

## Article

# Enhancing Teachers' Interdisciplinary Professional Development through Teacher Design Teams: Exploring Facilitating Conditions and Sustainability

Tina Gryson <sup>1,2,\*</sup>, Katrien Strubbe <sup>3</sup>, Tony Valcke <sup>1</sup> and Ruben Vanderlinde <sup>2</sup> <sup>1</sup> Department of Political Sciences, Ghent University, 9000 Ghent, Belgium; tony.valcke@ugent.be<sup>2</sup> Department of Educational Studies, Ghent University, 9000 Ghent, Belgium; ruben.vanderlinde@ugent.be<sup>3</sup> Department of Chemistry, Ghent University, 9000 Ghent, Belgium; katrien.strubbe@ugent.be

\* Correspondence: tina.gryson@ugent.be

**Abstract:** Teachers in secondary vocational education face challenges in interdisciplinary teaching due to their traditional teacher education within specific subject domains. Collaborative efforts—like those implemented in Teacher Design Teams (TDTs)—can prepare and support teachers for interdisciplinary teaching. Research has demonstrated the factors determining the effectiveness of TDTs. However, it is noted that the sustainable continuation of TDTs remains uncertain over the years. This research investigates the conditions that facilitate the sustainability of TDTs within the context of interdisciplinary teaching. Over the course of three school years, this qualitative study monitored 14 teachers participating in four TDTs within the context of an interdisciplinary vocational education course. During the initial two school years, the TDTs received external support from the main researcher, transitioning to an autonomous operation in the third school year. A yearly interview with each participating teacher and meeting reports were collected and analysed with thematic analysis. One of the main findings reveals that while the internal coach contributes to supporting TDTs' progress, the support of the school leader is particularly crucial for sustainability. Although this study focused on school-based TDTs, it underscores the importance of support from outside the school for TDTs' sustainability.

**Keywords:** teacher design teams; teacher professional development; interdisciplinary teaching; secondary vocational education



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## 1. Introduction

The contemporary educational landscape increasingly recognises the significance of an interdisciplinary approach towards teaching and learning [1]. The multifaceted nature of reality transcends the traditional segmentation of subjects as conventionally perceived in education [2]. Interdisciplinary teaching holds the promise of fostering connections across diverse realms of knowledge, thereby furnishing students with competencies essential for both their personal and professional development [3]. Furthermore, Mansurjonovich and Davronovich [3] illustrate that an interdisciplinary and integrated curriculum holds particular relevance in vocational education, effectively preparing students to meet the challenges of their future careers. Nevertheless, interdisciplinary teaching poses a challenge for teachers, given their restricted expertise within specific disciplines and an absence of prior experience with interdisciplinary approaches in education [2,4]. Furthermore, the development of an interdisciplinary curriculum demands considerable effort, knowledge, and skills from teachers, considering its inherent complexity [5].

Collaboration among teachers from different subject areas can enhance the creation of interdisciplinary curriculum materials, as intense collaboration combines diverse knowledge, skills, and experience [4]. Consequently, the cooperation of teachers in Teacher Design Teams (TDTs) can offer significant advantages for designing interdisciplinary curriculum

materials. Handelzalts [6] describes a TDT as ‘a group of at least two teachers, from the same or related subjects, working together regularly, with the goal to (re)design and enact (a part of) their common curriculum’ ([6], p. 7). Participating in TDTs not only provides collaboratively designed curriculum materials but also fosters the professional development of the teachers involved [7]. Consequently, it can be inferred that when participating in TDTs in the context of interdisciplinary teaching, teachers not only yield useful curriculum materials but also enhance their professional growth concerning interdisciplinary knowledge and teaching skills.

Various conditions, as highlighted in previous studies (e.g., Refs. [7,8]), significantly impact collaboration within and the outcomes of TDTs. However, while these conditions play a pivotal role, their ability to ensure the sustainable continuation of TDTs in educational settings remains uncertain. Research by Stoll et al. [9] underscores this uncertainty, emphasising the lack of continued and enduring implementations of long-term professional development initiatives in the field. Teachers play a central role in maintaining a sustainable continuation of professional development initiatives, actively engaging as key participants in these initiatives [10]. Consequently, exploring teachers’ perspectives on impactful conditions influencing the sustainability of TDTs can provide valuable insights to enhance their long-term effectiveness in educational settings. Examining these conditions within the context of interdisciplinary teaching is crucial as it can highlight how the challenges of interdisciplinary teaching in secondary vocational education influence the complex interactions between TDT conditions and the sustainability of TDTs.

## 2. Theoretical Framework

### 2.1. *Interdisciplinary Teaching in Vocational Education*

Traditional education is characterised by a rigid separation between disciplines as distinct subjects, creating a sharp contrast with the real world, where everything occurs in a holistic manner [11]. Interdisciplinary teaching aligns with the real world by the integration of different disciplines, and teaching differs from a multidisciplinary teaching approach by actively integrating and fostering interaction among diverse disciplines [4]. Unlike a multidisciplinary approach, where different disciplines exist alongside each other, interdisciplinary teaching emphasises the interconnectedness between and collaboration among at least two disciplines. However, interdisciplinary teaching does not imply the dismissal of mono-disciplinary knowledge [12]. Interdisciplinarity’s existence is rooted in a profound comprehension of diverse disciplines. The extent to which subjects are integrated and interconnected determines the quality and, consequently, the advantages derived from interdisciplinary teaching [4].

Interdisciplinary teaching offers advantages in terms of student motivation and achievement [4,13]. Integrating different disciplines enables students to comprehend the practical relevance of learning, aligning it more closely with their interests and real-life experiences [13]. This alignment fosters student motivation, which can address the persistent issue of high drop-out rates among the vocational student group. Moreover, students achieve an enhanced level of learning, wherein the interdisciplinary approach not only cultivates a profound understanding of individual disciplines but also underscores their interconnectedness [4]. The integration of subjects makes learning experiences more lifelike and equips students with the ability to apply diverse knowledge and skills in an interdisciplinary manner [3]. Through interdisciplinary teaching, vocational students gain valuable skills for their future professional careers and are equipped to tackle the challenges of society and the labour market [14]. In the context of interdisciplinary teaching, project-based learning is one of the approaches frequently emphasised and is well suited for vocational education [14,15]. Applying project-based learning entails students working actively and autonomously to tackle a practical and authentic task in the form of a project. Project-based learning requires the use of varied knowledge and skills to achieve the intended final product [16].

To facilitate interdisciplinary teaching, collaboration among teachers with diverse backgrounds can be highly advantageous [17]. Teachers often lack familiarity with interdisciplinary teaching approaches such as project-based education. Collaboration not only facilitates their professional development in other disciplines but also fosters their proficiency in the interdisciplinary teaching method [4]. Furthermore, Lenoir and Hasni [18] indicate that people today are trained very specifically within a particular subject, so that the mastery of different disciplines by teachers has often become an elusive goal. Consequently, interdisciplinary teaching demands collaborative efforts, enabling the pooling of cognitive contents and processes from diverse disciplines [18,19].

## 2.2. Collaborative Curriculum Development in Teacher Design Teams

Teacher Design Teams can be viewed as professional learning communities with a focus on collectively designing curriculum materials [7]. A TDT can be organised in two distinct ways. The first approach is a school-based TDT, in which teachers from the same school collaborate. The second approach is a networked TDT, where teachers collaborate across different schools. School-based TDTs offer the advantage of enabling teachers to design curriculum materials based on the specific needs of their school and students, leading to increased engagement and a stronger sense of ownership among teachers [6]. On the other hand, networked TDTs offer the advantage of fostering more professional development among teachers by introducing new knowledge and collaboration beyond school level [20].

Research by Binkhorst et al. [7] indicates that various conditions influence the effectiveness of a TDT. The prior knowledge and expertise of the teachers [8] as well as their motivation [7] have an impact on the functioning of the TDT. As school leaders play a central role in secondary schools, it is also imperative that school leaders provide their support to the TDT. School leaders must foster a culture of professional learning by expressing interest and promoting collaborative efforts [8]. Additionally, it is essential to offer logistical support, including facilitating the TDT by providing resources such as time and infrastructure [6]. Finally, communicating the realisations of the TDT is crucial to engage the entire subject department in its progress and to guarantee the implementation of the developed curriculum materials [21].

Binkhorst et al. [7] underscore that the processes within TDTs largely determine TDT outcomes. Setting a clear and common goal is an important activity in the process, as are the team interactions and activities used to achieve the goal. A coach can facilitate these processes by guiding TDT participants through the process. Consequently, a coach who guides the TDT process emerges as a crucial key actor [22]. However, the role of the coach within a TDT is challenging. While the coach exercises a form of vertical leadership by overseeing the progress of the TDT, it is also important to have shared leadership among the TDT participants to encourage sharing ideas and collective decision making [20]. Considering the crucial role of the coach within a TDT, it may be beneficial to divide coaching responsibilities into two roles: one responsible for introducing new knowledge and expertise, and another one monitoring the progress of the TDT [23]. A coach may be either an internal figure, typically a teacher who is a part of the TDT, or an external figure, such as a pedagogical expert from outside the school team. Both offer specific advantages, as indicated by Compen and Schelfhout's research [22]. Internal coaches provide more positive evaluations for coaching activities and learning beliefs and behaviours of the team. Conversely, teachers express greater satisfaction with the overall trajectory of the TDT when an external coach is involved.

## 2.3. Sustainability of Professional Development Initiatives

In the context of professional development initiatives in education, 'sustainability' denotes the capacity of these initiatives to maintain long-term effectiveness [24,25]. According to Van der Klink [25], this entails ensuring that the strategies, programmes, or practices implemented to support teacher professional development not only provide

short-term benefits but also provide sustainable and lasting changes in the teaching process and learning outcomes. For professional learning communities, and consequently TDTs, sustainability implies a self-sustaining continuation of the professional development initiative, lasting over time [26]. Although long-term professional development initiatives are frequently implemented with the belief that they represent a sustainable approach to teacher professional development, the sustainable continuation of these initiatives over time is often uncertain [9]. Moreover, scalability is linked to the sustainability of professional development initiatives. Scalability encompasses the expansion of the professional development initiative within the school or across diverse contexts and settings [10]. Essentially, these initiatives are not merely sustained but also diversified by engaging more teachers or different contexts. The sustainability of professional development initiatives is an important prerequisite for these initiatives to scale up.

The advantage of Teacher Design Teams lies in the fact that these collaborative curriculum design initiatives can ensure both continuing professional development among teachers and curricular sustainability and innovation [8]. After the implementation and investigation of professionalisation initiatives, research often lacks follow-up to ascertain the conditions and mechanisms by which these professionalisation initiatives continue [9]. However, research by Todorova and Osburg [27] and Bakah et al. [10] shows that the active engagement of the teachers, support from the school leader, and an inquiry-based design of the professional development initiative contribute to the sustainable continuation of professional development initiatives. It is imperative that teachers remain actively engaged and feel motivated to contribute their expertise to the development of curriculum materials [10]. To facilitate this, a culture of collaboration among teachers is essential, which the school leader can foster [10,27]. Additionally, Jesacher-Roessler and Agostini [28] highlight the importance of a school leader that addresses and adapts to the needs, concerns, and changes within a school to create an educational environment encouraging sustainable professional learning. To motivate the school leader to actively engage in this endeavour and effectively manage the TDT, it is important for the school leader to be aware of the positive outcomes arising from the professional development initiative [27]. Consequently, an inquiry-based design of the professional development initiative can guide the school leader to gain an understanding of the positive outcomes. The inquiry-based design also assists teachers in recognising the relevance of the initiative and enables them to effectively facilitate collaborative work within the team [10,27]. Finally, it is crucial to be aware of local and national policies that may impede the sustainability of the professional development initiative, over which a school has mostly no control [27].

### 3. Research Context

#### 3.1. *Project Integrated General Subjects in Flemish Secondary Vocational Education*

The research presented in this article was conducted in the context of the interdisciplinary course Project Integrated General Subjects (PGS) implemented in secondary vocational education in Flanders (the Dutch-speaking part of Belgium). The PGS course integrates the subjects of languages, mathematics, sciences, and social education, with the overall aim of fostering students' self-reliance and their resilience in their (professional) lives [29]. Both schools and teachers attain significant autonomy in shaping the PGS curriculum, guided by relatively open objectives determined by governmental regulations [30]. This autonomy enables schools to shape the PGS curriculum by selecting subjects and allocating hours, mostly ranging from 6 to 8 h per week. For teachers, this approach also introduces a level of uncertainty due to the broad spectrum of options available in developing curriculum materials for PGS [31].

In Flanders, teacher education programmes offer an elective course, called 'PGS didactics'. However, many PGS teachers lack a specific qualification for this course, as PGS may be taught by almost any teacher [31]. These teachers face the challenge of teaching a diverse vocational student group while utilising a project-based approach that requires a comprehensive knowledge base across subjects, despite lacking specific training for it [31].

Consequently, there is a high turnover among PGS teachers since many opt to teach within their own specialised subject areas when given the opportunity.

### 3.2. Teacher Design Team Programme

The research discussed in this article took place in the context of a TDT programme implemented at four participating secondary schools. The aim of the TDT programme was to enhance teachers' professional development through collaborative curriculum design, tailored to the needs of their own students and school for the PGS course. The design of this TDT programme was based on a preliminary investigation by the researchers [32]. During this preliminary investigation, relevant stakeholders were interviewed to determine their perspectives on the main conditions for the implementation of interdisciplinary TDTs in secondary vocational education.

Figure 1 illustrates the main conditions of the TDT programme (Figure 1). The TDT programme incorporates both individual school-based TDTs and a collaborative networked TDT. Each school-based TDT served as the foundation for designing curriculum materials customised specifically for their students. The teachers in the school-based TDT were recommended to meet at least monthly. Participation in the school-based TDTs was based on the voluntary long-term commitment of the teachers. Within each school-based TDT, a participating teacher received training to adopt the role of an internal coach to guide the team through the design process. As such, this teacher had the dual role of coach–teacher in the school-based TDT. This enabled the autonomous functioning of the school-based TDTs. Additionally, meeting reports documented the steps and decisions made during the meetings, with the objective of sustaining the team's progress and ensuring the continuity of the school-based TDT in the event of teacher turnover. Involvement of the school leader was encouraged, with an emphasis on providing logistical and mental support. Support for the school-based TDTs was also provided through a networked TDT and a digital platform. The networked TDT met four times per school year, with participation of the coach–teachers from the four different schools. In the networked TDT, expertise was exchanged, peer supervision on the dual role as coach–teacher was held, and feedback was provided on each other's designed curriculum materials. During the networked TDT meetings, the main researcher assumed the role of an external coach. A digital platform facilitated knowledge exchange among the school-based TDTs beyond the networked TDT meetings. Both meeting reports and curriculum materials were shared on the online platform to serve as sources of inspiration.

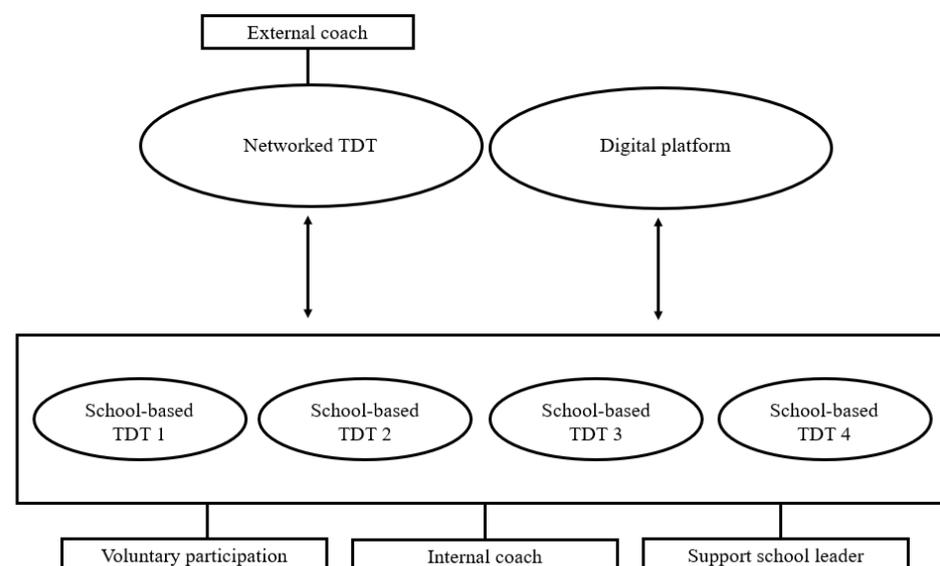


Figure 1. Main conditions of the TDT programme.

In view of an autonomous continuation and the sustainability of these school-based TDTs in the secondary schools, support was provided during the initial two years by the main researcher, both alongside and during the meetings in the networked TDT. This approach served to initiate and to embed the functioning of the school-based TDTs in the secondary schools. From the third school year onwards, the teachers could experience how an independent continuation of the school-based TDTs proceeds. The digital platform remained operational to facilitate autonomous collaboration across schools without external support.

#### 4. Research Purpose

This study investigates the conditions that affect the sustainability of TDTs in the context of interdisciplinary teaching in secondary vocational education. Within this context, sustainability pertains to the self-sustaining and ongoing continuation of TDTs within secondary schools. To investigate this, the study focuses on the conditions that teachers perceive as facilitating the sustainability of TDTs. The research question addressed in this study is as follows: 'Which conditions do teachers perceive as facilitating the sustainable continuation of TDTs within the context of interdisciplinary teaching?'

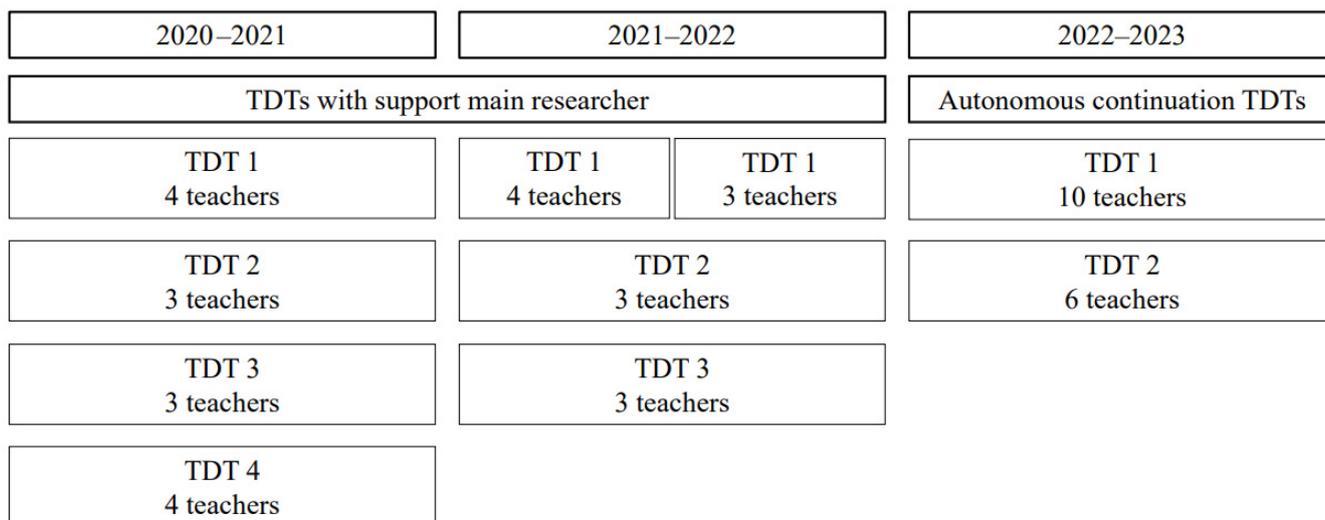
#### 5. Method

##### 5.1. Research Design and Participants

This research, spanning the school years 2020–2021, 2021–2022, and 2022–2023, aligns with Watts et al.'s [33] emphasis on investigating the long-term effects of educational interventions. Hence, a longitudinal qualitative study was conducted to examine the TDTs and the teachers involved across three consecutive school years.

In the 2020–2021 school year, this research started with the participation of 14 teachers across four secondary schools. Appendix A describes the demographics of these teachers per school-based TDT. A school-based TDT was established with three to four participating teachers. TDT 1 and TDT 4 took place in large urban schools with a student population ranging from 1000 to 1200, while TDT 2 and TDT 3 took place in smaller more rural schools with a student population ranging from 200 to 250. The selection of the participants involved extending a public invitation for the TDT programme via social media groups for PGS teachers. Specifically addressing PGS teachers rather than school leaders stemmed from the insights of the preliminary research [32], which underscored the importance of teachers' voluntary involvement. Following the teachers' voluntary commitment, the school leaders were briefed about the research, and their consent was asked accordingly.

A longitudinal research design inherently poses the risk of participant attrition throughout the study period [34]. This long-term study also faced instances of participant dropouts over its three-year duration. Figure 2 shows the participating TDTs and teachers during the three-year research period. Throughout the research period, TDT 4 decided to end its participation after the first school year (2020–2021), and TDT 3 decided to end its participation after the second school year (2021–2022). Starting from the second trimester of the 2021–2022 school year, TDT 1 had one less teacher participating. During the school year 2022–2023, TDT 1 and TDT 2 opted to proceed autonomously. Despite some teachers ending their participation, new teachers also joined the TDTs. Appendix B delineates the demographics of the teachers for each school-based TDT during the school year 2022–2023.



**Figure 2.** Participating TDTs and teachers during the research period.

### 5.2. Data Collection

This study encompasses longitudinal qualitative research. To gain a comprehensive understanding of the conditions and key events impacting the sustainability of TDTs, data were collected through various methods. By combining multiple data from different sources and at different times, the triangulation of data is aimed for [35]. This approach seeks to offer a comprehensive and in-depth portrayal of the TDTs over the course of three years and enhance the validity of our findings.

The first approach for data collection involved conducting semi-structured interviews, which were systematically recorded. A yearly interview was conducted with all participating teachers to investigate the facilitating experience and their desired conditions. However, in the school year 2021–2022, one teacher of TDT 3 chose not to participate in an interview. Then, in the following school year, 2022–2023, only six out of the ten teachers involved in TDT 1 were available for interviews. Teachers who chose to discontinue their involvement in TDTs were invited to participate in a concluding interview, aiming to gather insights into their experiences and perspectives relevant to the sustainability of TDTs. A total of 36 interviews were conducted over the three school years. The interviews ranged in duration from 40 to 60 min.

Secondly, the reports of the TDT meetings were collected for analysis. These reports were made during the TDT meetings using a pre-designed template, and the TDTs were asked to make a report of every meeting. The number of meeting reports varied across TDTs due to the TDTs’ autonomous scheduling of meetings. TDTs occasionally opted to provide oral reports or an additional explanation of their meetings through a (online) meeting between the coach–teacher and the researcher to provide more clarity. During the autonomous continuation of the TDTs in the school year 2022–2023, the TDTs were free to choose whether to make these reports or not. Table 1 illustrates the number of meeting reports for each TDT per school year.

**Table 1.** Number of meeting reports per TDT.

TDT	2020–2021	2021–2022	2022–2023
1	6	4	7
2	2	5	0
3	3	5	
4	2		

Besides the interviews and meeting reports, six observation reports were also made during the meetings at which the main researcher was present. This presence of the researcher at the meetings occurred twice in TDT 1, TDT 2, and TDT 3. In addition, informal conversations with the participating teachers also provided an interesting source of information throughout the three-year study. Short reports were made of these conversations.

To maintain ethical integrity, informed consent was obtained from each participant prior to data collection. Additionally, each school leader was asked for permission and was informed about the research.

### 5.3. Data Analysis

Prior to the data analysis, all the recorded interviews were transcribed verbatim. The transcripts and reports were anonymised to protect the confidentiality of the participants.

This study employed thematic analysis [36] to analyse both the interview transcripts and reports. Thematic analysis is characterised by a systematic analysis of qualitative data to identify recurring ideas, patterns, and ultimately themes [36]. Accordingly, an iterative approach was used to analyse the data, which implies a regular reconsideration and revision of the researcher's analysis based on the reflections and the changing understanding of the data. This iterative approach was guided by the six steps of thematic analysis [36,37]. During the first step, the researcher familiarised themselves with the data by transcribing the recorded interviews and subsequently thoroughly reading through the written data (interviews and reports). As a second step, initial codes were generated utilising in vivo coding. Subsequently, steps three, four, and five were conducted iteratively, wherein initial themes were formulated, revised, and refined, ultimately culminating in the delineation and establishment of final themes. Finally, the sixth step involved the reporting of the results.

As delineated by the described steps, the thematic analysis in this study mainly followed an inductive approach, with codes and themes emerging directly from the data. These are grouped in three categories which overarch the influencing conditions for the sustainability of the TDTs. The first category deals with the TDT conditions of the TDTs, focusing on the participants of the TDT and the organisation of the TDT meetings. The second category is school-related support for the TDT, highlighting the needed support of the TDT coach and the school leader. The third category is external support for the TDT, which focuses on a research-based foundation of the TDT and the need for cross-school initiatives. As the main researcher maintained close engagement with the participants throughout the three-year research period, this study endorses the revised designation of thematic analysis as reflexive thematic analysis according to the purified methodology of Braun and Clarke [37]. Reflexive thematic analysis recognises the subjectivity of the researcher and emphasises its value for qualitative research. It also highlights the researcher's reflexive action during the different steps of thematic analysis, which was applied by challenging the researcher's assumptions and revisiting the original data several times.

## 6. Results

### 6.1. TDT Conditions

#### 6.1.1. Participants of the TDT

The results show that the presence of enthusiastic and motivated teachers—for both interdisciplinary teaching in the PGS course and cooperation in the TDT—is imperative for the effective and continuing functioning of the TDT. If teachers lack motivation in the TDT, this causes TDTs to be unsustainable and eventually discontinue, like in TDT 3. The teachers in TDT 1 expressed that the enthusiastic and motivated team of teachers makes the collaborative work within the TDT gratifying and ensures that tasks are carried out effectively. One of the more experienced teachers viewed the TDT as a form of team building for the PGS teachers and appreciated the motivation of the newly starting teachers for the long-term functioning of TDT 1.

*There are also a few short graduates or people who have moved on to teaching and yes, actually, they surprised me positively . . . they really showed commitment and are really motivated for this TDT. (Alex, TDT 1, 2022–2023)*

This quote also shows that the motivation of team members is a determining condition, and teachers' expertise or background is less necessary for TDT collaboration and effective task performance. Starting teachers in the TDTs also highlighted the benefits of collaborating with more experienced PGS teachers, allowing them to acquire knowledge, while the just-starting and newly graduated teachers also provided new insights to the more experienced teachers.

Although this study assumes the high turnover of PGS teachers, it also establishes the need for a certain core team to sustain viable collaboration in the TDT. Both TDT 1 and TDT 4 experienced the dropout of team members, which had a major impact on the sustainability of the TDT. In TDT 1, two teachers dropped out during the 2021–2022 school year, including the coach–teacher. Consequently, the activities within the TDT remained suspended until the coach–teacher, despite no longer being employed at the school, chose to continue supporting the TDT. In TDT 4, from school year 2021–2022, only the coach–teacher remained on the team, which caused the coach–teacher to end the TDT:

*So, you have to start all over again, every time, and at the moment these are teachers who say 'well, that TDT is on top of the departmental work of my main subject and on top of the departmental work of PGS' . . . And always having to justify that . . . no, I can't do that anymore. (Sandra, TDT 4, 2021–2022)*

In addition, the above quote shows that teachers who have only a small assignment for PGS are difficult to motivate to invest their energy and time into the TDT. This was also apparent in the other TDTs and is related to the need for motivated teachers to continue the TDT in a sustainable way. This is also demonstrated by the following quote, which highlights the need for a fixed teaching assignment in PGS:

*I definitely find TDTs something interesting and I think that can definitely add value. But for me . . . personally . . . It's the first year I'm giving PGS, next year maybe again, but nothing says I'm going to teach PGS again the year after. (Diane, TDT 2, 2022–2023)*

### 6.1.2. Organisation of TDT Meetings

When organising TDT meetings, clear regularity and focus are important for the sustainability of TDTs. TDT 1 adhered to a clear annual schedule for its meetings. This schedule ensured clarity for all the participants regarding the designated meeting times and provided a clear and structured progression of the TDT. The remaining TDTs convened less regularly, often opting for informal gatherings during lunch breaks or combining TDT meetings with departmental meetings. Consequently, the irregularity and lack of focus among the remaining TDTs led to a slowdown in the TDT's progress.

*We didn't meet much, no. In fact, that was usually linked to a departmental meeting, because I even remember that one afternoon that Yves called me and that there was also a departmental meeting linked to it. (Clara, TDT 3, 2022–2023)*

This quote shows that meetings were also unexpectedly scheduled, which also causes teachers to not be completely focussed on the TDT while working together. The sense of adjunctiveness associated with the TDTs leads teachers to not only perceive a lack of progress but also to lose sight of the overarching purpose of the TDT. Scheduling the meetings with a clear focus ensures that all the participating teachers understand the importance of the TDT, which contributes to its sustainability.

An important aspect of working within TDTs is the necessity for teachers to convene in person to develop curriculum materials. During online meetings, the focus was primarily on dialogue and discussions concerning the curriculum materials rather than on substantial collaboration or joint design efforts. In addition, online meetings were also remarkably shorter, which also indicates less intense collaboration. This results in teachers making less

progress with their work and experiencing a less positive feeling during the TDT meetings. As teacher motivation is pivotal for the sustainability of the TDTs, it is crucial to prioritise cultivating a sense of meaning and productivity during the meetings.

A written report of the TDT meetings is essential for ensuring alignment among all teachers over time.

For the seamless continuation and thus sustainability of the TDT, this aspect is crucial. The way meeting reports are conducted appears to be of great importance. TDTs that approached this very summarily used the reports mainly to report to the main researcher. TDT 1, where the meeting reports were used as a working and communication tool between the members of the TDT, also ensured that everyone could always pick back up after an absence. It was also useful for the new teachers in TDT 1 during the 2022–2023 school year to use the meeting reports of the past two years to review the progression. The progression of the TDT over the years could unfold seamlessly and sustainably in this way.

## 6.2. School-Related Support for the TDT

### 6.2.1. Internal Coach

In the context of sustainability, it appears important for autonomous continuation that the coach is a teacher of the TDT who takes on the coach role. It also brings a lot of flexibility if shifts in the class schedule occur due to school activities. The teacher taking on the role of coach is also aware of this and can adjust schedules according to school events. Teachers indicate that the coach should be proactive. A proactive coach is active and forward-thinking in guiding and supporting the TDT members. This proactive coach takes initiative, anticipates needs, and strives to provide solutions even before the situation escalates.

Being a proactive coach requires a lot of skills. The coach–teachers therefore indicate that this role is very challenging, especially when combined with also helping to design the curriculum materials themselves. The coach–teachers need to find their position within the TDT. For some teachers, leading a team of peers may prove more manageable than for others. The selection of the internal coach is therefore crucial. The teachers in TDT 1 experienced two different coaches throughout the three years, and the difference between the two is very clear according to the functioning of the TDT:

*Vic always gave clear instructions and divided the work properly and then also not saving himself with the work he gave his own, so that was quite good actually . . . And the big difference with Miranda, she always had very big ideas and then halfway through saying maybe we'll do something else. Vic is more like okay, we've chosen this and now we're going to make sure it's finished. (Alex, TDT 1, 2022–2023)*

Despite the challenges for the internal coach–teacher, it was still stressed by the teachers that it is necessary to have a coach from their own team. While an external coach might ensure that more work is completed during TDT meetings by a more obvious perception of hierarchy, this does not outweigh the benefit of an internal coach:

*An answer could be that you would have played a bigger role or someone from the research would have put external pressure on us, but I wouldn't actually like that. Because then it is not our project, but then we are doing it for someone else and that is what I like about this, that it is really ours. (Susan, TDT 1, 2022–2023)*

### 6.2.2. School Leader

The school leader plays a pivotal role within the secondary school and consequently influences the functioning and sustainability of a TDT. The support extended by the school leader to a TDT is deemed a fundamental requisite. The essential support of the school leader is reflected in trust and appreciation, and in the allocation of time and resources.

An important element that emerges is that the teachers in the TDTs want to gain trust for their work in the TDT from the school leader. This trust is mainly visible by giving the teachers freedom in the TDT or by scheduling teaching hours for the teachers free of their other classes. A positive attitude of the school leader towards the interdisciplinary PGS

course can also create this sense of trust among teachers. The teachers indicate that trust is more based on a feeling.

Receiving appreciation from the school leader is also an important facilitating condition for the sustainability of a TDT. This appreciation can be shown in different ways. While teachers do not expect the school leader to exert substantial influence over the TDT, they would value the leader's interest and better understanding by engaging in communication with teachers and occasionally attending TDT meetings. The appreciation could also be visible at the school level by making other teachers and students aware of what the teachers in the TDT are working on. This communication should therefore initially come from the school leader, as the following quote shows:

*I don't think ANYONE at school knows that's going on (laughter). And that's a shame, they should know. I don't think the students themselves know that that's going on . . . Whereas that's actually simple to solve by just saying that once at the beginning of the school year . . . The principal to the teachers and the PGS teachers to the students. (James, TDT 2, 2022–2023)*

Participating in a TDT demands a lot from teachers. The effective functioning of a TDT is hindered when the school leader assumes that the time dedicated to the TDT is supplementary to a teacher's existing workload and responsibilities. This trend was noticeable across TDT 2, TDT 3, and TDT 4, as teachers frequently engaged in brief meetings during informal moments or connected TDT meetings to departmental meetings, or adjusted meetings by shortening or postponing them due to high absenteeism. The teachers of TDT 1 were allocated time off from regular classes on several afternoons over the span of three school years by the school leader specifically for meetings at the TDT. However, from April during the third school year, this arrangement was discontinued, and teachers had to meet in their spare time. This had a major impact on the meetings in the TDT and resulted in working mainly independently on the curriculum material and meeting only once at the end of the school year. It also caused the teachers of TDT 1 to decide not to continue with the TDT in the next year. Consequently, the spare moments for the TDT are very important for its sustainability.

Although efforts were made to schedule teachers off from their other classes in TDT 1, this was not uniformly positive for teachers either. Especially for the newly starting teachers, the cancellation of other classes caused additional stress:

*I also teach other subjects and mostly the TDT meetings resulted in vocational class cancellations, which gradually became less appealing as the same classes were consistently affected. (Bob, TDT 1, 2022–2023)*

Therefore, it would be advantageous if the school leader could facilitate common teaching-free periods within the timetable to allow teachers to meet between lessons. This need is also reflected by the teachers of the other TDTs. Beyond time allocation, it is crucial for the school leader to furnish the necessary resources for implementing the curriculum materials developed by the TDTs into classroom practices. In the case of TDT 3, although the curriculum revolves around ICT, there is a shortfall in the essential infrastructure required for its complete integration:

*Because you do indeed need the necessary infrastructure, enough computers . . . We do have a computer class but it's only 12 in there . . . for 19 students. (Kevin, TDT 3, 2022–2023)*

This quote demonstrates that the TDT was hindered in their design process due to a lack of essential resources. The provision of necessary resources by the school leader is essential to enable teachers to utilise the designed curriculum materials as intended.

### 6.3. School-Related Support for the TDT

#### 6.3.1. Research-Based Foundation

To ensure that all the participating teachers recognise the significance of the TDT and subsequently sustain its operations, it is crucial for all teachers to be aware that the TDT operates on a research-based foundation. On the one hand, this entails the participating teachers to understand why engaging in a TDT can be meaningful according to educational research. On the other hand, it also implies that the initiative to implement TDTs in schools originates from a research institution, such as a university in the context of this study.

A comprehensive understanding of the TDT's structure and objectives is crucial for all teachers. Only by having all teachers on the same page can sustainable cooperation in the TDT then be possible. If there is no communication about the TDT concept during the autonomous continuation of TDTs, cooperation with the new participating teachers will not be clear, as the following quote shows:

*(quieter) I didn't even know there was a collaboration . . . I didn't know that was something official . . . (Geoffrey, TDT 2, 2022–2023)*

Additionally, implementing TDTs in schools from a scientific research institution highlights the scientific character and significance of these TDTs. The fact that a research institution implemented the TDTs causes the teachers in the TDT to be more motivated and value the work within the TDT. The next quote shows that for the first time, the coach–teacher in TDT 2 was able to work well with the vocational subject teachers:

*They could also situate that, there is a concept, TDTs. TDTs do that this way and they do that with a reason. And also, it is something coming from the university, it has utility, it has an advantage. Sometimes it also needs to have a fancy name. (Sarah, TDT 2, 2021–2022)*

Therefore, communicating this to new TDT participants remains important. In TDT 1, the new teachers joining the TDT were aware of the scientific foundation of the TDTs. This contributed to positive functioning within the team.

#### 6.3.2. Cross-School Initiatives

Despite efforts to focus on the autonomous continuation of a school-based TDT in a secondary school, the results show that cross-school initiatives are also essential for the sustainability of TDTs. Teachers not only require the exchange of good practices, tips and tricks, and feedback on the designed curriculum materials but also the opportunity to meet and interact with like-minded individuals engaged in similar endeavours.

During the first two school years of this study, in which the TDTs were still supported by the researcher, the coach–teachers greatly valued the networked TDT meetings, where everyone could present both the progress made within the TDT and the curriculum materials already designed for discussion. The coach–teachers appreciated the networked TDT for reflecting on their role as coach–teachers and acquiring new knowledge through both feedback and information from coach–teachers from other schools. Some teachers who did not participate in the networked TDT themselves also indicate the benefits of cross-school networking as part of professional development initiatives. Miranda points out that this cross-school collaboration was the reason for her getting into the TDT programme, which was not going as expected due to teachers dropping out.

*And what I also find regrettable, if we had a larger network . . . It's just unfortunate that coaches dropped out of the networked TDT . . . I really believe in the principle of a networked TDT . . . I think that would take the burden off our job in general. (Miranda, TDT 1, 2022–2023)*

## 7. Conclusions and Discussion

This study investigated which conditions teachers perceive as facilitating the sustainability of Teacher Design Teams (TDTs). Sustainability was defined in this study as the

long-term and autonomous continuation of TDTs. This research is innovative because it focuses not only on the conditions that contribute to the functioning of TDTs but also on the required conditions for the autonomous continuation of these teams. By focusing on the sustainability of TDTs, this study adds to the literature in terms of the ways in which these TDTs can persist in the long term to foster continued professional development among participating teachers and curricular sustainability at secondary schools.

Longitudinal research took place within the context of the interdisciplinary Project Integrated General Subjects (PGS) course in secondary vocational education in Flanders (Belgium) during three school years. This context was chosen as collaboration in TDTs could support teachers in designing and implementing interdisciplinary teaching. The results of this research show that the sustainability of TDTs is a complex issue where several conditions are necessary and interact. Even if there is a core team of motivated teachers participating in the TDT with regular, structured meetings in person with thorough documentation, the teachers need support to sustain the TDT in the long term. The importance of both school-related support and external support is emphasised. For school-related support, an internal coach and the school leader are essential. For external support, the importance of a research-based foundation for the TDT and the need for cross-school initiatives are highlighted.

The results indicate that when an internal coach, a teacher within the TDT assuming the coaching role, is present, teachers perceive this as facilitating the sustainability of the TDT. Research by Binkhorst et al. [23] has already demonstrated the significant role of a coach in TDTs. The current study emphasises the need for an internal coach within a TDT. Besides practical considerations such as flexibility and autonomy in scheduling meetings, it becomes particularly evident that a collective sense of ownership develops among the teachers, making them feel that the curriculum materials they design result from their collaborative efforts. Research by Mooney Simmie [38] indicates that teachers who design their own curriculum materials experience a sense of ownership, which increases the effective use of these materials in the classroom. The current study demonstrates that the autonomous design of such materials, without an external coach, reinforces this feeling. This finding also contributes to the enhancement of curricular sustainability. However, it should be emphasised that taking on the role of coach in the TDT is not an easy task for the teacher. Coach training for this teacher is necessary. The choice of who takes on this role is of great importance and may be more obvious for some teachers than for others. Therefore, it is meaningful for the school leader to help steer this. Continuous support from the school leader for the internal coach is necessary for the sustainability of the TDT.

School leader support is also important for the entire teaching team within and the functioning of the TDT in the long term. While the internal coach supports the operation within the TDT, the school leader can ensure that the long-term continuation of the TDT is possible. The results in this study highlight school leader support based on trust and appreciation, time, and resources. Appreciation and trust can contribute to teacher motivation, which is important for the sustainability of a TDT. Time and resources can ensure that the organisation of the TDT is made possible at the secondary school and can continue in the long term. In addition, the school leader can also contribute to the sustainability of TDTs by recruiting and retaining a core team for the interdisciplinary PGS course.

This research revealed that not all teachers were inclined to engage in collaboration within the TDTs, despite the voluntary participation of the teachers. To foster collaboration within TDTs in secondary schools, it is imperative for teachers to move away from the notion of being a solitary teacher. Consequently, emphasising the importance of a culture of collaboration among teachers is crucial [10]. On the one hand, school leaders could play a pivotal role in cultivating and actively promoting a culture of collaboration. On the other hand, it would be advantageous if teachers, at the onset of their teaching careers, have already acquired the competencies and attitudes related to collaborative practices in education during their teacher education. Research by Willegems et al. [39] indicates that involving pre-service teachers in collaborative endeavours within schools contributes to

pre-service teachers' extended professionalism, including their receptivity to collaboration and reflection on their teaching practices. In this regard, teacher education programs could focus on initiating a culture of collaboration among pre-service teachers by incorporating collaborative professional development initiatives during their training in partnership with in-service teachers. The specific advantage of working within TDTs is that pre-service teachers learn to design curriculum materials, while in-service teachers also gain new insights during the collaborative curriculum design. It can contribute to the creation of curriculum materials that remain relevant over time and can be sustainably utilised by the various collaborating teachers. Sustainable collaborations between secondary schools and teacher education could also provide a response to the need for a research-based foundation of the TDTs and external support in cross-school initiatives.

Although this research focused on school-based TDTs, with teachers autonomously designing curriculum materials with an internal coach, the meetings within the networked TDT were valued by the coach-teachers for facilitating reflection on their roles and acquiring new knowledge from the other teachers. While the emphasis remains on school-level curriculum design, teachers emphasise the importance of cross-school initiatives as a facilitating factor for the sustainability of TDTs. Collaboration with peers, like a community, can enhance the contributions within the TDTs. Teachers use a community to support each other and provide content contributions and inspiration [40]. To ensure sustainability, one possibility could be to organise this online, allowing teachers to maintain it in a relatively autonomous manner over the long term. Research by Duncan-Howell [40] shows the potential of these online communities to achieve teachers' professional development where, at the same time, emotional support can be offered to each other. The sharing of curriculum materials could also be addressed within this online community, thereby enhancing curricular sustainability by enabling curriculum materials to be adapted and used across schools. Additionally, cross-school initiatives could serve as anchor points for TDTs facing significant teacher turnover. The PGS course is characterised by high teacher turnover [31]. By being part of a community engaged in these TDTs, new teachers can also rely on the expertise of other schools to rebuild the sustainable operation of their TDT.

Scalability of the TDTs is an additional aspect when considering their sustainability [10]. During the final school year, wherein two TDTs continued their collaboration autonomously, both TDTs independently decided to scale up the TDT initiative. Both approached the scaling up differently, with one TDT involving more teachers in the TDT, while the other TDT established multiple TDTs within the school. In both cases, this upscaling did not completely succeed. This research shows the importance of establishing a strong foundation with the facilitating conditions before scaling up the TDTs. The conditions remain necessary not only for the sustainability but also for the scalability of TDTs.

A limitation of this study is that the initial two school years were affected by COVID-19 restrictions. Consequently, the TDT program, as originally conceived, could not be fully implemented, primarily due to schools transitioning to remote learning and physical gatherings being limited. In this regard, Todorova and Osburg's [27] insight that local and national policies can impact the sustainability of TDTs beyond schools' control has been manifested in practice. This emphasises even more the need for a good foundation with the necessary support for the long-term operation of a TDT. Additionally, on the one hand, the longitudinal design of this study contributes to the long-term monitoring of teachers and therefore allows for the observation of evolutions over time. On the other hand, a significant number of participating teachers dropped out, leading to reduced continuity in following the same teachers across the three school years.

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## Appendix A

**Table A1.** Demographics of the teachers in the TDTs at the start of the TDT programme in the 2020–2021 school year.

TDT	Teacher	Gender	Education	Years as Teacher (in PGS)	Teaching Hours in PGS
1	Miranda (coach)	Female	Master's degree in psychology	14 (12)	16
	Vanessa	Female	Bachelor's degree in economy	14 (14)	20
	Vic	Male	Bachelor's degree in secondary education (PGS and physical education)	2 (2)	21
	Alex	Male	Master's degree in history	14 (14)	16
2	Sarah (coach)	Female	Bachelor's degree in secondary education (PGS and Roman Catholic religion)	6 (4)	12
	Peggy	Female	Bachelor's degree in secondary education (beauty studies)	27 (vocational subject teacher)	3
	Noah	Male	Bachelor's degree in secondary education (woodworking and physical education)	13 (vocational subject teacher)	3
3	Yves (coach)	Male	Master's degree in history	15 (15)	16
	Clara	Female	Bachelor's degree in secondary education (French, history, and geography)	32 (20)	7
	Kevin	Male	Bachelor's degree in primary education	20 (17)	3
4	Sandra (coach)	Female	Bachelor's degree in finances and insurance	13 (4)	20
	Celine	Female	Bachelor's degree in secondary education (Dutch and geography)	4 (3)	12
	Julia	Female	Bachelor's degree in secondary education (history and Roman Catholic religion)	8 (7)	6
	Anna	Female	Master's degree in educational needs	4 (3)	8

## Appendix B

**Table A2.** Demographics of the teachers involved in the independent continuation of the TDTs during the 2022–2023 school year. Teachers in bold are new team members.

TDT	Teacher	Gender	Education	Years as Teacher (in PGS)	Teaching Hours in PGS
1	Miranda	Female	Master's degree in psychology	15 (13)	-
	Vic (coach)	Male	Bachelor's degree in secondary education (PGS and physical education)	4 (4)	21
	Alex	Male	Master's degree in history	16 (16)	16
	<b>Susan</b>	Female	Master's degree in arts and culture	2 (2)	16
	<b>Charlie</b>	Female	Bachelor's degree in cultural heritage	2 (2)	16
	<b>Bob</b>	Male	Master's degree in fine arts—painting	6 (2)	7
2	Sarah (coach)	Female	Bachelor's degree in secondary education (PGS and Roman Catholic religion)	8 (6)	9
	Peggy	Female	Bachelor's degree in secondary education (beauty studies)	29 (vocational subject teacher)	3
	<b>James</b>	Male	Bachelor's degree in secondary education (geography and English)	3 (1)	16
	<b>Geoffrey</b>	Male	Bachelor's degree in secondary education (economics and English)	14 (vocational subject teacher)	3
	<b>Vicky</b>	Female	Bachelor's degree in secondary education (maths, physical education, and English)	5 (3)	2
	<b>Diane</b>	Female	Master's degree in pharmaceutical care	6 (1)	2

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