Fostering subject teachers' integrated language teaching in technical vocational education

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Research paper

Fostering subject teachers' integrated language teaching in technical vocational education: Results of a professional development program

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HIGHLIGHTS

- The PDP successfully changed teachers’ practical knowledge and teaching behaviour.
- Teachers became more aware about addressing subject-specific language while teaching.
- More teachers used strategies to stimulate students’ productive language use.
- The relation between change in teachers’ practical knowledge and behaviour is complex.

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ABSTRACT

This study reports on a Professional Development Program (PDP) designed to raise teachers’ subject-specific language awareness (TSLA) as a relevant and specific element of their practical knowledge and improve their language integrated teaching behaviour. The design of the PDP was based on the interconnected model of teacher professional growth (Clarke & Hollingsworth, 2002). Data were collected using semi-structured interviews, classroom observations, and video-stimulated interviews. The PDP resulted in change in both teachers’ subject-specific language awareness and related teaching behaviour. Teachers’ sense of responsibility to address students’ language learning appeared to be relevant for teachers’ change of behaviour.

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1. Introduction

This study focuses on the impact of a Professional Development Program (PDP) designed to raise subject teachers’ subject-specific language awareness (TSLA) and improve their teaching behaviour regarding integrated language teaching in first language (L1) content lessons in Dutch technical vocational education (TVE).

Language is an important cognitive tool for students to share and construct new knowledge (Derewianka & Jones, 2016; Schleppegrell, 2004). Students in vocational education need to learn how to use subject-specific language and concepts in a way that is supportive for the development of vocational knowledge (De Bruijn & Bakker, 2017) and appropriate for what thinking and communicating in a specific discipline looks like (Derewianka & Jones, 2016; Freebody et al., 2008). However, language as a medium for learning is often overlooked in subject-matter teaching (Escobar Urmeneta, 2019) and pedagogical aspects of integrated language teaching are usually not part of subject teachers’ thinking and acting in vocational education (Elbers, 2012; Van Knippenberg, 2010). As a result, opportunities to contribute to students’ language development in subject-matter teaching are insufficiently exploited. This might be due to subject teachers not having learned about...
integrated language teaching during teacher education (Elbers, 2012). They seem unaware of the relation between language and learning and reluctant to invest time in student language learning as they see it as the responsibility of language teachers (Elbers, 2012; Wildeman, et al., 2021). Guiding students in learning how to use subject-specific language requires deep understanding of subject-matter and subject-specific ways of language use (Fang, 2014; Vázquez & Ellison, 2013) and depends on specific practical knowledge (Prediger, 2019; Swart et al., 2018). In the context of integrated language teaching a specific element of practical knowledge, namely Teachers’ Subject-specific Language Awareness (TSLA), is essential (Wildeman, et al., 2021). Teachers who are aware of the relation between language and learning and subject-specific language requirements, are more likely to create classroom conditions that support the development of students’ subject-specific language and communicative skills (Hajer, 2006; Tan, 2011; Unsworth, 2006; Vázquez & Ellison, 2013).

We developed a Professional Development Programme (PDP) to explore the way to effectively raise teachers’ subject-specific language awareness and support them to implement content and language integrated teaching into their own teaching practice. Research on teachers’ professional development regarding integrated language teaching reveals that its implementation is difficult to accomplish. Integrated language teaching is demanding for teachers as it involves adapting their usual teaching practice (Vázquez & Ellison, 2013). Teachers do provide their students with comprehensible language input, but rarely with opportunities to actively produce language themselves, for example, during meaningful interaction because they not always appreciate the value of classroom interaction or do not possess the ability to create adequate classroom conditions for that (Elbers, 2012; Hajer, 2006). Implementing integrated language teaching depends on teachers’ practical knowledge regarding the relevance of language learning (Hajer, 2006; Prediger, 1999; Swart et al., 2018; Van Knippenberg, 2010). Teacher’s practical knowledge is the knowledge of teachers (Fenstermacher, 1994). It is the knowledge that teachers use when they face the practical situations of teaching, including its planning and evaluation (Clandinin, 1985); it guides their actions in practice. More specifically, teachers’ practical knowledge is considered as personal, related to context and content, often implicit or tacit, and based on and developed through experiences in practice (Verloop et al., 2001; Van Driel et al., 2001). Practical knowledge consists of both knowledge and beliefs, whereby beliefs function as a filter for the extent to which new information is interpreted and integrated in teachers’ existing practical knowledge (Pajares, 1992).

For successful professional development, a single focus on teachers’ teaching behaviour is not enough. Their existing practical knowledge must also be taken into account (Barendsen & Henze, 2017; Beijaard & Verloop, 1996; Hajer & Norèn, 2017; Van Driel et al., 2001). This study investigates the improvement of subject teachers’ practical knowledge and teaching behaviour regarding content and language integrated teaching. The study evaluates the impact of a PDP on senior secondary technical vocation teachers’ awareness of subject-specific language (TSLA) and their use of teaching strategies based on the interconnected model of teacher professional growth developed by Clarke and Hollingsworth (2002) and operationalised by the use of video clubs (Van Es & Sherin, 2010) and features of effective professional development (e.g., Garet et al., 2001; Van Veen et al., 2010). The central research question is: ‘What are the results of a PDP aimed at improving subjects teachers’ practical knowledge (TSLA) and teaching behaviour regarding content and language integrated teaching?’

Studying the impact of this PDP provides insight into the extent in which a PDP can change subject teachers’ understanding of how language and learning are related and into enhancement of their teaching strategies regarding integrated language teaching. This study might also reveal implications for teacher education programs about integrated language teaching in L1 content lessons. It will give insight into how to raise teachers’ awareness of the importance of addressing subject-specific language teaching in content lessons and how teachers learn to create classroom conditions in order to use language in support of students’ subject-matter knowledge development.

2. Professional development aimed at changing teachers’ practical knowledge and teaching behaviour

Changing existing practices are gradual, difficult and complex processes for teachers (Guskey, 2002; Richardson & Placier, 2001). This study adheres to two overarching principles of changing teachers’ practical knowledge and teaching behaviour through participation in a PDP: (1) bringing about change through experimenting in practice and reflection on experiences and (2) aligning and building on the participating teachers’ practical knowledge closely related to their own classroom practice (Beijaard & Verloop, 1996; Van Driel et al., 2001; Guskey, 2002; Opfer & Pedder, 2011; Richardson & Placier, 2001). Both principles refer to relevant components of the interconnected model of teacher professional growth developed by Clarke and Hollingsworth (2002) (see Fig. 1a). This model consists of four domains of change: the personal domain (teacher knowledge and beliefs, i.e. teachers’ practical knowledge), the domain of practice (teaching behaviour), the domain of consequence (salient outcomes, in this study of teacher learning), and the external domain (in this study a PDP). Change in one domain leads to change in another domain by the processes of ‘enactment’ and ‘reflection’ as the mechanisms by which teacher change occurs. Enactment is the process of putting new knowledge and beliefs into practice, while reflection on new experiences may nourish these knowledge and beliefs (Clarke & Hollingsworth, 2002).

Clarke and Hollingsworth’s model provides possibilities to learn in a way that fits teachers’ preferences to learn and connects with their personal teaching practice. Teacher learning can begin in any of the four domains of change (Clarke & Hollingsworth, 2002; Opfer & Pedder, 2011). To foster the development of teachers’ practical knowledge and teaching behaviour in our study, we supported the processes of enactment and reflection (see Fig. 1b). The process of enactment is integrated into the PDP by encouraging teachers to experiment with implementing new knowledge and insights (external domain) into their classroom practice (domain of practice), for example by asking them to videotape their new classroom practices in preparation for the video-club meetings. The process of reflection is integrated in the PDP by teachers’ reflections on their experiences with implementing new ideas or teaching strategies, for example during discussions with colleagues about these experiences. These reflections are considered to impact their practical knowledge (Allas et al., 2017; Guskey, 2002). Both processes (enactment and reflection) are not only mediated by the PDP, they can also be initiated by the salient outcomes (domain of consequence). The value a teacher ascribes to (positive) outcomes of experimenting with new teaching behaviour, for example more student involvement during whole-classroom interaction, can also influence the personal domain and the domain of practice (Clarke & Hollingsworth, 2002).

2.1. Characteristics of a video-club based PDP

The PDP in this study is based on characteristics of effective
professional development; video clubs are the core of the PDP. Video clubs are meetings in which groups of teachers watch and discuss video excerpts of their own classroom work (Borko et al., 2008; Sherin & Han, 2004; Sherin & Van Es, 2009; Van Es & Sherin, 2010). These activities have the potential of fostering learning (Sherin & Van Es, 2009) and positively affecting learning outcomes of professional development (Van den Bergh et al., 2014; Van Eerde et al., 2006). Watching videos provides opportunities for teachers to notice specific teaching events (Borko et al., 2008; Gaudin & Charlier, 2015; Sherin & Han, 2004; Sherin & Van Es, 2009). They provide clear illustrations of theory and good examples of the target behaviour in the classroom (Van den Bergh et al., 2014; Zhang et al., 2011). By observing and analysing videos, teachers learn new instructional strategies and better understand their students’ thinking (Sherin & Han, 2004). In terms of Clarke and Hollingsworth’s model (2002) for professional growth, video clubs stimulate teachers to experiment with new teaching strategies (enactment) and discuss about these experiences during the video-club meetings (reflection) (see Fig. 1b). Below we outline features relevant for designing high-quality professional development programs that a video club, combined with informative meetings, coaching, and continuous reflection and enactment, can do justice (Luna & Sherin, 2017).

First, the program has to provide opportunities for active learning (Garet et al., 2001; Nassaji, 2012). A video club encourages teachers to implement new knowledge into practice and actively inquire about the particular roles of their practices (Van Es & Sherin, 2010). Second, it is important to focus on subject-matter in the program so that it is central in teachers’ work and thus relevant for their motivation for professional development (Garet et al., 2001). A video club enables teachers to focus on subjects-matter during discussions of video fragments (Luna & Sherin, 2017; Van Es & Sherin, 2010), in this study about how the language of technology can be explicitly addressed in content lessons. Third, the program needs to focus on teachers’ daily classroom practices and the application of newly learned aspects in their own teaching practice. Video-club participation challenges teachers to experiment (Van Es & Sherin, 2010) and, through that, they experience the benefits of participating (Nassaji, 2012). Fourth, the program activities require collective participation and professional communication of groups of teachers from the same school, subject, or grade level (Garet et al., 2001; Van Veen et al., 2010). Collective participation positively relates to teachers’ knowledge development and improvement of their classroom practices as it encourages them to share their practice and learn from each other’s experiences. A video club is a relevant setting for teachers to engage in and function as a community. It creates opportunities for cooperation and provides an environment where members who trust each other participate in a professional discourse based on video fragments, including giving and receiving critique (Sherin & Han, 2003). Fifth, the program needs to be intensive and of long-term duration (Garet et al., 2001; Yoon et al., 2007). Video clubs make it possible to organize meetings on a regular basis and provide opportunities to experiment with and reflect on the implementation of new pedagogical strategies over a long period of time. Sixth, and finally, the program has to provide support by individual coaching. Coaching can support teachers in modifying their behaviour according to new knowledge and pedagogical strategies they learn (Batt, 2010). Coaching provides opportunities to adapt the program to individual teachers’ learning patterns and needs (Van den Bergh et al., 2014). This aspect of individual coaching has been included in the design of the PDP in this study as an addition to existing practices around video clubs.

2.2. Changing teachers’ subject-specific language awareness

Part of the PDP in this study aims at enhancing teachers’ practical knowledge, specifically teachers’ subject-specific language awareness (TSLA) being a substantial part of their practical knowledge and essential for successful implementation of content and language integrated teaching (Hajer & Nören, 2017; Swart & Wildeman, 2018; Wildeman et al., 2021). TSLA is defined as teachers’

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**Fig. 1.** a) The interconnected model of professional growth (Clarke & Hollingsworth, 2002). b) The interconnected model of professional growth (Clarke & Hollingsworth, 2002) adapted to this study.
knowledge and beliefs about underlying subject-specific linguistic features of subject-matter to make knowledge comprehensible to students and teach them to participate in subject-specific communicative practices. TSLA consists of the following three characteristics (Andrews, 2003, 2007). Firstly, TSLA is part of teacher subject-matter knowledge (Andrews, 2003). To stimulate TSLA, the content of our PDP needs to be about learning to recognize specific language characteristics of the language of technology and its use in vocational contexts (Rose, 1997; Van Dijk & Hager, 2018). Secondly, the nature of TSLA is metacognitive. It involves teachers’ reflections on how language as a cognitive tool relates to the development of subject-matter knowledge. Such reflections need to be an important aspect of the PDP as teachers’ practical knowledge regarding language seems to consist of a formal, grammar-oriented view on language, instead of a more functional view (Hajer, 2006). A more functional view on language enables teachers to reflect on how language as a cognitive tool is related to student learning (Schleppegrell, 2004) and how it is used in vocational contexts (Derewianka, 2012). Thirdly, TSLA encompasses awareness of language from a learner’s perspective. Teachers need to realize that language at school is abstract and often decontextualized (McKeon, 2013) and be able to take the potential difficulties their students might experience into account (Andrews, 2007).

2.3. Changing teachers’ behaviour regarding integrated language teaching

The PDP in this study also aims at improving subject teachers’ language integrated teaching behaviour. Through stimulating them to implement integrated language teaching they are encouraged to change their teaching practice by building in more conditions for classroom interaction and using speaking and writing tasks with the purpose of creating a learning environment in which students have to produce language themselves. In order to define what this looks like, we used the characteristics of Content and Language Integrated Learning (CLIL). CLIL is a teaching approach focusing on students’ language learning in the context of subject-matter teaching (Dalton-Puffer, 2007; Hajer & Meestringa, 2015) assuming that integration of subject-matter and language learning enhances learning in both domains (Gibbons, 2002; Stoddart et al., 2002). The two main characteristics of CLIL are: (1) making content comprehensible by providing comprehensible language input and (2) focusing on students’ language use and thinking by stimulating their active language production (Escobar Urmeneta, 2019).

The first characteristic, making content comprehensible, entails that language learning occurs when students receive comprehensible language input (Krashen, 1985). It is essential to confront students with different sources of contextualized language use (materials such as photos, videos, electric schemes, and technical manuals) and different forms of language (visual, oral, and written language). Comprehensible language input can support students in understanding the meaning of subject-specific language. It helps students to bridge the gap between the use of language in daily situations and the more abstract, decontextualized subject-specific language used at school (Gibbons, 2009; McKeon, 2013).

The second characteristic, stimulating productive language use, implies that language learning occurs when students actively use language, both orally and in writing. Language production can take place during meaningful interaction (Gibbons, 2002), a natural conversation between learners that provides opportunities for students to practice language (Lyster, 2002). It encourages students to explicate their thoughts about subject-matter (Gibbons, 2009; Rojas-Drummond & Mercer, 2003) and their comprehension of subject-matter (Gibbons, 2009; Pica et al., 1987; Rojas-Drummond et al., 2013). Meaningful interaction requires teachers to master high quality interaction strategies, particularly asking open and follow-up questions, providing time to think, and stimulating students’ initiatives to contribute to classroom interactions (Knezić et al., 2010; Li, 2011). Effective questioning is one of the most important teaching strategies to engage students in classroom interaction, help them understand content and language, promote development of their thinking skills (Li, 2011; Rojas-Drummond & Mercer, 2003; Saeed et al., 2012), and challenge students to use language at higher, more abstract levels (Anderson & Krathwohl, 2001; McDougald, 2018; Saeed et al., 2012).

3. Method

3.1. Participants

Eight subject teachers from two different Dutch senior secondary vocational education schools participated in this study (four from each school). The teachers from one school taught technical subjects regarding Maritime Education, the teachers from the other school taught technical subjects regarding Automotive Technology. Both schools are located in a large city. All teachers were teaching at the two highest qualification levels in senior secondary vocational education, which prepare students for a job qualification at professional and middle-management level. All teachers, except one, were male. This is representative of Dutch Maritime and Automotive sectors in which most practitioners (91%) are male (Techniekpact monitor, 2020). The teachers were not familiar with language integrated teaching; they did not learn this during their teacher education either. The teachers were informed about the purpose of the study and the use of the data. They all gave their consent and voluntarily participated in the PDP and the associated research.

3.2. Design of the study

A pre-post design was used to identify changes in the practical knowledge, focusing on TSLA and teaching behaviour about integrated language teaching in the context of L1 (Dutch) content lessons. Teachers’ practical knowledge and teaching behaviour were investigated prior to and after the PDP.

3.3. The professional development program

The PDP was based on Clarke and Hollingsworth’s model with a central role for video-clubs. Its content focussed on aspects of practical knowledge related to using subject-specific language in technical subjects, in this study referred to as TSLA. It also encompassed theoretical concepts related to the pedagogical principles of CLIL. For implementing the PDP we operationalised the above-mentioned features which are considered to be effective for professional development (see Table 1). The overall program consisted of eight meetings carried out over a period of six months (see Fig. 2). These meetings encompassed four informative meetings (three at the start and one at the end of the PDP) and four video club meetings. Halfway through the PDP one moment of individual coaching was planned for each teacher.

In preparation for the video-club meetings, the teachers designed and implemented content and language integrated classroom activities in order to put the theory from the informative meetings into practice. Each teacher executed a sequence of the following activities three times during the PDP:
Table 1
Features of effective professional development and their operationalisation.

<table>
<thead>
<tr>
<th>Features of effective professional development</th>
<th>Professional development program</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 The program provides opportunities for active learning</td>
<td>The program activates teachers to reflect on how theory about the relation between language and learning is related to technical vocational education and how a content and language integrated teaching approach can be implemented in their own classroom practice. The informative meetings are interactive and activating. Teachers are required to experiment with adapting their teaching behaviour in their regular lessons. At the end of each informative meeting teachers are asked to fill out a short form about what elements of the theory they are willing to experiment with in their own classroom practices.</td>
</tr>
<tr>
<td>2 The program relates to subject-matter content</td>
<td>The program focuses on teachers’ awareness of subject-specific language aspects which are part of teachers’ subject-matter knowledge. In the context of this study, the program specifically focuses on the characteristics of the language of technology.</td>
</tr>
<tr>
<td>3 The program is compatible with teachers’ own daily classroom practices</td>
<td>Teachers’ current practical knowledge and teaching practices are taken into account at the start of the PDP. Based on the results prior to the PDP, video fragments of their own lessons and excerpts of how they interact with students are presented and discussed during the first two meetings to provide teachers with examples of the pedagogical aspects of CLIL. The program is also compatible with teachers’ own daily classroom practices, because video fragments of teachers’ own teaching practices are used and discussed in the video-club meetings.</td>
</tr>
<tr>
<td>4 The program provides collective participation of groups of teachers from the same school, subject, or grade level</td>
<td>The video-clubs consist of a group of teachers from the same school, the same technical department, and the same qualification level for senior secondary vocational education. During the video-club meetings teachers function as a group of teachers that watch, discuss, and reflect on excerpts of videos from their own classroom practices.</td>
</tr>
<tr>
<td>5 The program is intensive and of long-term duration</td>
<td>The program is conducted over a period of six months. The program includes a sequence of the following ongoing activities: designing, implementing and videotaping classroom activities as well as selecting, presenting and discussing video fragments. The teachers also attend 8-2 h meetings: there are three informative meetings at the start of the PDP, followed by four video-club meetings, and there is one informative meeting at the end of the PDP.</td>
</tr>
<tr>
<td>6 The program provides teachers differentiated feedback by individual coaching</td>
<td>The program provides support by individual coaching, because three lessons of each teacher (at the start, middle, and end of the PDP) are observed by and then directly discussed with the facilitator. Half way the PDP there is a 1 h individual coaching meeting for each participating teacher. The goal of this coaching meeting is to help each teacher to further operationalise his/her ideas about content and language integrated teaching into his teaching practice. Providing teachers with feedback is realized after the classroom observations (3 times), during the video-club meetings, and during the individual coaching meeting.</td>
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</table>

(1) Designing content and language integrated classroom activities (e.g. speaking tasks or assignments to practice the meaning of symbols and abbreviations).

(2) Videotaping the implementation of the designed classroom activities (e.g. a lesson where a teacher practices asking open questions during an interaction moment).

(3) Individually watching the videotaped lesson and then selecting video fragments (e.g. a fragment where the teacher helps a student to read a technical handbook).

(4) Sharing and explaining selected fragments in the video-club meeting (e.g. the teacher explains to show a fragment in which students practice conversations that are authentic for the occupational practice).

(5) Discussing and reflecting on these fragments during the video-club meetings (e.g. about what kind of questions a teacher asks during an interaction moment that went very well).

The teacher whose video fragment was discussed during the video-club meetings first provided the other teachers with contextual information of the fragment being watched, so that a lack of contextual understanding would not limit the discussion (Sherin & Han, 2004; Zhang et al., 2011). The fragment was then watched, discussed, and reflected on. The facilitator was essential as s/he initiated and guided the video-club meetings and helped teachers to optimize their reflections during the discussions of the video fragments (Groschner et al., 2014; Zhang et al., 2011). During the video-club meeting, the facilitator took notes which included the teachers’ intentions with the teaching activities they experimented with as revealed in the introduction of the video fragments to be shown. The notes also contained the facilitator’s comments on what was already going well and what could be improved in the lessons shown. The facilitator monitored the focus and direction of the discussions in the video club. The main themes of the informative meetings were the starting point for this. Questions that teachers discussed were, for example: ‘To what extent are students challenged to actively use professional language with this speaking task?’ and ‘To what extent are students stimulated to think about the meaning of technical concepts with the questions asked by the teacher?’ The facilitator also provided teachers with new knowledge and encouraged them to implement new teaching strategies based on their own concerns and experiences (Groschner et al., 2014).

3.4. Data collection

Semi-structured interviews, classroom observations, and video-stimulated recall interviews were used to collect the pre- and post-data. Semi-structured interviews were used to gain insight into the development of TSLA as a specific element of teachers’ practical knowledge. Semi-structured interviews enable teachers to express their practical knowledge and are therefore frequently used to make this knowledge explicit (Black & Hallwell, 2000). The pre-interview consisted of three themes: (1) teacher’s awareness of the relation between language and learning, (2) teacher’s responsibility to stimulate students’ language proficiency, and (3) teachers’ self-reported teaching activities related to the pedagogical principles of CLIL. Examples of questions related to these themes are: ‘Are there any subject-specific language aspects that you think should be addressed during teaching?’, ‘To what extent do you, as subject teacher, feel responsible to stimulate your students’ language development?’, and ‘How do you pay attention to language skills of your students in class?’. These main questions were further elaborated by asking follow-up questions like: ‘In what way do oral language skills play a role in the subject you teach?’ and ‘Can you give an example of classroom activities or
assignments you use to stimulate students' language development? The post-interview consisted of the same three themes. All interviews were audio-recorded and transcribed verbatim.

Classroom observations were used to gain insight into changes in the teachers' teaching behaviour regarding their use of: (1) language to make content comprehensible, (2) types of interaction strategies to stimulate students' active language use, and (3) classroom activities to stimulate students' active language use. Prior to and after the PDP, a 50-min-lesson was observed and videotaped for each teacher. During the observations, the researcher made notes of all interaction moments between the teacher and the whole class. A new interaction moment began when the teacher started a new topic to discuss. All observed interaction moments were fully transcribed.

In order to capture teachers' practical knowledge, in this study TSLA, semi-structured interviews are often supplemented with stimulated recall interviews (Meijer et al., 2002). In this study, we used video-stimulated recall interviews to stimulate teachers to explicate their motives and thoughts closely related to their behaviour in practice, while watching a fragment of a lesson they had just given. These recall interviews were conducted directly after the classroom observations and used to better understand how teachers transferred TSLA into their teaching practices. The first part of the interview had the character of a semi-structured interview consisting of questions about the lesson's subject-specific language requirements and the way teachers took these requirements into account in their lesson design. During the second part of the interview two video fragments were shown to the teacher. Depending on the observed classroom activities, these fragments consisted of teacher behaviour during whole-class interaction or an instruction by the teacher about a specific classroom activity, like a reading or writing task. Questions were asked to clarify the teacher's intentions with the activities and to gain insight into how the teacher's underlying motives regarding classroom activities were in accordance with the pedagogical principles of CLIL. The video-stimulated recall interviews took place at the same day or sometimes one or two days after the observed lesson. The interviews were audio-recorded and fully transcribed.

3.5. Analysis

Teacher professional development is characterized by change in practical knowledge, teaching behaviour, and the relation between the two and becomes visible in explicated knowledge and observed behaviour (Zwart et al., 2007). The analysis of the impact of the PDP took place by constructing and comparing two pictures of teachers' practical knowledge and teaching behaviour based on the data collected with the general semi-structured interviews, lesson observations, and video-stimulated recall interviews before and after the PDP. Qualitative data analysis took place following a process of data reduction by summarizing and displaying the data in matrices for each teacher separately (Miles et al., 2019). The interpretation of the data was based on the theoretical concepts presented in Table 2. We used the five categories in this table for the analysis of the pre- and post-data and to ascertain whether there was a change in teachers' practical knowledge and related teaching behaviour as a
result of the PDP. Together these categories provide insight into the extent of TSLA and how teachers translate this awareness into their actual teaching practice (Wildeman, et al., 2021).

Changes in TSLA were determined by categorizing and comparing the data from the semi-structured interview and the video-stimulated recall interview prior and after the PDP. The analysis of the interview data consisted of four steps. First, using the transcripts, each teacher’s answer to each question was summarized and illustrated with a representative quote in a matrix. Second, the summarized data and quotes were given a colour according to the colours of the categories in Table 2. Decision rules were formulated to assign the data and quotes to the relevant category of Table 2. For example, statements in which teachers mentioned the importance of language in general were assigned to category 2 ‘Raising awareness’. Third, the colour-coded data were used to determine which subcategories (a, b, c, d) of TSLA of each of the categories of Table 2 were present in the summarized data and quotes of each teacher. For each teacher, a colour was assigned to each subcategory that was present in his/her TSLA in accordance with the colour of the categories in Table 2. We used the colour gray to indicate that a certain subcategory was not present in the interview data. The teachers’ colour-coded subcategories were presented in a matrix. Fourth, based on the colour-coded subcategories a dominant colour was assigned to each category for each teacher representing the final classification of each teacher’s TSLA according to the categories in Table 2. This resulted in a colour-pattern that characterized each teacher’s TSLA (see Table 3). Finally, the teacher’s colour-patterns after the PDP were compared with their colour-pattern prior to the PDP.

Change in teachers’ teaching behaviour was determined by comparing the pre- and post-observation data by using category 3, 4 and 5 of Table 2. These categories represent the pedagogical principles of CLIL. Category 3 is about making content comprehensible, category 4 and 5 are about CLIL’s characteristic of stimulating students’ productive language use. Besides teacher’s use of advanced interaction strategies as represented by category 4 and 5, category 5 is also about formulating language learning goals and using language related speaking and writing tasks. The data analysis consisted of five main steps. First, a general description was made of each teacher’s teaching strategies (explaining words and explaining visualizations) to make lesson’s content comprehensible (category 3, Table 2). Second, the nature of the use of subject-specific words and visual representations of information (like photos, videos, graphs) was determined for each teacher. Indicators used to categorize the teaching strategy explaining words were: referring to vocational context, mentioning words background, meaning of related abbreviations, mentioning related units and symbols, and giving examples. Indicators for the teaching strategy explaining visualizations were: referring to vocational context, meaning of symbols, mentioning the components, mentioning the structure, and analyzing relations in the visualizations. Third, the nature of each teacher’s interaction behaviour was determined by analysing the teacher’s contributions to each interaction moment according to the indicators of the subcategories Simple interaction strategies and Advanced interaction strategies (category 3 and 4, Table 2). Fourth, a process of colour-coding was used to determine which of the indicators and subcategories of category 3, 4, and 5 (Table 2) were present in the observation data of each teacher. For

<table>
<thead>
<tr>
<th>Category</th>
<th>Teachers’ practical knowledge</th>
<th>Teaching behaviour</th>
</tr>
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<tbody>
<tr>
<td>1. Unaware of the relation between language and learning</td>
<td>a. Unaware of the relation between language and learning [not applicable] b. Having a formal view (grammar orientated) of the concept of language c. Not having any concerns about students’ language proficiency d. Not mentioning any language requirements in teaching a specific subject</td>
<td></td>
</tr>
<tr>
<td>2. Raising awareness</td>
<td>a. Awareness of the relation between language and learning b. Having a functional view of the concept of language c. Expressing general concerns about students’ language proficiency d. Recognizing general language requirements in teaching a specific subject</td>
<td></td>
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<tr>
<td>3. Making content Comprehensible</td>
<td>a. Awareness of the relation between language and learning b. Having a functional view of the concept of language c. Expressing content specific concerns about students’ language proficiency d. Recognizing general language requirements in teaching a specific subject</td>
<td>Strategies to make content comprehensible; mostly teacher centered: a. Teacher is explaining words b. Teacher is explaining visualizations c. Simple interaction strategies closed questions, no follow-up questions, little time to think, turn exchange by teacher, questions at low order thinking</td>
</tr>
<tr>
<td>4. Stimulating productive language use</td>
<td>a. Awareness of the relation between language and learning b. Having a functional view of the concept of language with a focus on students further professional development c. Expressing content specific concerns about students language proficiency d. Recognizing subject-specific language requirements – recognizing the value of talking and writing a. Awareness of the relation between language and learning</td>
<td>Strategies to stimulate productive language use; focused on student learning: a. Inviting students to explain words b. Inviting students to explain visualizations c. Advanced interaction strategies open questions, follow-up questions, providing time to think, turn taking by students, questions at high order thinking</td>
</tr>
<tr>
<td>5. Expanding language proficiency in the content area</td>
<td>a. Awareness of the relation between language and learning b. Having a functional view of the concept of language with a focus on students further professional development c. Pinpointing content specific concerns about students language proficiency d. Recognizing subject-specific language requirements</td>
<td>Strategies to stimulate productive language used in relation to formulated learning objectives: a. Use of (subject-specific) language learning goals b. Advanced interaction strategies c. Use of language related speaking and writing tasks</td>
</tr>
</tbody>
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Table 2
Categories of teachers’ practical knowledge regarding TSLA and behaviour regarding integrated language teaching.

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Table 3  
Changes in TSLA.

<table>
<thead>
<tr>
<th>TSLA – before PDP</th>
<th>Andy</th>
<th>Bob</th>
<th>John</th>
<th>Joshua</th>
<th>Neil</th>
<th>Robin</th>
<th>William</th>
<th>Lynn</th>
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<td>1 Unaware of the relation between language &amp; learning</td>
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<td>3 Making content comprehensible</td>
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<td>4 Stimulating productive language use</td>
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<td>5 Expanding language proficiency in the content area</td>
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*Note.* The colours are consistent with the colours of the categories of Table 2. The colour grey indicates that a teacher did not explicate any of this kind of TSLA. The names are pseudonyms.

3.6. Reliability

The first author conducted the analysis of the data. All decisions during each analysis step were discussed with and consented by the other authors who also checked the findings from the interviews and classroom observations on their accuracy. To underline the reliability of the study, the interview results were illustrated by representative quotes of the teachers (Maso & Smaling, 1998). An audit procedure was conducted by an external researcher familiar with the domain and methodology of the study to check the quality of the data collection and analysis, (Akkerman et al., 2008; De Kleijn & Van Leeuwen, 2018). The auditor received a sample of three teachers’ complete data sets collected prior to the PDP, including a process document with analysis steps, decision rules for assigning the data to the categories of Table 2, all notes made by the researcher, and available matrices. The auditor considered the data collection and analysis as accurate and acceptable and the reported results justifiable. The audit report can be requested from the first author.
4. Results

4.1. Changes in TSLA

Table 3 presents an overview of changes in TSLA. The colours represent different categories of TSLA; they differ in the extent to which teachers can be considered language aware. The colours in the upper part of Table 3 show according to which category TSLA can be characterized for each teacher before the PDP. The colours in the lower part of Table 3 show this for each teacher after the PDP. The ordering of teachers from the left to the right in Table 3 is based on the extent to which their TSLA before the PDP was determined to be ‘not so language aware’ or ‘more language aware’.

Before the PDP, two of the eight teachers were unaware of the relation between language and learning (yellow coding category 1, Table 3). They did not consider language teaching to be related to the subjects they teach and believed it is only the language teachers’ responsibility to stimulate the students’ language development. After the PDP, all teachers were aware of the role language has in their students’ learning process (red coding category 2). They all have a functional perspective on language as they consider language to be functional for students’ knowledge development and vocational practices. For example, teacher William mentioned that language has an important role in students’ knowledge development:

I think that’s quite a big role. Because in the end, a large part of what they [students] have to master is both a new practice and new theory. And those things are about sand and water and the relation between these concepts. It is a kind of jargon that is used.

With regard to TSLA related to category 3, before the PDP three of the eight teachers possessed some awareness of subject-specific language requirements and the importance of making this language comprehensible for their students (purple coding category 3). However, they mainly mentioned general language skills that are important for their students, like reading and writing. After the PDP, all the teachers were aware of subject-specific language requirements and the importance of addressing these while teaching. They mentioned the importance of using technical words. Teacher Neil: “The technical name of various components. I think that’s the most important thing.” The teachers also mentioned all kinds of subject-specific language requirements related to the vocational context. Teacher Lynn explained: “They must be able to use professional concepts to express themselves and to write them down. Because you have to fill in ship’s journals and sometimes make reports of something.”

Teacher John mentioned that students need to be able to read subject-specific texts.

They must be able to read a piece of manual, which almost step-by-step explains what they should do. If you can read that manual, it’s not that hard at all. If you cannot read that manual, it becomes super complex to do.

After the PDP, five teachers seemed more aware of teaching strategies to stimulate students’ productive language use during interaction compared to what they mentioned before the PDP (blue coding category 4). Teacher Joshua said about his lessons: “During instructions I let the technical concepts students have to learn come back repeatedly. I just try to use it a lot. I also stimulate students to supplement the meaning of those technical concepts.” Teacher Andy explained that the aim of the questions he asks, is stimulating students’ higher order thinking skills:

What I actively try to do is to distinguish between the level of questions I use. So I also set the goal of this lesson to make more active use of the “what if” combination. I try to ask the question, what are you researching then? And what does that research mean? So what happens if you change this or that? By asking something more openly at a higher level, you stimulate them to give answers that show more knowledge in0020 contexts.

Before the PDP, none of the teachers expressed any TSLA related to the category ‘Expanding language proficiency in the context area’ (green coding category 5). A distinctive part of TSLA related to this category is teachers’ ability to indicate precisely their specific concerns regarding students’ subject-specific language proficiency. These concerns are expressed in (subject-specific) language learning goals and teachers’ intentions with these goals. After the PDP, two of the eight teachers formulated language learning goals for the lesson observed. For example, teacher Joshua formulated the following language learning goal: ‘The students can explain the concepts of work, ability, and torque in their own words to the others.’ During the video-stimulated recall interview after the lesson, Joshua revealed his intention with this learning goal: “And the most important thing is that the concept really comes to life for them, that it is not just a word.” Teacher William formulated as a language learning goal: ‘The students write a scenario of a safety exercise aboard a ship and add points for improvement’. William’s underlying motive related to this learning goals was: “It is mainly about how you evaluate something like this and what you encounter in practice.”

4.2. Changes in teachers’ teaching behaviour

Table 4 presents an overview of the changes in teachers’ teaching behaviour. The colours in Table 4 represent category 3, 4 and 5 of Table 2. The upper part of Table 4 shows according to which category each teacher’s teaching behaviour can be characterized before the PDP. The lower part of Table 4 shows this for each teacher after the PDP. The ordering of teachers in Table 4 is based on their teaching behaviour before the PDP (from less to more in line with the pedagogical principles of CLIL).

Before the PDP, three of the eight teachers did not show any CLIL-related teaching behaviour (only gray coding in category 3, 4, 5, Table 4). Their lessons were more about the lesson’s planning and providing instructions, and less about making subject-matter content comprehensible. Before the PDP, five teachers did use some teaching strategies to make the lesson content comprehensible (purple coding category 3), mostly strategies to explain words. They created limited opportunities for students to actively use subject-specific language themselves; for example, during whole class interaction moments or other classroom activities.

After the PDP, all teachers used teaching strategies to make lessons’ subject-matter comprehensible by using comprehensible language input (purple coding category 3). They all used strategies to make the meaning of technical words and visualizations comprehensible. The observations showed some meaningful differences in the number of teachers using the strategies ‘referring to the vocational context’ (4 teachers before vs. 7 teachers after the PDP) and ‘giving examples’ to do so (3 teachers before vs. 7 teachers after the PDP). After the PDP, teachers used more visual representations of information to make lesson content comprehensible, like photos, videos, and graphics. The observations showed again some meaningful differences in the number of teachers using the strategy ‘referring to the vocational context’ (4 teachers before vs. 6 teachers after the PDP). After the PDP, there were also differences in the number of teachers using strategies to help students to ‘read’ visual representations of information compared to before the PDP.
More teachers mentioned the components (2 teachers before vs. 6 teachers after the PDP) and structure (2 teachers before vs. 4 after the PDP) of the visualisations, and showed students the relation between components (3 teachers before vs. 5 teachers after the PDP) in order to teach them how to analyse and interpret the visual representation of information. After the PDP, whole classroom interaction became an important aspect of all teachers’ lessons. Teaching strategies to explain the meaning of words and visualisations were used during interaction moments. The observations revealed that the number of interaction moments after the PDP increased to 55 moments compared to 23 before the PDP. Regarding teachers’ use of interaction strategies, there was an increase in the number of teachers who used the simple interaction strategies ‘asking closed questions’ (4 teachers before vs. 8 teachers after the PDP) and ‘asking questions aimed at lower order thinking’ (3 teachers before vs. 8 after the PDP).

Regarding category 4 (Table 4), before the PDP only two teachers used teaching activities to stimulate students’ productive language use (blue coding category 4). Whole-class interaction was an important aspect of their teaching. They now and then used some advanced interaction strategies to stimulate students to talk about subject-matter and provoke their higher order thinking. They also actively involved students with simple tasks that included using subject-specific language by recalling the correct technical concepts. After the PDP, six teachers used teaching strategies to actively stimulate students’ productive language use by using advanced interaction strategies as a result of the PDP (blue coding category 4). The observations clearly showed meaningful differences in the number of teachers using the following advanced interaction strategies: ‘asking follow-up questions’ (2 teachers before vs. 8 teachers after the PDP), ‘providing time to think’ (2 teachers before vs. 6 teachers after the PDP), ‘turn taking by students’ (3 teachers before vs. 7 teachers after the PDP) and ‘asking questions at high order thinking’ (2 teachers before vs. 7 teachers after the PDP). The advanced interaction strategy of asking open questions was only used by two teachers after the PDP.

Regarding category 5 (see Table 4), before the PDP none of the teachers used expert teaching strategies to further expand their students’ language proficiency compared to two of the eight teachers after the PDP (green coding category 5). Besides the use of advanced interaction strategies during whole class interaction moments, the observation data revealed that these two teachers also used classroom tasks related to the subject-specific language learning goals they formulated in advance of the observed lessons. Although four teachers mentioned using subject-specific language learning goals in relation to their content lessons, only two of them also specifically related these language learning goals to the use of language related learning tasks.

4.3. The relation between TSLA and teaching behaviour

The data showed that more language awareness, indicating an increase of practical knowledge regarding the use of language in technical subjects, not automatically leads to more content and language integrated teaching behaviour. For example, teacher Neil showed no change in his teaching behaviour (purple and blue coding category 3 and 4, before and after the PDP; see Table 4), which was less than expected based on the change in his TSLA (red coding – category 2 – before the PDP versus red, purple, and blue coding – category 2, 3, and 4 - after the PDP; see Table 3). The data revealed two aspects of TSLA that possibly influence or hinder their teaching behaviour: (1) teachers’ sense of responsibility to address students’ language learning and (2) teachers’ experiencing lack of time to implement content and language integrated teaching. The first aspect, teachers’ sense of responsibility, was only part of the TSLA of three teachers (Joshua, John, and Andy).
Andy, William) who showed much change in their TSLA and teaching behaviour. These teachers were very explicit about their responsibility. As subject teachers they feel no responsibility to stimulate students' general language development. However, they do feel the responsibility to teach students how to use subject-specific language necessary for their future profession. Teacher William explained: “It is my responsibility that a student is able to cope on board of a ship and to understand what is being discussed.” Teacher Joshua said:

We train students for companies and see that they make mistakes there. It sounds very heavy, but I think they are more valuable if they have gone through that [language] development, especially when it comes to writing. We are the school, so we have to do that.

The second aspect, teachers’ experiencing lack of time to implement aspects of CLIL, was mentioned by five teachers who did show some change in their TSLA, but not much in their teaching behaviour. To a certain extent, these teachers believe they have the responsibility to stimulate students’ subject-specific language development, but their lack of time might explain why their teaching behaviour did not change as much as might have been expected based on the change in their TSLA. Teacher Lynn pointed out: “I would like to pay a little more attention to language in class, but it is already almost impossible to get through the normal curriculum.” Teacher John explained: “I would certainly like to do more with language, for example by making assignments in line with what is interesting for those students. In which they see ‘this is useful to me’. But it is all extra work.”

5. Discussion and conclusion

This study indicates that the designed PDP had a reasonable influence on teachers’ professional development. Although the relation between teachers’ practical knowledge and teaching behaviour is complex (Van Driel et al., 2001) and, in this study, not always appears to be linear, the PDP clearly resulted in change in both teachers’ practical knowledge and teaching behaviour.

5.1. Teachers’ practical knowledge

All teachers who participated in the PDP improved their TSLA to some extent. They became more aware that language is functional for students’ knowledge development and communication in vocational contexts. Teachers also became more aware of the importance of addressing subject-specific language aspects while teaching in order to enhance students’ language skills. It appeared more difficult to change teachers’ views about their responsibility as subject teacher for addressing students’ (subject-specific) language learning and teach in a language integrated way. Although teacher practical knowledge is considered to be stable and rigid, and change in teacher knowledge and beliefs is difficult to accomplish (Van Driel et al., 2001), changes in TSLA as a specific element of teachers’ practical knowledge could be realized by the PDP.

A first explanation for this result in the personal domain of the teachers (cf. Clarke & Hollingsworth, 2002) might be due to video clubs providing a learning environment with opportunities to experiment and reflect repeatedly and thus stimulate the processes of enactment and reflection that mediate change. According to Clarke and Hollingsworth (2002), profound change is not achieved if teachers try out and reflect on their TSLA. Teacher change only really gets going when teachers go through and execute several cycles in succession within the model (Clarke & Hollingsworth, 2002). During the video-club meetings, teachers discussed and interpreted what they saw in the video fragments according to their new knowledge about the relation between language and learning and subject-specific language aspects, and how to attend to these aspects in their teaching. These conversations might have influenced teachers to acknowledge the importance of providing comprehensible language input in order to bridge the gap between students’ daily language and the more abstract language used at school and to stimulate students to actively use abstract and complex subject language. This is also in line with previous research about the effect of video-club participation, revealing that during discussions about video fragments with a particular focus in mind teachers become increasingly able to see what happens in teaching practice and what is important for student learning (Luna & Sherin, 2017; Van Es & Sherin, 2010).

A second explanation for the change in teachers’ practical knowledge is that the new knowledge provided in the PDP builds on teachers’ existing practical knowledge (Van Driel et al., 2001). An important aspect of the PDP in this study was that the newly provided knowledge (TSLA) was related to technical subject-matter. Subject-matter knowledge is considered part of teachers’ practical knowledge (Meijer et al., 2002); it is this knowledge in which TVE teachers are experts. It is therefore essential that a PDP about integrated language teaching in L1 content lessons is primarily based on subject-specific language demands of subject-matter (Nikula, 2015) and not on general language requirements.

5.2. Teachers’ content and language integrated teaching behaviour

All teachers incorporated linguistic elements into their content teaching after the PDP, i.e., their domain of practice (Clarke & Hollingsworth, 2002). They used teaching strategies to make lesson content comprehensible and whole classroom interaction became an important aspect of the lessons of almost all teachers. Different teaching strategies were used to explain the meaning of technical words and visualizations during these interaction moments. The observed teaching practices became more student-oriented by inviting students to actively participate in classroom conversations. However, the quality of teachers’ interaction behaviour varied. Only some teachers actively stimulated students’ productive language use by using advanced interaction strategies. Overall, there was much variation in the change in each teacher’s individual behaviour. The change in teachers’ teaching behaviour was not as strong as the change in their practical knowledge. More practical knowledge does not automatically seem to lead to more content and language integrated teaching behaviour. Inconsistencies between teachers’ practical knowledge and teaching behaviour are a very common result of innovations (Van Driel et al., 2001). Although this study reveals the possibility of bringing about change in subject teachers’ teaching behaviour, this still seems to be complicated. Implementing CLIL seems to depend on the relevance teachers attach to language learning (Vazquez & Ellison, 2013). According to Hajer (2006), teachers not always appreciate the value of interaction. They might not relate the importance of language learning to the learner’s perspective (third characteristic of TSLA).

Some aspects of the PDP might explain the achieved change in teachers’ teaching behaviour. To pursue change in behaviour, teachers need the possibility to apply newly learned aspects in their own teaching practice (Nassaji, 2012). Video-club participation challenged them to experiment with and reflect on their own lessons. They were requested by the facilitator to regularly present video fragments of their own teaching practices in the video-club meetings. These meetings encouraged them to explain, discuss, and reflect on their experiences with implementing CLIL (Sherin & Han, 2004; Van Es & Sherin, 2010). The moments of individual coaching might also have encouraged reflection and consideration
how to translate new knowledge into practice. Coaching further helps teachers to make their ideas compatible with their daily teaching practices (Batt, 2010).

Differences in teachers’ sense of responsibility for their students’ language development might explain the variety in teachers’ behavioural change. Teachers who clearly felt this responsibility showed many changes in their teaching behaviour. Teachers’ sense of responsibility could be related to their willingness and ability to transfer their knowledge about the relation between language and learning and the language of technology into their teaching practice.

5.3. Categories for analysing teachers’ practical knowledge and teaching behaviour

The categories used in this study to determine the extent of TSLA, as relevant part of teachers’ practical knowledge, and their teaching behaviour proved to be useful for the analysis of the data and to describe the changes in practical knowledge and teaching behaviour. The categories offer a rich and precise way of looking at content and language integrated teaching in the context of TVE. They might be applicable in other teaching and learning contexts as well. For example, a clear view of the aspects of TSLA as an element of teachers’ practical knowledge, might also be relevant for developmental activities in secondary education in general and other school subjects.

We consider these categories as representations of different stages teachers might go through in the process of becoming a language aware subject teacher. Due to the variations in teachers’ development and contradictions in the relation between teachers’ practical knowledge and teaching behaviour, we do not consider these stages as mainly linear. They might represent a more dynamic process of teacher development and can be seen as aspects of TSLA and CLIL where teachers can move back and forth during the process of implementation (Van Eerde et al., 2006).

5.4. Practical implications

This study provides insight into what is important for professional development activities and teacher education. First, we suggest that the concepts TSLA and integrated language teaching need to be part of subject teachers’ knowledge base so that they become aware of language aspects of their subject and how to pay attention to these. Particularly in vocational education teachers need to know how to teach students an appropriate use of subject-specific language as this prepares and supports them in their participation in professional workplaces. Second, the categories used in this study can function as a learning tool in professional development activities. They can support and guide subject teachers to reflect on their own teaching practices and increase their language awareness and language-oriented behaviour. Third, using video clubs seems an important part of learning environments aiming at raising TSLA and improving teaching behaviour as it triggers the mechanisms of enactment and reflection.

5.5. Limitations and further research

The findings of this study must be interpreted with caution, because a limited number of teachers participated in the PDP. A second limitation pertains to the duration of the PDP and the time teachers had to experiment with new teaching methods in addition to their teaching duties. Although we took into account the importance of designing a PDP of long-term duration, the teachers mentioned a lack of time to put their ideas into practice. Taking into account that only a few teachers used advanced interaction strategies after the PDP, more emphasis could be placed on these strategies in the video club and when coaching teachers individually. A third limitation is that the domain of consequences was not included in the data collection in this study. The aim was to initiate the learning process of teachers. Therefore, the impact of the PDP was examined and not the learning process itself. A follow-up study will look in more detail at the underlying learning activities of teachers.

More research on teacher professional development regarding content and language integrated teaching in L1 content lessons in vocational education is needed. For example, each subject has its own specific language aspects to take into account, so it seems necessary to investigate if the designed PDP may also have an impact on subject teachers from other domains in vocational education. Research on long-term effects would furthermore provide insight into whether the changes teachers made become part of their regular teaching practice.

5.6. Conclusion

The emphasis of the PDP was on promoting teachers’ awareness of subject-specific language (TSLA) and the enactment of pedagogical principles of CLIL. It is relevant that subject teachers in vocational education explicitly teach students to understand and use subject-specific language in accordance with the customs of occupational practice. The outcomes show that a PDP about integrated language teaching in L1 content lessons, that specifically takes into account subject-specific language aspects, is suitable to foster subject teachers’ practical knowledge and teaching behaviour. Raising awareness of the role of language in education and teachers’ subject-specific language awareness must be explicit parts of professional development activities and initial teacher education programs so that the role of language as a cognitive tool in education is no longer overlooked by subject teachers.

Acknowledgement

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tate.2021.103626.

References