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VET leaders' collaborative problem-solving skills: insights from a professionals' master's degree program

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Vocational education and training (VET) structures are ecosystems bound to collaboration. As VET leaders' roles become increasingly diverse and demanding, challenges must be addressed through collaborative efforts within teams. Leaders' collaborative problem-solving (CPS) skills remain unexplored despite the importance of CPS in VET settings. This single case study investigates the CPS skills that VET leaders use in addressing tasks and challenges in an educational setting. Postgraduate students in a professional master's degree program with several years of work experience in VET leadership positions served as study participants. We utilised content analysis on video data of participants engaging in group work on an assignment that required them to give both constructed responses and creative solutions. The study also analysed VET leaders' self-reflections on their CPS skills collected through a survey tool. Our results revealed that despite participants' similar professional profiles, their performance in CPS varied significantly. Older participants seemed to have better self-reflection skills, and experienced professionals could allocate cognitive resources to more complex strategic and meta-cognitive processes. This study can be used as a roadmap for targeted professional development programs aiming to improve CPS skills and for informed decisionmaking in choosing professionals for pivotal leadership positions.

KEYWORDS

collaborative problem-solving, vocational education and training (VET), vocational education and training leaders, 21st century skills, lifelong learning

1 Introduction

In recent years, societies and economies have encountered complex challenges which individuals have been unable to address in a unified manner or through the lens of a specific discipline (Graesser et al., 2018). A joint study by the World Bank, UNESCO, and ILO (2023) illustrates how these challenges, like the recent pandemic and technological advancements, have profoundly impacted the imperatives for vocational education and training (VET) (Tommasi et al., 2023). The need for sustainable, digitalised, and innovative VET calls for transformation and adaptation (Cedefop, 2023; McGrath and Powell, 2016). As a result, leaders' roles in vocational education and training have become increasingly diverse and demanding.

VET leaders are responsible for developing and maintaining national educational systems, even during times of disruption (Avis et al., 2020). This critical role requires skills in communication, collaboration, and stakeholder engagement, along with proficiency in resource allocation in frequently scarce financial situations (OECD, 2021). VET leaders' tasks

involve overseeing staff management, policy planning, quality assurance, teaching, and networking, and demand a blend of interdisciplinary (Tang, 2019) and transdisciplinary expertise.

Over a decade ago, professionals in VET key positions expressed the importance of solid problem-solving skills in their work by describing the complexity of their roles as "skating on thin ice" (Coates et al., 2013). Problem-solving can manifest through collaborative efforts within teams, where diverse expertise is harnessed collectively (Meyer et al., 2020). In this case, the cognitive actions required take a different, distributed form. This perspective is illuminated by Rosen et al. (2020), who challenge the conventional notion that cognition is an individual, internal process. They assert that cognition inherently assumes a distributed nature within team collaboration. This conceptual shift aligns with the theoretical underpinnings of social-cultural theory (Vygotsky, 1987) and has prompted a notable transition in research focus from an emphasis on individual cognition to an exploration of collaborative problem-solving dynamics within teams.

Collaborative problem-solving (CPS) is a complex construct (Sousa et al., 2023) that draws on social and cognitive features (Hesse et al., 2015). It is an essential 21st-century skillset linked to efficiency, effectiveness, and economic growth (Fiore et al., 2018; OECD, 2017) and organically related to VET and improved employability prospects in the field (Argyri, 2019).

To date, extensive research has investigated leaders' problem-solving and collaborative problem-solving skills in various fields, such as in medicine (Kaul et al., 2020), the military (Mumford et al., 2017), education (Sinnema et al., 2021) and general leadership positions (e.g., Mumford et al., 2000a, 2000b; Patuawa et al., 2023). However, while CPS skills are essential for VET leaders' performance, there is a dearth of empirical research in this area. To our knowledge, no studies have described VET leaders as collaborative problem-solvers.

Past research on VET leaders mainly comprises policy reports that analyse challenges and offer best-practice examples and international recommendations (Cedefop and ETF, 2020; Subrahmanyam and Law, 2020). Sporadic research publications on CPS skills in VET address the matter from the student's point of view (Firdausa and Istiyono, 2019) or within the context of distributed leadership (Bouwmans et al., 2019; Jäppinen, 2010). In the latter examples, VET leaders and teachers in schools constitute teams for collaboration, and the research questions examine the variables related to distributed leadership dynamics. Finally, country-specific studies have examined the importance of staff collaboration for vocational school students (Jäppinen and Maunonen-Eskelinen, 2012). Overall, there is a stark mismatch between the importance of CPS within VET settings and the depth of investigation of this phenomenon in empirical research. The current single case study aims to fill this research gap by exploring the CPS skills of VET leaders in addressing tasks and challenges.

2 Theoretical background

2.1 Vocational education and training leaders

VET leaders are experienced professionals in leadership positions in governance, industry, international organisations, and higher education institutions. They oversee VET programs and have strategic or operational management responsibility for these programs' national-or international-level goals (OECD, 2021). VET leaders may be school or higher education leaders with a teaching background (Ruiz-Valenzuela et al., 2017) or work in VET policymaking. Those working in educational institutions often focus on continuous educational advancements to maintain or enhance academic quality (Bouwmans et al., 2019), while those in governance and policymaking play a strategic role in introducing and implementing innovation (Arribas and Papadakis, 2019).

New megatrends that have emerged in recent years—like digitalisation, the transition to green economies, and the disruption due to the COVID-19 pandemic—have added to the complexity of VET leaders' roles (Mathur et al., 2022). The impact of these trends on VET leaders is significant because they generate new demands in organisational, educational, and technological domains. Arribas (2016) emphasizes the crucial roles of individuals such as employers, union representatives, and members of civil society to actively promote inclusion and strengthen collaboration and coordination among regional and local VET stakeholders. Their efforts have the potential to build stronger social partnerships that actively shape and drive investments in skill development initiatives. For leaders in VET, responding to these demands necessitates the cultivation of resilient and interdisciplinary skill sets (Coates et al., 2013).

2.2 Synergies and networks in vocational education and training

VET structures inherently require collaboration. Previous work in the field offers diverse insights into the predominant role of collaboration on a national level. Rusten and Hermelin (2017) discuss collaborative arrangements in Sweden and Norway, focusing on partnerships between industry and schools and their impact on the quality of VET programs. Bürgi and Gonon (2021) present the way in which professional associations (meso level) shape governance structures in Swiss VET, as well as examples of collaboration among state actors, unions, VET schools and single firms.

On the international level, a report for the European Training Foundation (Arribas and Papadakis, 2019) emphasise collaboration and synergy as integral characteristics of VET on several levels. First, within the school context, the VET dual model (which many countries consider optimal) is premised on collaboration between the workplace and school-based training programs. In Germany, for example, on the federal, state, and regional levels, the dual apprenticeship system shows a high degree of institutionalised collaboration, wherein the vocational schools are coupled with partners and companies (Gonon, 2014). Additionally, VET professionals working in schools must establish networks with social partners and develop the capacity to engage in VET policy development in cooperation with governments (Emmenegger and Seitzl, 2020). On a governmental level, VET requires vertical and horizontal coordination and cooperation (ETF, 2013). The horizontal dimension of multilevel governance involves coordination and collaboration between actors at the same organisational or institutional level, whereas the vertical dimension extends from higher governmental levels to the foundation of VET systems and vice versa. In the context of governmental coordination, the education and training policy sector has enacted laws to promote collaboration amongst EU Member States and other institutions

(Arribas and Papadakis, 2019). VET leaders collaborate when, for example, they participate in advisory national or sectoral councils, coordinate between social partners and vocational schools, and take over new roles within territorial governmental departments and local offices on behalf of the central level.

2.3 Collaborative problem-solving: from education to the workplace

In our increasingly complex professional lives, challenges necessitate combining individual expertise into a collective context (Graesser et al., 2018). Traditionally, CPS skills have been categorised into two fundamental domains: cognitive and social (Care et al., 2014). The framework for CPS skills explored in this study is grounded in this broader skill differentiation and builds upon this classification (Hesse et al., 2015; Liu et al., 2016). Social skills constitute the "collaborative" element of CPS, while cognitive skills represent the "problem-solving" dimension (Bagnou et al., 2022).

CPS research centres on two critical questions. The first considers how we can teach and learn to collaborate effectively in teams. Educational curricula across all levels increasingly recognise the significance of integrating CPS skills into training (Fiore et al., 2018). However, identifying effective pedagogical approaches to enhance CPS skills remains challenging (Graesser et al., 2018; Rosen, 2017). Merely assigning group activities does not guarantee improved collaboration skills (Karakostas and Demetriadis, 2010). Recent efforts have investigated instructional methods conducive to CPS skill development. Initiatives such as the Animalia Project (Rosen et al., 2020) have introduced performance indicators that shed light on collaborative learning processes leading to improved CPS in 14-year-old students. Additionally, Gu et al. (2015) have devised conversation exercises and problem-solving skills trainings to assist primary school students in planning, organising, and evaluating their collaborative tasks. Educational paradigms like this are critical for the early promotion of CPS skills. However, the practical application of these findings in corporate settings is questionable, given the complexities of group dynamics and the ill-defined tasks in professional contexts.

The second pivotal question about CPS pertains to its measurement, specifically focusing on how CPS skills can be assessed and quantified in tangible work and learning environments. A substantial body of literature has generated theoretical frameworks to address this issue. The most prominent are the large-scale international frameworks used in CPS assessments: PISA (PISA/ OECD, 2017) and Assessment and Teaching of 21st-Century Skills (Griffin and Care, 2015). In 2015, the Organization for Economic Cooperation and Development (OECD) measured CPS skills in students from 52 countries. The study revealed deficient cooperation skills, with fewer than 10% of pupils in OECD member countries achieving high scores. These results are a significant concern, as CPS skills are in high demand in the workforce (Fiore et al., 2018). Small-scale assessments have also explored various indicators for measuring performance in CPS, again in educational settings. The performance indicators include the quality of the solutions produced by collaboration (Avouris et al., 2003) and the level of team communication (Foltz and Martin, 2013). A combination of measurement tools has been used, including surveys, observations, and think-aloud protocols (Oliveri et al., 2017) in both online and face-to-face environments (Andrews-Todd et al., 2018; Siddiq and Scherer, 2017).

Moving beyond the educational realm, we need to investigate CPS as a driving force behind efficiency, effectiveness, and innovation (Fiore et al., 2018) in corporate and professional settings (Pappa et al., 2023). While working in groups, leaders discuss and analyse problems and their causes and identify solutions through conversations with those affected or involved (Saiti, 2014). Because CPS manifests in such practical applications, the present study focuses on conversations involving actual tasks. Research has already delved into how human-robot interaction transforms collaboration from the leadership perspective in the era of artificial intelligence (Sejera and Bocarnea, 2022; Tsai et al., 2022). This study addresses the gap in research focusing on human interactions and leaders' everyday conversations (Meyer et al., 2020).

2.4 Aim of the study

The present case study seeks to examine the CPS skills of VET leaders, with a specific emphasis on their team dynamics while handling tasks and challenges. To bridge the gap between laboratory measurements and real-world environments, we utilise an educational setting of an executive master's program for experienced professionals.

Existing research on leaders' collaboration makes use of hypothetical scenarios (Marcy and Mumford, 2010; Patuawa et al., 2022). Although these scenarios are based on realistic situations, they do not replicate the way in which real-life situations involve pressure and interpersonal dynamics (Graesser et al., 2018; Robinson et al., 2020).

Recognising the importance of CPS skills in enhancing leaders' professional performance and employability prospects, we investigated the following research questions (RQs):

(1) How do VET leaders perform as collaborative problem-solvers?
(2) What is the relationship between the social and cognitive dimensions of VET leaders' CPS skills?
(3) Are VET leaders' personal attributes, like professional experience and leadership experience, related to how they collaborate?

3 Methods

3.1 Participants

This single case study (Yin, 2018) recruited postgraduate students from a professional master's degree program (n = 15) with a minimum of 5 years of work experience in leadership positions in VET. Some have positions managing or leading ministries, chambers, companies, and associations (n = 11), while others work in vocational education institutions such as vocational schools and colleges (n = 4). Participants who did not complete the self-reflection survey on their assessment of CPS skills (n = 3) were excluded. As a result, we report on data from nine female and three male participants with a mean age of 41.66 years (SD = 4.69). Nine have already obtained a master's degree at the time of enrolment in the study. The average work experience is 17.1 years (SD = 6.3), and the average experience in leadership is approximately 7 years.

3.2 Context of the study

VET professionals in leadership positions participated in a master's program aimed at upskilling experts in vocational education and training. We utilised videos of leaders working in groups of three or four on an assignment during the program's first semester. The assignment required the groups to create a framework for peer-group mentoring (Prummer et al., 2023) to support them throughout their studies. Participants had 2 hours for this task, and they were asked to work on different elements and to prioritise the subtasks on which they could work as a team. All groups had access to the same supplementary materials and needed to choose what would be helpful for them to use. The videos were analysed to evaluate the participants interaction with a focus on their CPS skills.

3.3 Study design

The study utilised content analysis on video data and a survey tool asking VET leaders to self-reflect on their CPS skills. At the beginning of the first semester, participating leaders attended face-to-face classes. No previous knowledge was required for the group assignment, which demanded various stages of work and problem-solving skills. The assignment required participants to give both constructed responses and creative solutions (Puccio et al., 2018). The group activity was video recorded with the participants' consent and the university's approval, and the videos were transcribed verbatim. One rater coded the videos (Table 1) with a coding scheme based on the Hesse et al. (2015) rubric. The assessment noted each time that the participants showed behaviour relevant to a criterion, which sometimes occurred several times during the task. Two months after the video-recorded sessions, participants watched the videos of their group activities and used a simplified version of the evaluation rubric (Table 2) to reflect on their roles as collaborative problem-solvers.

3.4 Coding scheme

To investigate VET leaders as collaborative problem-solvers, we employed a combination of concept-driven and inductive approaches and followed the five steps for validity in content analysis devised by Rourke and Anderson (2004). We draw from previous work on skills assessment frameworks, particularly relying on the rubrics developed by Hesse et al. (2015). Hesse and his team highlight that success in collaborative problem-solving (CPS) requires two key types of skills: social skills, which enable individuals to coordinate their actions effectively with others, and cognitive skills, which closely align with those used in individual problem-solving tasks. The social and cognitive skills outlined in this framework are essential for leadership roles in VET. According to Hesse et al.'s framework, the social dimension of CPS encompasses three categories: participation, perspective taking (Trötschel et al., 2011), and social regulation (Peterson and Behfar, 2004), which in turn link to nine corresponding codes altogether. The cognitive dimension includes two categories: task regulation and learning and knowledge-building skills, which are also associated with nine codes. In Table 2, we include six indicative codes from the overall 18 codes of the five social and cognitive categories, along with their indicators, descriptions of the inferences derived from the data to understand participants' behaviours, and coded segments. After completing the deductive coding, we excluded the code "action" because the focus of the research is the quality and not the quantity of the interactions.

The simplified version of the rubric that the participants used for the self-reflection included items for the same dimensions and codes as the one used by the coder. This ensured that the independent coding of video data and the participants' self-assessments were comparable. For example, the coding scheme for the coder included the following inferences: The participant acknowledges communication directly or indirectly (1 point), responds to or initiates interaction (2 points), or promotes interaction (3 points). For the same code, participants answered the following in the self-report survey: "Reflecting on my interaction, helping and responding to the contributions of others: a. I accepted communication directly or indirectly, b. I responded to cues in communication, or c. I started a conversation or activity and supported it."

TABLE 1 Means and standard deviations for the dimensions of CPS skills content analysis according to the coder.

Dimension	Min.–Max. Score	*M*	*SD*	*Mean %* Correct
Participation	16–121	55.75	35.86	46.11
Perspective taking	0–39	11.58	11.60	29.69
Social regulation	1–31	14.33	11.36	46.16
Task regulation	3–82	37.33	26.23	45.44
Learning and knowledge building	0–42	15.33	14.04	36.45
Total	39–275	134.33	4.64	48.79

3.5 Video analysis

We used the MAXQDA (2022) software to analyse the video-recorded discussions during the assignment, focusing on the content and relevance of the individual contributions in relation to the task. We developed a coding scheme including low-, medium-, and high-inference codes, using one to three points depending on the speaker's compliance with the predefined quality criteria (Table 2). This method enabled us to consider and account for the distinct characteristics and the quality of the interactions in a detailed way. For the coding, we used event sampling. The coding was conducted by an independent researcher to mitigate bias. To assess the intrarater reliability, a single rater coded the data on two occasions (Harvey, 2021). The second coding occurred 2 months after the initial assessment and followed the same coding scheme. It involved the random selection of four out of the 12 participants. We compared the scoring obtained on the two occasions and quantified the degree of agreement with the intraclass correlation coefficient (ICC) to assess the reliability of measurements made by the coder. Using the two-way random effects, consistency, single rater formula of ICC = (MSR - MSE) / (MSR + (k-1) * MSE), we obtained the ICC value ≈ of 0.78. This value indicates a good level of consistency, aligning with the thresholds suggested by Koo and Li (2016).

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TABLE 2 Examples of the codes used for the social and cognitive dimensions of collaborative problem solving.

Code	Indicator	Inferences	Example coded segment
1. Participation			
Action	Participating in the discussion	Activity in all contexts	This code was excluded after the revision of the coding scheme.
Interaction	Interacting with others	Acknowledges communication directly or indirectly (1 point), responds to or initiates interaction (2 points), or promotes interaction (3 points)	*So … We need a sentence about tools, and there is also a section about goals that speaks to expanding the work project and how to support relationships, share ideas, or learn specific skills. We should also specify, in the second part, some of these ideas.* (2 points)
2. Perspective taking			
Adaptive responsiveness	Ignoring, accepting, or adapting the contributions of others	Contributions or prompts from others are taken into account (1 point), incorporated (2 points), or used to give a solution (3 points)	*So, summarising what we just shared … We have gathered … potential contributions on a regular basis for individual and group progress … It will serve us all at the same time as a group but individually as well because we'll be able to ask questions and receive answers to share the experience.* (3 points)
3. Social regulation			
Self-evaluation	Recognising own strengths and weaknesses	Notes (1 point), comments (2 points), or infers capability (3 points) based on own performance	*We need to keep track of how often we meet and remind us that we should have a meeting.* *I may be bad at that.* (3 points)
4. Task regulation			
Problem analysis	Describing and analysing problems	The problem is stated as presented (1 point), divided into subtasks (2 points), or connections and the sequence of subtasks is stated (3 points)	*So, we need a sentence or tools, and there is a section on goals that speaks to expanding the work project and how to support relationships, share ideas, or learn specific skills … we can also specify in the second part, some of these ideas.* (3 points)
5. Learning and knowledge building			
Relationships	Identifying connections and patterns between and among elements of knowledge	Focuses on isolated pieces of information (1 point), links elements of information (2 points), or formulates patterns among them (3 points)	*There are three elements and maybe some specific element requires that we all do it when we are face-to-face together and maybe another element does not require that … For example, peer group mentoring roadmap.* (2 points)

3.6 Data analysis

We calculated separately the frequencies, means, and standard deviations for the five CPS dimensions of the coded video transcripts (Table 1) and from the point of view of the participants' responses from the self-report survey tool (Table 3). For both sources of data, we calculated the mean percentage correct for each dimension by converting mean scores to percentages based on the number of points available for that dimension.

To understand the relationship between the social and cognitive dimensions of VET leaders' CPS skills (RQ2), according to the scoring of the independent coder, we performed a correlation analysis and calculated the Pearson correlation coefficient (r). In turn, we calculated how the social aspects of the participants' CPS skills predicted their performance in the cognitive dimensions by running linear regression to measure the strength and direction of the relationship between these two continuous variables.

Finally, for the third RQ, we ran descriptive statistics on participants' sociodemographic data, professional experience, and experience in leadership positions. We then conducted a correlation analysis between a. the sociodemographic characteristics and the different dimensions from the video content analysis conducted by the coder and b. the sociodemographic characteristics and the participants' self-reflection surveys.

TABLE 3 Means and standard deviations for the dimensions of CPS skills according to participants' self-reflection.

Dimension	Min.–Max. Score	*M*	*SD*	*Mean %* Correct
Participation	5.0–9.0	7.33	1.50	81.44
Perspective taking	3.0–5.0	4.50	0.67	90.00
Social regulation	7.0–11.0	8.92	1.08	80.91
Task regulation	10.0–18.0	14.67	2.71	81.58
Learning and knowledge building	3.0–6.0	4.92	1.00	81.94
Total	34.0–47.0	40.33	4.64	82.00

4 Results

4.1 VET leaders as collaborative problem solvers

We ran means and standard deviations for each CPS dimension to answer the first research question on how VET leaders act as collaborative problem-solvers (Table 1), according to the coder. In total, with a wide range of earned points (39–275) and a small standard

deviation (SD = 4.64), the data appears to be less dispersed around the mean (M = 134.33), implying that most participants scored relatively close to the average. Most participants collected higher scores on the social dimensions of participation and social regulation (M % correct = 46.11 and 46.16, respectively). The high standard deviation (SD = 35.86) in participation reveals that participation levels among the sample vary considerably. Perspective taking (M % correct = 29.69) had the lowest total score amongst the dimensions, with eight participants scoring below average and a minimum of zero points (maximum = 39). Similarly, almost two-thirds of the participants collected scores below average in the cognitive dimension of learning and knowledge building (M % correct = 36.45).

Table 3 describes how participants evaluated themselves as collaborative problem-solvers through the self-report survey. Perspective taking stands out as particularly strong (M % correct = 90), indicating that participants believe that they are highly self-efficacious. Overall, the total score of M % correct = 82 reflects participants' assessment of their performance as strong across all dimensions (Table 4).

4.2 Social and cognitive dimensions of VET leaders' CPS skills

We performed a Pearson correlation analysis to answer the second research question exploring the relationship between the social and cognitive dimensions of VET leaders' CPS skills according to the scoring of the coder. In summary, we found a significant, strong positive relationship between the two variables [r (12) = 0.705, p = 0.05].

To further investigate the nature and strength of the relationship between the two variables, we ran a linear regression analysis (Table 5). A significant regression was found: F (1.10) = 9.88, $p < 0.05$. The R^2 was 0.497, indicating that social dimensions explained approximately 49.7% of the variance in the cognitive dimensions. The standardised coefficient of $beta$ = 0.705 suggests that these social dimensions have a strong positive standardised effect on cognitive dimensions, and the t-statistic had a value of 3.143 > 2.

4.3 VET leaders' personal attributes in relation to their CPS skills

The correlation analysis between the participants' sociodemographic data and the scoring of the coder's video content analysis, revealed a significant moderate positive correlation [r (12) = 0.589, p = 0.044] level (2-tailed) between participants' age and their performance in the cognitive dimensions. The years of work experience also had a significant, moderate positive correlation to the cognitive dimension of task regulation [r (12) = 0.577, $p < 0.05$]. In contrast, the correlation between participants' attributes and the results from the self-reflection survey was found to be weak and nonsignificant in most cases, with one exception: Participants' age and the self-reflection survey general score were moderately negatively correlated and statistically significant [r (12) = −0.633, $p < 0.05$] level (2-tailed).

TABLE 4 Descriptive statistics and correlations for study variables.

Variable	n	M	SD	1	2
Social dimensions	12	81.67	55.25	—	
Cognitive Dimensions	12	52.67	38.64	0.705*	—

Correlation is significant at the 0.05 level (2-tailed).

TABLE 5 Simple linear regression analysis of social dimensions of CPS predictors of the cognitive dimensions according to the coder's scoring.

Model	B	SE	β	t
Social dimensions	12.404	0.157	0.705	3.143
Cognitive dimensions	0.493	15.262		

N = 12, R^2 = 0.497, ΔR = 0.05, F = 9.88, p = 0.01.

5 Discussion

This study investigated VET leaders' CPS skills in the context of a university program, contributing empirical evidence to this previously under-researched area. We focused on three research questions. We explored first the way that VET leaders engage in CPS processes according to the scoring of an independent coder and also based on participants' responses to a self-reflection survey tool. Secondly, we explored how their social interactions and cognitive abilities relate to their CPS performance. Finally, we examined how personal attributes, such as professional experience and leadership experience, are associated with CPS competence, aiming to uncover how these attributes influence VET leaders' collaboration methods.

A prominent finding from the coder's video content analysis is that despite participants' similar professional profiles, their performance in CPS varied significantly. Specifically, we found that their performance was below average for each dimension, and only a few participants significantly outperformed. The interpretation of this finding remains open. It could suggest that individuals in each group did not fail in the tasks but instead employed specific strategies or focused on different facets of the problem that were not well represented in the content analysis (Graesser et al., 2018). Depending on their assumed roles within the team, participants may not have had the opportunity to excel in all of the social and cognitive aspects outlined in the coding scheme. However, demonstrating more complex skills, as outlined in the rubric, has the potential to enhance cooperation efficiency. Viewing the results through the lens of our original evaluation framework may offer a different explanation of these results. Hesse et al. (2015) argue that there is an escalation in the functioning of dimensions within their framework. Problem-solvers initially explore the problem space to familiarise themselves with its various elements. Subsequently, they identify patterns and relationships between these elements, formulating them into rules. The rules are then generalised and tested for alternative outcomes. Scores in our analysis were low in the cognitive aspects of learning and knowledge-building, which involve more complex procedures. During the interaction in the videos, we rarely observed participants shifting strategy in the light of new information or reconstructing their initial understanding to find innovative solutions.

A second interesting finding is obtained by comparing the dimensions with the lowest and highest scores according to the coder's scoring. The results suggest that VET leaders are more competent in two of CPS's social aspects: encouraging engagement and participation and successfully negotiating amongst each other. The latter dimension signifies the ability to reach a resolution or find a middle ground,

address differences, establish mutual understanding, and ultimately resolve disputes. While carrying out the assigned task, participants often recognised their strengths and weaknesses and noted their performance in terms of its appropriateness and adequacy. They did the same regarding others' performance by commenting on it, evaluating its sufficiency, and occasionally assessing the available expertise based on their peers' performance history. Taking responsibility of task completion in this way aligns with previous research suggesting that VET leaders are expected to demonstrate responsibility as part of their social skills in professional environments (Coates et al., 2013). Notably, one of the highest-performing aspects involved taking responsibility and ensuring the completion of specific task elements collaboratively or independently.

In contrast to previous findings, participants did not meet the expected performance level in the social domain of perspective taking. While participation is a crucial indicator of how well a group will work together to solve a problem, perspective-taking abilities depend more on the quality of interaction (Hesse et al., 2015). Although the mean score of perspective taking was below the average of all dimensions in the scoring from the video content analysis, the same dimension is particularly strong in the self-reflection results. This suggests that incorporating feedback and adapting to group behaviours posed challenges for the participants, as noted by the observer and reflected in the data (Horton and Keysar, 1996). However, the participants see this matter differently. The survey respondents may have assessed their performance in perspective taking using only part of the criteria, considering how this domain involves numerous and complex affective, social-developmental, and linguistic aspects. Previous research in the field of CPS also indicates that leaders find it challenging to engage in a broad spectrum of actions, especially when it comes to the more complex but crucial behaviours of offering feedback on others' viewpoints and soliciting feedback on one's own (Meyer et al., 2020). Individuals' professional roles and the way feedback is discussed might also play a decisive role in how it is perceived. Cheng and Wu (2020) suggest that vocational high school principals generally accept 360-degree evaluation feedback as a tool to improve leadership effectiveness and drive behavioral change. Also, feedback that is presented in an encouraging way (not necessarily positive) nurtures positive relationships and promotes collaboration in VET environments (Wenström et al., 2019).

Contradicting the average performance in the overall scoring from the video analysis, participants generally scored themselves very high in the self-reflection survey, across all domains. This finding aligns with previous research indicating that when applying triangulation to the evaluation of knowledge, skills, and abilities, self-perceptions diverge from the perceptions of an external observer. For example, Fiore et al. (2018) report results from a study (Hart Research Associates, 2015) indicating that nearly two-thirds of graduates believe they can collaborate effectively in a team, while only about a third of managers think that the newly-graduated students have proven this skill. This is a vital explanation of why the total CPS skills scores from the video analysis and the self-reflection survey results did not align [$r\,(12) = -0.21$, $p = 0.52$].

The self-reflection survey analysis found a significant moderate negative correlation to participants' age. Other studies also report that older participants have better self-reflection skills (Lyons and Zelazo, 2011). Kostons et al. (2012) suggest that individuals with greater prior knowledge, possibly as a result of life experience, tend to be more accurate when assessing themselves. This is because working on professional tasks is cognitively less demanding for experienced individuals, who can, at the same time, allocate more mental resources to monitor their performance (Van Gog et al., 2010) and consequently offer more accurate self-assessments.

Finally, we found a positive correlation between the years of work experience and successful task regulation. In fact, Lord et al. (2010) suggest that experienced professionals execute tasks automatically and are left with more cognitive resources to engage in more complex cognitive processes like task regulation.

5.1 Limitations and implications

The limitations of the current study mainly stem from the fact that the fields of psychology and education are still in the early stages of addressing evaluation methods in the context of CPS. The Hesse et al. (2015) framework used for the content analysis is detailed and robust but also complex to administer and time-consuming for small settings. The framework was initially used to evaluate participants' performance in several well-articulated, computer-based tasks. For this reason, a shortened version of the instrument should be used for small-scale future studies.

As Rosnow and Rosenthal (1991) highlight, the test–retest reliability method also comes with notable limitations. The purpose of our study and the behavioural and situational nature of the data we analysed led us to choose intrarater reliability (Harvey, 2021). We addressed reliability concerns by carefully considering the time gap between the initial and subsequent tests, ensuring that it was not too short in order to avoid coder recall bias. Additionally, it is essential to note the constraints of a small sample size like ours. To counterbalance this limitation, we augmented our approach by collecting rich video data and implementing triangulation in the analysis.

Despite these limitations, the current study's findings have implications for research and practice. By examining leaders' interactions in complex, practical situations, this study sheds light on how VET leaders navigate challenges and contributes to a clearer understanding of effective leadership in this context. Moreover, by obtaining detailed empirical data on CPS skills and identifying areas where leaders excel and areas for improvement, practitioners can develop targeted interventions and training programs to enhance these skills among VET leaders. Future research should actively address this gap, employing diverse assessment methods. We also suggest exploring CPS from various perspectives, such as the viewpoint of peers assessing their peers' CPS skills. Finally, our findings emphasise the need to further study the reasons for the significant differences in leaders' performance in CPS.

6 Conclusion

This single case study was initiated to bridge an evident research gap and shed light on the CPS capabilities of VET leaders participating in a master's program for experienced professionals. Acknowledging the significance of CPS skills in boosting professionals' performance, we investigated VET leaders' social interactions and cognitive skills connected to their CPS performance. We also examined how personal

characteristics such as leadership experience and professional experience relate to participants' competency to work effectively in teams. We observed that participants had significant disparities in their performance, but our analysis could explain the grounds for these differences to an extent. We did find that self-reflection on CPS skills seems to improve with age, and work experience drives more skillful task management. In a swiftly changing professional landscape, boosting CPS skills among VET leaders is crucial. To do that effectively, the design of professional development programs must be based on evidence about the level of leaders' proficiency. Decisions on who is competent for pivotal leadership positions should also be informed by this type of data. This study can be used as a roadmap in this direction.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

AT: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. DG: Supervision, Writing – review & editing, Conceptualization. DP: Funding acquisition, Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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