.195***	-1.157***
	(0.109)	(0.413)	(0.102)	(0.108)	(0.108)
Characteristics of VET					
School-based (versus work-based)	-2.070***	-1.681***	0.158***	-0.568***	0.484***
	(0.0581)	(0.167)	(0.0424)	(0.0449)	(0.0458)
VET level 2 (level 3 = reference)	-0.132*	-0.552**	0.191***	-0.512***	0.490***
	(0.0518)	(0.199)	(0.0545)	(0.0577)	(0.0584)
VET level 4 (level 3 = reference)	-0.846***	0.666***	0.617***	0.101*	-0.120*
	(0.0408)	(0.158)	(0.0474)	(0.0486)	(0.0498)
Characteristics of cohort in educational program					
Competency-based (vs. classical learning)	**-0.288*** **	**-0.586*** **	**-0.0659**	**-0.0889* **	**0.0836* **
	(0.0336)	**(0.168)**	**(0.0405)**	**(0.0412)**	**(0.0421)**
Characteristics of individuals					
Age	0.266***	-0.257***	0.0403***	0.0109	-0.0274***
	(0.00827)	(0.0217)	(0.00793)	(0.00801)	(0.00827)
Female (male = reference)	0.142***	-0.183	0.128***	-0.115**	0.116**
	(0.0290)	(0.115)	(0.0372)	(0.0374)	(0.0382)
Western immigrant (Dutch native = reference)	-0.263***	-0.275	-0.298***	-0.212**	0.201**
	(0.0584)	(0.208)	(0.0756)	(0.0750)	(0.0771)
Non-Western immigrant (Dutch native = reference)	-0.746***	-1.333***	-0.334***	-0.493***	0.467***
	(0.0418)	(0.136)	(0.0596)	(0.0583)	(0.0590)
Average grade	-0.0234*	0.192***	0.179***	0.106***	-0.116***

	(0.0117)	(0.0432)	(0.0150)	(0.0148)	(0.0152)
Graduation cohort 2008	-0.0779	0.419	0.142**	-0.154**	0.134*
	(0.0429)	(0.353)	(0.0535)	(0.0516)	(0.0529)
Graduation cohort 2009	-0.128**	-0.347	-0.0828	-0.127*	0.161*
	(0.0494)	(0.336)	(0.0630)	(0.0619)	(0.0631)
Graduation cohort 2010	-0.182***	0.0182	0.105	-0.0540	0.0896
	(0.0490)	(0.354)	(0.0640)	(0.0620)	(0.0632)
Graduation cohort 2011	-0.0203	-0.240	-0.0225	0.229***	-0.253***
	(0.0469)	(0.309)	(0.0589)	(0.0606)	(0.0626)
Graduation cohort 2012	0.0257	-0.524	-0.158*	0.0427	-0.0663
	(0.0500)	(0.304)	(0.0641)	(0.0650)	(0.0670)
Graduation cohort 2013	-0.0551	-0.710**	-0.143*	-0.00405	-0.0270
	(0.0458)	(0.268)	(0.0574)	(0.0584)	(0.0601)
Graduation cohort 2014	-0.0857	-0.895**	-0.254***	-0.211***	0.213***
	(0.0479)	(0.275)	(0.0607)	(0.0614)	(0.0622)
Variance components					
School	-1.367***	-23.31	-16.28	-2.129***	-15.29
	(0.143)	(622244550.5)	(814604.2)	(0.373)	(309290.4)
Education program within school	-0.546***	-17.96	-0.405***	-0.277***	-0.287***
	(0.0374)	(25649786.9)	(0.0390)	(0.0368)	(0.0368)
Graduation cohort within education program	-1.714***	2.137***	-1.629***	-1.580***	-1.660***
	(0.260)	(0.0397)	(0.394)	(0.311)	(0.412)
Individual within graduation cohort	n/a	n/a	n/a	n/a	n/a
N	40876	27400	25624	25582	25582

Source: VET-survey 2007-2015. */**/*** significant on 10%/5%/1% level

Finally, we turn to competencies outcomes of secondary VET programs and the general impact the implementation competency-oriented programs has on them. As discussed earlier, the data allows us only to measure the level of competencies graduates possess for the years 2011-2015 and for the paid working force. By that, our sample is further restricted to around 12.000 graduates. Table 4 presents the results of the linear analyses with respect to the three competency clusters defined 'vocational competencies', 'basic generic competencies' and 'advanced generic competencies'. We find on a 10% significance level a negative effect of COE on the acquisition of vocational competencies. That negative effect is not substituted by an increased acquisition of any type of generic competencies. The introduction of COE hardly affected the competencies of students, although there do seems to be a small negative effect on the vocational competencies.

Table 4: Competencies outcomes (standard errors in brackets)

	Vocational	**Basic generic**	**Advanced generic**
Fixed parameters			
Constant	3.810***	3.310***	3.652***
	(0.0359)	(0.0536)	(0.0330)
Characteristics of VET			
School-based (versus work-based)	-0.124***	0.0573***	-0.0278*
	(0.0117)	(0.0171)	(0.0128)
VET level 2 (level 3 = reference)	-0.116***	-0.0379	-0.111***
	(0.0168)	(0.0233)	(0.0151)
VET level 4 (level 3 = reference)	0.00433	0.0610***	0.0993***
	(0.0155)	(0.0144)	(0.0133)
Characteristics of cohort in educational program			
Competency-based (vs. classical learning)	-0.0366*	0.0119	-0.0149
	(0.0152)	(0.0205)	(0.0118)
Characteristics of individuals			
Age	-0.00247	0.00889**	0.000558
	(0.00267)	(0.00313)	(0.00251)
Female (male = reference)	0.00683	0.263***	0.100***
	(0.0158)	(0.0132)	(0.0123)

Western immigrant (Dutch native = reference)	0.0305	-0.00142	0.0306
	(0.0365)	(0.0306)	(0.0224)
Non-Western immigrant (Dutch native = reference)	0.0879***	0.152***	0.147***
	(0.0228)	(0.0311)	(0.0246)
Average grade	0.0848***	0.0999***	0.0844***
	(0.00544)	(0.00568)	(0.00500)
Graduation cohort 2011	-0.0645**	-0.0915***	-0.0878***
	(0.0212)	(0.0237)	(0.0142)
Graduation cohort 2012	-0.0424*	-0.0612*	-0.0669***
	(0.0179)	(0.0242)	(0.0159)
Graduation cohort 2013	0.001	-0.0526**	-0.0466***
	(0.0158)	(0.0179)	(0.0132)
Graduation cohort 2014	0.00652	-0.0536*	-0.0642***
	(0.0144)	(0.0208)	(0.0140)
Variance components			
School	-16.45	-2.652***	-3.347***
	(10.93)	(0.160)	(0.453)
Education program within school	-2.170***	-2.729***	-2.430***
	(0.0941)	(0.327)	(0.146)
Graduation cohort within education program	-15.33	-14.58	-10.57
	(31.75)	(28.90)	(114.5)
Individual within graduation cohort	-0.478***	-0.375***	-0.642***
	(0.00880)	(0.00684)	(0.00976)
N	12352	12285	12375

Source: VET-survey 2011-2015. */**/*** significant on 10%/5%/1% level

5. Competencies outcomes and different elements of COE implementation

So far, our analyses presented did not come up with the expected positive effect of the implementation of competency-oriented education in the Dutch secondary VET system with respect to the transition to the labor market. If anything, the effect was negative rather than positive. The implementation is however a fact: all secondary VET programs are required to work with COE 'dossiers'. However within that context, schools have a large freedom in the way they provide COE and the design of the learning environment. Schools are free to divide e.g. the number of hours directed at learning discipline-specific competencies or generic competencies, the extent to which the program is part of a vocational route from junior vocational training over secondary VET to higher vocational education or the extent to which the training program interacts with practice. To get further insight into the effects of implementing COE in secondary VET, it is therefore interesting to explore the extent to which different approaches to implement COE yield possible different competencies outcomes. To do so, we analyze a subsample of the dataset analyzed in Section 4 for which further information of the learning environment provided within COE is available. In total the subsample covers 9.126 respondents of the VET surveys 2011-2015 within 735 combinations of programs in schools.

Given that the elements of implementation of COE distinguished are expected to have an impact on the competencies outcomes of students of these programs, we further restrict our analyses to the 3 competencies outcomes. Table 5 provides an overview of the expected relations between a particular implementation characteristic and the competencies outcomes.

Table 5: Expected relation between training programs and outcomes

Nr.	***Implementation characteristics***	***Expected relation***	***Outcome***
A	Activities by professionals in study program	Positive Positive Positive	Discipline-specific Basic generic Advanced generic
B	Vocational theories in study program	Positive	Discipline-specific
C	Vocational skills in study program	Positive	Discipline-specific
D	Generic skills in study program	Negative/Positive Positive Positive	Discipline-specific Basic generic Advanced generic
E	Activities of teachers in study program directed towards practice	Positive Negative/Positive Negative/Positive	Discipline-specific Basic generic Advanced generic

F	Activities teachers in study program directed towards vocational route	Negative Positive	Discipline-specific Advanced generic
G	Students have to gather knowledge on their own in study program	Positive	Advanced generic

We expect activities of professionals (in fact teachers) to have a positive effect on competencies of learners. Generally, more active teachers, in described fields, lead to more competent learners (A). Competencies exists of knowledge, skills and attitude, so we expect more hours spend on vocational theories during the training program will yield a higher level of discipline specific competencies acquired(B). The same applies to the relationship hours spend on vocational skill and discipline specific competencies (C). We expect hours spend on generic skills (during the training program) to lead to stronger basic and advanced generic competencies (D). The relation between hours directed towards generic competencies and the acquisition of discipline-specific competencies is not clear-cut. Earlier research (see e.g. Meng, 2006) shows this depends strongly on the approach used and the question if students are set in an activating learning environment where the role of the teacher is reduced to a process manager (negative impact on the acquisition of discipline-specific competencies) or where the activating learning environment is combined with a teacher transferring knowledge (positive effect on the acquisition of discipline-specific competencies). Activities directed towards practice are expected to positively impact the acquisition of discipline-specific competencies. With respect to the two clusters of generic competencies, the relation is depending on the extent to which the influence from the practical side on the program is not purely focused on the acquisition of discipline-specific competencies (E). Although the vocational route of in the Netherlands generally has a strong linkage between discipline-specific competencies in junior vocational education, secondary vocational education and higher vocational education (students remain often within a given educational sector, e.g. health) activities directed towards the vocational route can be expected to be targeted on the acquisition of an increased level of generic competencies to provide students with a good basis for further education and not so much on discipline-specific competencies (F). Finally, requesting from students an active attitude and to gather knowledge on their own is expected to increase the level of advance generic competencies.

The data imply, similar to analyses on the general impact (4), a multilevel model. Given the reduced sample however, the models had to be adjusted and robustness checks have been carried out to find the most powerful models.

Table 6 provides a summary of the key results with respect to the theoretical hypotheses presented in Table 5 on the three competency clusters as outcome[16].

[16] The full set of estimations are presented in Appendix 2.

Table 6 Key results (standard errors in brackets)

Implementation characteristics	*Discipline-specific*	*Basic Generic*	*Advanced Generic*
Activities by professionals in study program	0.14 (0.20)	.011 (0.019)	0.045** (0.017)
Vocational theories in study program	-0.01 (0.02)	X	X
Vocational skills in study program	-0.01 (0.02)	X	X
Generic skills in study program	-.009* (0.04)	-0.01 (0.004)	X
Activities of teachers in study program directed towards practice	0.040* (0.019)	.012 (0.018)	0.040* (0.016)
Activities teachers in study program directed towards vocational route	-0.08 (0.015)	X	034** (0.061)
Students have to gather knowledge on their own in study program	X	X	.061* (0.028)

*/** significant on 5%/1% level. /X= not estimated. / See Appendix 2 for full estimations

With respect to discipline-specific competencies, we find that only two of the seven implementation characteristics show a significant relation. Both are in line with our expectations. An increased intensity of activities/attention of teachers directed towards practice is positively related with the level of discipline-specific competencies students possess at the end of the program. The number of hours spent on teaching generic competencies on the other hand decreases the level of discipline-specific competencies. This latter finding suggests that the approach used by secondary VET programs during the hours directed towards the acquisition of generic competencies does not allow for a symbiotic process in acquiring generic and discipline-specific competencies at the same time. Variations in the other elements of implementation distinguished do not show any relation with the discipline-specific competencies outcome. Combining our earlier results that the general implementation of COE in secondary VET yielded a reduction in the level of discipline-specific competencies, the findings seem to indicate that secondary VET programs have directed an increased number of hours towards the acquisition of generic competencies without providing a learning environment where students acquire generic competencies in a combination with discipline-specific competencies.

With respect to the level of basic generic competencies, none of the elements shows a significant relation.

The acquisition of advanced generic competencies is influenced by four elements: The expertise of the teachers, activities directed towards the vocational route and hence towards further education, the link to the practice as well as the extent to which students have to gather knowledge independently. The last finding is in line with earlier research (Meng, 2006 or Vaatstra and Vries, 2007) indicating that student-centered learning environments where students are not fed passively but have to act as active learners stimulate the acquisition of advanced generic competencies.

6. Conclusion

Central objectives of secondary vocational education are preparing students for further education, the labor market and lifelong learning. As a results of the ICT revolution the labor market has rapidly changed in the last 20 years. Competencies acquired in secondary VET have to be adjusted in line with these changes. The labor market requires more than just technical or professional knowledge. Implementation of competency oriented education (COE) has therefore been set central in the secondary vocational education in the Netherlands and COE has gradually been introduced between 2004 and 2012. However, schools have been given a large extent of freedom in the manner they adapt their learning environment given the nationally set context of competencies to be acquired per educational program.

The central question of this study is to what extent there is a link between characteristics of the learning environment in secondary VET program, competencies acquired , the position in the labor market after graduation and the success in further education We distinguished two levels of 'implementation characteristics': whether or not the program worked according to COE during the transition phase and differences in design of COE after the definitive implementation of COE.

We find that the general implementation of COE increased the percentage of graduates that continued to study directly after receiving the degree, be it on a higher level program with the secondary VET system or in the program of the higher vocational system. This might be related to the outcome that in implementing COE schools have directed the learning environment more towards the acquisition of advanced generic competencies which provide a strong basis for further learning. We find no indication that graduates from COE programs have more success in the first one and half year in further education, although it would be fair to assess this at a later moment in time. At least we can say that the higher enrollment in further education is not accompanied by an increase in the early dropout rate.

For graduates of secondary VET entering the labor market, the general implementation of COE seems to have a negative impact rather than a positive one. We find that graduates from COE programs are more likely unemployed. Moreover there are no indications that, if they succeed in finding a job, the quality of the match is better. If anything the results point to a negative effect of more students ending up in a job outside their own domain. In that sense, they will lose their comparative advantage provided by their discipline-specific competencies when working in their own educational domain. This horizontal mismatch is in most cases the outcome of finding a job in the generic domain, the domain of jobs for which no specific VET program provides a comparative advantage. These outcomes can be related to the finding that the implementation of COE in secondary VET seems to have harmed the acquisition of discipline-specific competencies.

Our analyses on the general impact of the implementation of COE in the Dutch secondary VET system provides again evidence that the simple implementation of COE risks a trade-off outcome between the acquisition of discipline-specific and generic competencies. To get more insight into that, we analyzed for a sub-sample different ways of implementing COE. The outcomes indicate that while implementing COE, schools seem to have directed time and activities from teaching discipline-specific competencies to the acquisition of (advance) generic competencies without providing a strong link and allowing for a symbiotic process in the acquisition of these two competencies.

Appendix 1: Elements of implementation

8. Degree of activities/expertise by professionals in study program (*10 Items*: Cronbach alpha: 0.87)
    a. Intensity of contact between teacher / practice
    b. Intensity of teachers in the study program translating developments in practice to education.
    c. Intensity of teachers in the study program focussing on the connection between intra- and extra-mural learning.
    d. Intensity of teachers in the study program making connections between needs of students, industry and training program.
    e. Intensity of teachers in the study program having a broad view on the domain of the training program.
    f. Intensity of cooperation between teachers in the training program
    g. Intensity of cooperation between teachers in the training program and trainers in liaised companies
    h. Intensity of cooperation between teachers in the training programs and the applicable industry
    i. Intensity of cooperation between teachers in the training programs and junior vocational education
    j. Intensity of cooperation between teachers in the training programs and higher vocational education
9. Activities directed towards vocational route[17] (*VRoute*: Cronbach alpha: 0.66)
    a. Intensity of cooperation between teachers in the training program
    b. Intensity of cooperation between teachers in the training programs and junior vocational education
    c. Intensity of cooperation between teachers in the training programs and higher vocational education
10. Average number of hours for vocational theories in study (*VTheory*: Cronbach alpha: 0.90)
    a. How many hours per week are spend on vocational theories in the first year
    b. How many hours per week are spend on vocational theories in the second year

[17] 'Vocational route' refers to the route students after primary school can take to prepare for the labour market: the route through junior general and prevocational education, secondary vocational education and higher professional education. Opposed to the 'vocational route' students can take the 'general or academic route', via pre university and university to labour market. Cross routes are allowed and take place, but the bulk of students follow a specific route after primary education. See figure 1.

c. How many hours per week are spend on vocational theories in the third year
d. How many hours per week are spend on vocational theories in the fourth year

11. Average number of hours for vocational skills in study (*VSkills*: Cronbach alpha: 0.88)
    a. How many hours per week are spend on vocational competencies in the first year
    b. How many hours per week are spend on vocational competencies in the second year
    c. How many hours per week are spend on vocational competencies in the third year
    d. How many hours per week are spend on vocational competencies in the fourth year
12. Average number of hours for generic skills in study (*GSkills*: Cronbach alpha: 0.88)
    a. How many hours per week are spend on generic competencies in the first year
    b. How many hours per week are spend on generic competencies in the second year
    c. How many hours per week are spend on generic competencies in the third year
    d. How many hours per week are spend on generic competencies in the fourth year
13. Proximity of practice in study program (*Pracprox*: Cronbach alpha: 0.59)
    a. Frequency of integral assignments for an external mandatory
    b. Frequency of integral assignments being developed by teachers (reverse coding)
    c. Frequency of integral assignments acquired from third parties
14. Extent to which students have to gather knowledge on their own (*Self*: Cronbach alpha: 0.60)
    a. Intensity of the requirement of students to independently plan and organise their own learning activities
    b. Intensity of the requirement of students independently obtain knowledge for integral assignments
    c. Intensity of the requirement of students independently obtain knowledge for training subjects

Appendix 2: Full set of estimations

A) Discipline-specific Competencies

Table 1: Results multi-level models for 'Discipline-specific'. Standard errors between brackets (gm=grand mean centered). Testing the necessity of variance levels in model.

Model	1	2	3	4	5
Fixed part					
Intercept	3.848 (.008)	3.845 (.011)	3.845 (.011)	3.846 (.012)	3.847 (.015)
Random part					
province variance					.001 (.001)
brin variance				.001 (.001)	
sector variance			.002 (.002)		
brincrebo variance		.015 (.003)	.012 (.004)	.013 (.003)	.014 (.003)
cases variance	.443 (.008)	.429 (.008)	.429 (.008)	.429 (.008)	.429 (.008)
Deviance	12555.991	12505.829	12504.374	12504.615	12503.071
Reference model & Fit improvement		model 1 χ^2=50.162 df=1 p<.001	model 2 χ^2=1.455 df=1 p=n.s.	model 2 χ^2=1.214 df=1 p=n.s.	model 2 χ^2=2.758 df=1 p<.05
	N-provinces=12; N-Brin=122; N-sector=246; N-Brincrebo=548; N-cases=6202				

#=sig at 10% (=5% one sided); *=sig. at 5%; ** sig. at 1%; ***=sig. at 0.1%. (n.s.=non significant)

Table 2: Results multi-level models for 'Discipline-specific'. Standard errors between brackets (gm=grand mean centered). Results after correction for significant covariates.

Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Fixed part									
Intercept	3.847 (.015)	3.819 (.019)	3.816 (.019)	3.815 (.019)	3.815 (.019)	3.816 (.019)	3.817 (.019)	3.815 (.019)	3.816 (.019)
Gender (0=man; 1=woman)		.045* (.020)	.047* (.020)	.047* (.020)	.047* (.020)	.047* (.020)	.044* (.020)	.047* (.020)	.047* (.020)
Age (gm)			.012** (.004)	.012** (.004)	.012** (.004)	.012** (.004)	.011** (.004)	.012** (.004)	.012** (.004)
Expertise				.013 (.020)					
VTheory					-.001 (.002)				
Vskilss						-.001 (.002)			
Gskills							-.007* (.004)		
Practice								.038* (.018)	
VRoute									-.009 (.015)
Random part									
province variance	.001 (.001)	.001 (.001)	.001 (.001)	.001 (.001)	.001 (.001)	.001 (.001)	.001 (.001)	.001 (.001)	.001 (.001)
brincrebo variance	.014 (.003)	.013 (.003)	.011 (.003)	.011 (.003)	.011 (.003)	.011 (.003)	.011 (.003)	.010 (.003)	.011 (.003)
cases variance	.429 (.008)	.429 (.008)	.429 (.008)	.429 (.008)	.429 (.008)	.429 (.008)	.429 (.008)	.429 (.008)	.429 (.008)
Deviance	12503.07 1	12498.18 5	12489.28 9	12488.82 7	12489.12 1	12489.07 9	12486.46 2	12485.22 3	12488.95 5
Reference model & Fit improvemen		model 1 χ^2=4.886 df=1	model 2 χ^2=8.896 df=1	model 3 χ^2=.462 df=1	model 3 χ^2=.168 df=1	model 3 χ^2=.210 df=1	model 3 χ^2=2.827 df=1	model 3 χ^2=4.066 df=1	model 3 χ^2=.334 df=1

t		p<.05	p<.01	p=n.s.	p=n.s.	p=n.s.	p<.10	p<.05	p=n.s.
% expl. var. province-level		-	-				-	-	
% expl. var. brincrebo-level		7.14%	15.38%				-	9.09%	
% expl. var. cases-level		-	-				-	-	
	N-provinces=12; N-Brin=122; N-sector=246; N-Brincrebo=548; N-cases=6202								

#=sig at 10% (=5% one sided); *=sig. at 5%; ** sig. at 1%; ***=sig. at 0.1%. (n.s.=non significant)

Table 2 (continuation): Results multi-level models for **'Discipline-specific'**. Standard errors between brackets (gm=grand mean centered). Results after correction for significant covariates (models 1 and 2) and results without correcting for covariates (models 3 to 9).

Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Fixed part									
Intercept	3.816 (.019)	3.817 (.019)	3.847 (.015)	3.847 (.015)	3.847 (.014)	3.847 (.015)	3.847 (.014)	3.846 (.015)	3.847 (.015)
Gender (0=man; 1=woman)	.047* (.020)	.045* (.020)							
Age (gm)	.012** (.004)	.011** (.004)							
Expertise (gm)				.014 (.020))					
VTheory(gm)					-.001 (.002)				
VSkills (gm)						-.001 (.002)			
GSkills(gm)		-.006 (.004)					-.009* (.004)		
Practice (gm)		.035# (.018)						.040* (.019)	
VRoute (gm)									-.008 (.015)
Random part									
province variance	.001 (.001)	.001 (.001)	.001 (.001)	.001 (.001)	.001 (.001)	.001 (.001)	.001 (.001)	.001 (.001)	.001 (.001)
brincrebo variance	.011 (.003)	.010 (.003)	.014 (.003)	.014 (.003)	.014 (.003)	.014 (.003)	.013 (.003)	.013 (.003)	.014 (.003)
cases variance	.429 (.008)	.429 (.008)	.429 (.008)	.429 (.008)	.429 (.008)	.429 (.008)	.429 (.008)	.429 (.008)	.429 (.008)
Deviance	12489.289	12483.071	12503.071	12502.560	12502.981	12502.851	12498.541	12498.645	12502.786
Reference model & Fit improvement		model 1 χ^2=6.218 df=2 p<.05		model 3 χ^2=.511 df=1 p=n.s.	model 3 χ^2=.729 df=1 p=n.s.	model 3 χ^2=.220 df=1 p=n.s.	model 3 χ^2=4.530 df=1 p<.05	model 3 χ^2=4.426 df=1 p<.05	model 3 χ^2=.285 df=1 p=n.s.
% expl. var. province-level		-					-	-	
% expl. var. Brincrebo-level		9.09%					7.14%	7.14%	
% expl. var. cases-level		-					-	-	
	N-provinces=12; N-Brin=122; N-sector=246; N-Brincrebo=548; N-cases=6202								

#=sig at 10% (=5% one sided); *=sig. at 5%; ** sig. at 1%; ***=sig. at 0.1%. (n.s.=non significant)

B) Basic generic competencies

Table 1: Results multi-level models for 'Basic generic'. Standard errors between brackets (gm=grand mean centered). Testing the necessity of variance levels in model.

Model	1	2	3	4	5
Fixed part					
Intercept	3.909 (.009)	3.882 (.012)	3.881 (.015)	3.880 (.015)	@
Random part					
province variance					
brin variance				.000 (.000)	
sector variance			.013 (.004)	.014 (.004)	
brincrebo variance		.026 (.004)	.013 (.004)	.012 (.004)	
cases variance	.493 (.009)	.469 (.009)	.469 (.009)	.469 (.009)	
Deviance	13132.989	13048.304	13031.766	13030.603	
Reference model & Fit improvement		model 1 χ^2=84.685 df=1 p<.001	model 2 χ^2=16.538 df=1 p<.001	model 3 χ^2=1.163 df=1 p=n.s.	
	N-provinces=12; N-Brin=122; N-sector=246; N-Brincrebo=598; N-cases=6161				

#=sig at 10% (=5% one sided); *=sig. at 5%; ** sig. at 1%; ***=sig. at 0.1%. (n.s.=non significant). A model with variance levels for respectively cases, brincrebo, sector and province does not converge.

Table 2: Results multi-level models for 'Basic generic'. Standard errors between brackets (gm=grand mean centered). Results after correction for significant covariates (models 1 to 6) and results without correcting for covariates (models 7 to 9).

Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Fixed part									
Intercept	3.881 (.015)	3.749 (.018)	3.747 (.018))	3.746 (.018)	3.747 (.018)	3.746 (.018)	3.881 (.015)	3.882 (.015)	3.881 (.015)
Gender (0=man; 1=woman)		.217*** (.021)	.220*** (.021)	.220*** (.021)	.219*** (.021)	.219*** (.021)			
Age (gm)			.009* (.004)	.009* (.004)	.009* (.004)	.009* (.004)			
Expertise (gm)				.011 (.019)			.006 (.022)		
GSkills(gm)					-.001 (.004)			-.004 (.005)	
Practice (gm)						.012 (.018)			.014 (.021)
Random part									
sector variance	.013 (.004)	.004 (.002)	.005 (.002)	.005 (.002)	.005 (.002)	.005 (.002)	.013 (.004)	.013 (.004)	.013 (.004)
Brincrebo variance	.013 (.004)	.005 (.003)	.004 (.003)	.004 (.003)	.004 (.003)	.004 (.003)	.013 (.004)	.013 (.004)	.013 (.004)
cases variance	.469 (.009)	.471 (.009)	.471 (.009)	.471 (.009)	.471 (.009)	.471 (.009)	.469 (.009)	.469 (.009)	.469 (.009)
Deviance	13031.766	12944.355	12939.405	12939.067	12939.389	12938.947	13031.692	13031.191	13031.354
Reference model & Fit improvement		model 1 χ^2=87.411 df=1 p<.001	model 2 χ^2=4.95 df=1 p<.05	model 3 χ^2=.336 df=1 p=n.s.	model 3 χ^2=.016 df=1 p=n.s.	model 3 χ^2=.458 df=1 p=n.s.	model 1 χ^2=.074 df=1 p=n.s.	Model 1 χ^2=.575 df=1 p=n.s.	model 1 χ^2=.412 df=1 p=n.s.
% expl. var. province-level		69.23%	-						
% expl. var. brincrebo-level		61.54%	20.00%						
% expl. var. cases-level		-	-						
	N-provinces=12; N-Brin=122; N-sector=246; N-Brincrebo=598; N-cases=6161								

#=sig at 10% (=5% one sided); *=sig. at 5%; ** sig. at 1%; ***=sig. at 0.1%. (n.s.=non significant)

C) Advanced generic competencies

Table 1: Results multi-level models for 'Advanced generic'. Standard errors between brackets (gm=grand mean centered). Testing the necessity of variance levels in model.

Model	1	2	3	4	5
Fixed part					
Intercept	3.916 (.007)	3.902 (.010)	3.904 (.012)	3.904 (.012)	@
Random part					
province variance					
brin variance				.000 (.000)	
sector variance			.009 (.003)	.009 (.003)	
brincrebo variance		.017 (.003)	.010 (.003)	.010 (.003)	
cases variance	.317 (.006)	.301 (.006)	.301 (.006)	.301 (.006)	
Deviance	10531.870	10437.952	10421.649	10421.570	
Reference model & Fit improvement		model 1 χ^2=93.918 df=1 p<.001	model 2 χ^2=16.303 df=1 p<.001	model 3 χ^2=.079 df=1 p=n.s.	
	N-provinces=12; N-Brin=122; N-sector=247; N-Brincrebo=600; N-cases=6230				

#=sig at 10% (=5% one sided); *=sig. at 5%; ** sig. at 1%; ***=sig. at 0.1%. (n.s.=non significant)
@: A model with variance levels for respectively cases, brincrebo, sector and province does not converge.

Table 2: Results multi-level models for 'Advanced generic'. Standard errors between brackets (gm=grand mean centered). Results after correction for significant covariates.

Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Fixed part							
Intercept	3.904 (.012)	3.842 (.015)	3.839 (.015)	3.838 (.015)	3.838 (.015)	3.839 (.015)	3.840 (.015)
Gender (0=man; 1=woman)		.100*** (.017)	.103*** (.017)	.104*** (.017)	.103*** (.017)	.103*** (.017)	.100*** (.017)
Age (gm)			.011*** (.003)	.011*** (.003)	.010*** (.003)	.011*** (.003)	.011*** (.003)
Expertise (gm)				.045** (.017)			
Practice (gm)					.040* (.016)		
VRoute (gm)						.034** (.013)	
Self (gm)							.061* (.028)
Random part							
sector variance	.009 (.003)	.004 (.002)	.004 (.002)	.004 (.002)	.004 (.002)	.004 (.002)	.004 (.002)
brincrebo variance	.010 (.003)	.008 (.003)	.007 (.002)	.006 (.002)	.007 (.002)	.007 (.002)	.007 (.002)
cases variance	.301 (.006)	.302 (.006)	.302 (.006)	.302 (.006)	.302 (.006)	.302 (.006)	.302 (.006)
Deviance	10421.649	10394.461	10384.703	10377.668	10378.509	10378.021	10379.959
Reference model & Fit improvement		model 1 χ^2=27.188 df=1 p<.001	model 2 χ^2=9.758 df=1 p<01	model 3 χ^2=7.035 df=1 p<.01	model 3 χ^2=6.194 df=1 p<.05	model 3 χ^2=6.682 df=1 p<.01	model 3 χ^2=4.744 df=1 p<.05
% expl. var. sector-level		55.56%	-	-	-	-	-
% expl. var. brincrebo-level		20.00%	12.50%	14.29%	-	-	-
% expl. var. cases-level		-	-	-	-	-	-
	N-provinces=12; N-Brin=122; N-sector=247; N-Brincrebo=600; N-cases=6230						

#=sig at 10% (=5% one sided); *=sig. at 5%; ** sig. at 1%; ***=sig. at 0.1%. (n.s.=non significant)

Table 3: Results multi-level models for 'Advanced generic'. Standard errors between brackets (gm=grand mean centered). Results without correcting for covariates.

Model	**1**	**2**	**3**	**4**	**5**
Fixed part					
Intercept	3.904 (.012)	3.904 (.012)	3.904 (.012)	3.904 (.012)	3.904 (.012)
Expertise (gm)		.045* (.018)			
Practice (gm)			.043* (.017)		
VRoute (gm)				.035* (.014)	
Self (gm)					.073* (.030)
Random part					
sector variance	.009 (.003)	.009 (.003)	.009 (.003)	.009 (.003)	.008 (.003)
brincrebo variance	.010 (.003)	.009 (.003)	.009 (.003)	.009 (.003)	.009 (.003)
cases variance	.301 (.006)	.300 (.006)	.300 (.006)	.300 (.006)	.301 (.006)
Deviance	10421.649	10415.326	10415.525	10415.489	10415.747
Reference model & Fit improvement		model 1 χ^2=6.323 df=1 p<.05	model 1 χ^2=6.124 df=1 p<05	model 1 χ^2=6.160 df=1 p<.05	model 1 χ^2=5.902 df=1 p<.05
% expl. var. sector-level		-	-	-	11.11%
% expl. var. Brincrebo-level		10.00%	10.00%	10.00%	10.00%
% expl. var. cases-level		.33%	.33%	.33%	-
	N-provinces=12; N-Brin=122; N-sector=247; N-Brincrebo=600; N-cases=6230				

#=sig at 10% (=5% one sided); *=sig. at 5%; ** sig. at 1%; ***=sig. at 0.1%. (n.s.=non significant)

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