

Team Learning Behaviours and Team Affective Reactions: an Empirical Study on Interdisciplinary Work Teams

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Abstract This study examined interdisciplinary vocational educator teams to identify differences in their team learning behaviours and examined whether their team affective reactions could explain these differences. We used a mixed-methods approach comprising a survey of 117 interdisciplinary work teams with 604 members and a qualitative analysis of our observations of the meetings of six of these teams. The team-level cluster analysis to identify differences in team learning behaviours revealed three clusters that differed significantly ($p = .00$) regarding nearly all team learning behaviours. We named these clusters according to their patterns in team learning behaviours: ‘very active all-round teams’, ‘active all-round teams’ and ‘active teams with high knowledge sharing’. These differences in team learning behaviours could be explained by significant differences in team affective reactions ($p < .05$). Each cluster was represented by two teams whose team meetings (five per team) were audio- and videotaped. The overall findings of this study indicate that team affective reactions are related to team learning behaviours. The results of the qualitative analysis of the observation data provide additional information that not only positive but also negative team affective reactions can stimulate the engagement in team learning behaviours.

Keywords Team learning · Affect · Interdisciplinary work teams · Mixed-methods approach · Vocational educators

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Introduction

Teams are a key source of learning and accomplishing work in organisations, such as vocational colleges (Knapp 2010). Team member diversity with respect to qualifications and professional experiences can trigger learning, which can increase the chances of cognitive development, such as team learning (e.g. Rupperecht et al. 2011). Diverse teams are characterised by a wide spectrum of task-relevant knowledge and skills (Van Knippenberg et al. 2004) or by diverse mind sets and perspectives on solving problems (Bouncken et al. 2016). In the present study, diverse teams are understood as interdisciplinary teams comprising team members who are diverse in their qualifications, experiences and work responsibilities. Such teams enjoy increased learning because cognitive diversity can lead to cognitive conflicts rooted in differences in individuals' thinking (Piaget 1977). Thus, team learning is more likely to happen in interdisciplinary teams than in non-interdisciplinary teams.

Vocational educators in vocational colleges vary in their qualifications, experiences and work responsibilities within their vocational colleges. The vocational educator teams in focus in this present study are characterised by interdisciplinarity. Vocational educators working in teams can learn directly from the sharing of ideas or experiences, as well as indirectly from mutual observations (Ellis et al. 2003; Kozłowski and Ilgen 2006). Such teams have to cope with new challenges, such as increasing diversity due to immigration (Teräs and Lasonen 2013). In Germany, for example, which has recently experienced an increased migration flow, newly created vocational educator teams are tasked with designing, implementing and organising the education of refugees. Other teams have been tasked with improving the quality assurance of vocational colleges. In both of these examples, effective interaction processes are necessary to ensure the efficiency of the teams' complex, knowledge-intensive and unstructured tasks (e.g. Truijen et al. 2013), which often lead to cognitive conflicts.

Extensive research has been conducted on collaboration in the field of education. However, Vangrieken et al.'s (2015) review of 82 studies on teacher collaboration and facilitative and inhibitive factors revealed that most research has focused on primary and secondary education, rather than higher and vocational education. Furthermore, though a few studies have examined teacher teams in the field of vocational education (e.g. Bouwmans et al. 2017; Kunst et al. 2017; Truijen et al. 2013; Wijnia et al. 2016; Zoethout et al. 2017), none have focused on vocational education in Germany. Moreover, to our knowledge, no studies have adequately investigated the combination of cognitive and affective aspects in vocational educator teams. Cognitive conflicts may be supported by negative affects (De Dreu and Weingart 2003), and they can increase learning by fostering fruitful discussion (Decuyper et al. 2010). This, in turn, can be accompanied by positive affects (Cahour 2013). Affect, which refers to affective traits, affective states, or emotions (Barsade and Gibson 2007; Forgas 1994), is used here as an umbrella term. Affect is integral to learning and an indicator of learning (Benozzo and Colley 2012) and an essential part of teachers' identities and daily work (e.g. Hargreaves 1998). While studies show that affect influences learning processes within teams (e.g. Cahour 2013; Marchand and Gutierrez 2012; Näykki et al. 2014; Walter and Van der Vegt 2013), it is not entirely clear to what extent affect (positive or negative) is associated with the team learning behaviours of teams. Therefore, there is a need to understand relationships between affect and team learning to be able to foster team learning and development in

practice. This in turn is needed for work teams to meet future challenges. Vocational educator teams are an appropriate sample for investigating team learning and the relation with affect because of their interdisciplinary character and their work on knowledge-intensive tasks.

The present study extends the literature on team learning by investigating the team learning behaviours of work teams and their relationships with team affective reactions. This study answers the following research questions: (1) How do work teams differ in their team learning behaviours? and (2) Can these differences in team learning behaviours be explained by team affective reactions? To answer the research questions, a mixed-methods design (Schoonenboom and Johnson 2017) was deemed appropriate for investigating the differences in team learning behaviours and their relationships with team affective reactions. Data were collected from self-reports and observations, which offered insight into teams' social interactions (e.g. Raes et al. 2015; Zoethout et al. 2017). Observations gave insight into team affective reactions in real time during team meetings and offered explanations for differences in teams' team learning behaviours.

In this contribution, we first explore the theoretical foundation of learning within teams, team learning behaviours and team affective reactions. In the [Methods](#) section, we describe our mixed-methods approach, which involved two parts: a cross-sectional study based on a questionnaire and an observation study of team meetings with audio and video recordings. We analysed both data sets. The subsequent section outlines the results of the analyses. We then discuss the study results and limitations, offer suggestions for future research and present our conclusions.

Theoretical Background

Learning within Teams

Vygotsky's (1978) sociocultural theory emphasises the social, interpersonal and interactional nature of cognitive development and provides an appropriate and effective interactive instructional strategy that can lead to cognitive advancement (Ormrod 2016). Informal learning at the workplace 'refers to implicit or explicit mental and/or overt activities and processes that are leading to changes in knowledge, skills or attitudes, or the ability to learn of individuals, groups or organisations...' (Simons and Ruijters 2001, p. 104). Informal learning can occur during teamwork (Lave and Wenger 1991). Teams are social units that are embedded in organisational systems and consist of two or more individuals who socially interact, possess one or more common goals and are interdependent in accomplishing and performing organisationally relevant tasks (Kozlowski and Bell 2003; Kozlowski and Ilgen 2006). In the present study, we comply with this definition by examining interdisciplinary vocational educator teams. Unlike the definition of Kozlowski and Bell (2003); Kozlowski and Ilgen (2006) we selected teams who are composed of three or more individuals to ensure the interdisciplinary character of the teams.

Team Learning Behaviours

According to Ellis et al. (2003), learning in teams requires team members to both individually acquire knowledge and skills and collectively share this information with

their team members, implying a process-oriented perspective of team learning (e.g. Argote et al. 2001; Edmondson 1999; Decuyper et al. 2010; Raes et al. 2016; Van den Bossche et al. 2006). Team learning refers to ‘a compilation of team-level processes that circularly generate change or improvement for teams, team members, organisations, etc. ...’ (Decuyper et al. 2010, p. 128). Decuyper and colleagues (2010) distinguished two categories of team learning behaviours: (1) basic team learning behaviours, which ‘are responsible for the power of team learning’ (p. 117), and (2) facilitating team learning behaviours, which are responsible for directing team learning and teamwork in an efficient and effective way. In the present study, we consider three team learning behaviours within these two categories: knowledge sharing, which is a basic team learning behaviour, and team reflection and boundary spanning, which are facilitating team learning behaviours. We also consider the behaviour of ‘storing and retrieving’, which supports the persistence of team learning over time. All of the considered team learning behaviours were identified by Decuyper and colleagues (2010) and are interrelated in practice.

Knowledge sharing is the process by which team members share ideas and/or knowledge with other team members (Staples and Webster 2008). Team members’ sharing of new information can support more elaborate team learning behaviours, such as team reflection (Decuyper et al. 2010; Van den Bossche et al. 2011). *Team reflection* is the extent to which team members reflect upon the team’s objectives, strategies and processes (Schippers et al. 2007). In particular, it involves questioning, planning or reviewing past events before, during or after the execution of a team task. Team reflection can vary in depth. For example, team reflection on task-related issues may involve thinking about tasks, strategies or processes, as well as engaging in a deep reflection of the team’s values and norms (Schippers et al. 2007). *Boundary spanning* describes team members’ communications with the environment (e.g. during meetings or outside the team), including other teams, team members, supervisors or members of other organisations (Decuyper et al. 2010). External interactions focus on seeking information, resources or support for teamwork (Hirst and Mann 2004). Finally, by *storing and retrieving*, teams can maintain the outcomes of teamwork, such as ideas or decisions (Widmann et al. 2016). Storing and retrieving refers to the saving (i.e. in a computer database or as a shared mental model) of shared knowledge, developed procedures, shared ideas or plans resulting from basic and facilitative team learning behaviours to be used by the team in the future (Decuyper et al. 2010; Van Offenbeek 2001). In our survey study, these four behaviours served as means to study the teams’ *team learning behaviours*.

Team Affective Reactions

In team learning situations, affects, such as gratitude, sympathy or anger (Pekrun et al. 2002), can be received from or directed toward other team members (cf. Wosnitza and Volet 2005). Cahour (2013) found that both positive affects (e.g. empathy) and negative affects (e.g. disagreement) can be useful for learning in teams. In the present study, *affect* is used as an umbrella term to refer to affective states and affective traits (cf. Barsade and Gibson 2007; Forgas 1994). *Affective states* (which are often considered synonymous with emotions) are episodes of ‘interrelated, synchronized changes in states of all or most of the five organismic subsystems in response to the evaluation of an external or internal stimulus event as relevant to major concerns of the organism’

(Scherer 2005, p. 697). According to the appraisal theory (Ellsworth and Scherer 2003; Frijda 1986), stimuli lead to arousal (i.e. affective states) when they are perceived as having a significant effect on one's well-being (Frijda 1986). Affective states are influenced by *affective traits*, which are relatively stable tendencies to experience specific affects (Watson et al. 1988). Moreover, affective states can be positive or negative and may encompass cognitive, motivational, somatic, motoric and subjective aspects (Scherer 2005; Watson et al. 1988).

According to the emotions as social information theory (EASI; Van Kleef 2009), affective states have intrapersonal effects on those experiencing them and interpersonal effects on those observing them. During teamwork, team members can both experience their own and observe other team members' affective states. Consequently, we refer to both the characteristics of affective states and their corresponding behaviours as *affective reactions* (Van Kleef et al. 2012), which can occur simultaneously in team learning situations. In particular, we take into account (1) team members' self-estimations of their own affective reactions relating to the team (intrapersonal) and (2) team members' estimations of affective reactions within the team (interpersonal). Following a bottom-up approach, each interdisciplinary team was assigned a score indicating its *team affective reactions*. This approach is consistent with recent research that treats affect as a team phenomenon by investigating teams' mean scores (e.g. in affective convergence or diversity) (Barsade and Knight 2015).

Based on the broaden-and-build theory (Frederickson 2004), which suggests that positive affects broaden individuals' scope of attention, cognition and action, we assume that teams' positive team affective reactions are accompanied by higher engagement in team learning behaviours. For example, if a team exhibits positive affective reactions, such as happiness or confidence, its tendency toward action will increase. Such a team is more likely to share, store and retrieve knowledge; reflect on tasks or processes; and communicate with its environments during teamwork. By contrast, teams that exhibit negative affective reactions are not likely to engage in team learning behaviours. For instance, frustration and anger can lead to less knowledge sharing and, in turn, less storing and retrieving and less reflection and communication with outside persons. This assumption is in line with Walter and Van der Vegt (2013) suggesting that negative affects can lead to a decrease in action tendencies.

Methods

A mixed-methods design was considered appropriate to answer the research questions. The empirical study comprised two parts of data collection: a survey and observations. The study examined vocational educator teams in Germany. The system of vocational education in Germany consists of a widely known dual system comprising both on-the-job and off-the-job components (Cedefop 2017). We selected interdisciplinary vocational educator teams, because team learning is more likely to happen in interdisciplinary teams than in non-interdisciplinary teams. In addition, vocational educator teams consisting of members with diverse qualifications, experiences and work responsibilities within their vocational colleges work on knowledge-intensive tasks. These teams are seen as social entities within vocational colleges and comprise more than three individuals who are interdependent in accomplishing their work tasks (cf. Kozlowski and Bell 2003; Kozlowski and Ilgen 2006).

Sample

The recruitment of the sample began with contacting, both personally and through email, 339 vocational colleges in the state of Bavaria. Of the colleges contacted, 138 did not respond and 124 declined participation. We discussed the selection criteria for interdisciplinary work teams with the principals or in school meetings. Overall, 124 teams from 77 colleges agreed to participate in the survey, which was conducted during the 2015/16 school year. Of these, seven teams had to be excluded because they comprised only two team members. In the end, data from 604 vocational educators from 117 interdisciplinary teams (ranging from 3 to 20 team members) from 76 colleges were included in the analysis. Of the participants, 240 were female (39.7%) and 324 were male (53.6%; $n = 40$ unknown). The mean age was 45 years ($SD = 9.82$; range: 26–68).

The second, in-depth study involved observations of the team meetings of six vocational educator teams selected from the survey sample based on (1) their team learning behaviours, (2) the topic of the work task (quality assurance or education of refugees) and (3) the team size (3–10 persons) in order to represent the three clusters that emerged in the first part of the study. Overall, 10 teams working on quality assurance or refugee education met the selection criteria. Of these, four teams declined to participate in the observation study due to for instance reservations concerning privacy. Each of the participating teams was observed and audio- and videotaped. At the time of the first observations, the team meetings involved 5 to 11 individuals, of whom 46.3% were female and 53.7% were male. During the observation period two of the teams grew in size, such that, at the time of the final observation, the teams comprised 5 to 24 persons, of whom 49.2% were female and 50.9% were male.

Data Collection

Collection of Quantitative Data

The survey data were collected through a questionnaire (answered online or in paper-pencil format) with a response rate of 94.4%. Each team received a number, and each team member created an individualized code, which allowed the team member to be assigned to his or her respective team. The questionnaire included validated scales to measure team learning behaviours and affective reactions. To measure affective traits, we developed a new scale. Adequate internal consistency (Cronbach's α) was achieved for the scales measuring team learning behaviours: knowledge sharing ($\alpha = .89$; e.g. 'People in this team are willing to share knowledge/ideas with others'; 8 items; Staples and Webster 2008), team reflection ($\alpha = .94$; e.g. 'As a team, we usually take well-considered decisions'; 23 items; Schippers et al. 2007), storing and retrieving ($\alpha = .76$; e.g. 'We store team documents in a common archive'; 5 items; Van Offenbeek 2001) and boundary spanning ($\alpha = .72$; e.g. 'Team members scan the environment inside and outside the college for ideas and expertise'; 4 items; Hirst and Mann 2004). Items were scored on a 5-point Likert scale ranging from 1 (never) to 5 (very often). The team learning behaviour scales captured the extent to which team members engaged in team learning behaviours. To measure *affective reactions*, we used an instrument developed by Watson et al. (1988) and adapted by Angehrn (2004). The instrument measured (1) team members' self-estimations of their own affective reactions relating to the team

(e.g. ‘When I think about my team, I am frustrated/disappointed/angry/irritated/defiant/confident/happy’) and (2) team members’ estimations of affective reactions within the team (e.g. ‘How often are the following affects expressed in your team? Frustration/Anger/Confidence/Happiness’). We selected five positive and five negative affective reactions relevant to teamwork. Unlike Angehrn (2004), we revised the response dimension into a 5-point Likert scale ranging from 1 (never) to 5 (always). A confirmatory factor analysis (with 604 participants) supported the theoretical distinction between positive and negative affective reactions. Satisfactory reliabilities were found for the resulting scales representing own positive affective reactions ($\alpha = .85$), own negative affective reactions ($\alpha = .87$), positive affective reactions within the team ($\alpha = .81$) and negative affective reactions within the team ($\alpha = .86$). Regarding *affective traits*, we developed a scale comprising eight self-developed items to be rated on a 5-point Likert scale (1 = totally disagree; 5 = totally agree; e.g. ‘It is important to show pleasant affects in teams’; for an overview, see Appendix 1 Table 4). In particular, the items were developed based on the theoretical foundation of affective traits representing relatively stable tendencies to experience particular affects (Watson et al. 1988). As affective traits are meaningful for affective states, team members were asked to estimate to what extent affects are of relevance for both in teams and for teamwork. Four items measured team members’ estimation of the relevance of affects in general, while four items further distinguished pleasant and unpleasant affects (i.e. affects characterised by positive and negative valences) (Watson et al. 1988). Satisfactory internal consistency ($\alpha = .79$) was achieved. As control variables, team characteristics such as team stability ($\alpha = .73$; e.g. ‘This team is quite stable, with few changes in membership’; range 1 = does not apply at all; 5 = fully applies; Wageman et al. 2005), length of team membership and age of the team were investigated. The last two variables were measured in months.

Collection of Qualitative Data

The observation data comprised audio- and videotaped meetings of six vocational educator teams, recorded using a 360° camera to give an objective estimation of team members’ affective reactions during team meetings. Each team was observed for a maximum of five consecutive team meetings over the course of three to five months (excluding the 2016 school summer vacation). Team meetings lasted between 40 min and two hours ($M = 61.17$ min). We collected observation data of 29 team meetings, of which 28 could be used for analysis. One team meeting had to be excluded because it turned out to be a formal training session, and one team meeting was not recorded because it fell outside the data collection period. In total, we obtained data from five meetings for five teams and three meetings for one team.

Data Analyses

Quantitative Analysis

The variables measured in the survey were conceptually meaningful both for teamwork and at the team level. The data gathered from individual team members were aggregated at the team level to investigate team learning behaviours and team affective

reactions. To empirically justify the creation of a team-level data-set, we assessed within-group agreement using the multiple-item estimator $r_{wg(j)}$ (James et al. 1984) and the intraclass correlation coefficient (ICC) (LeBreton and Senter 2008). The analysis showed satisfactory $r_{wg(j)}$ values for affective reactions and affective traits (ranging from .85 to .92) and team learning behaviours (ranging from .75 to .94). All scales exceeded the proposed cut-off value for aggregation of .70 (LeBreton and Senter 2008). For affective reactions, affective traits and team learning behaviours, the ICC (1) values varied from .12 to .40. All exceeded the proposed value of .12 (Bliese 2000). The ICC (2) values varied from .41 to .77.

To identify differences in the vocational educator teams' team learning behaviours, the aggregated data were classified, and a cluster analysis was conducted. First, a hierarchical cluster analysis was calculated using SPSS (cf. Yim and Ramdeen 2015), using a single-linkage approach to eliminate statistical outliers. For subsequent analyses ($N = 117$), we used a ward approach to allow for approximate clusters. The results showed a three-cluster solution, with clusters differing in their mean values for knowledge sharing, team reflection, storing and retrieving and boundary spanning. To validate the three-cluster outcome, we used the latent class analysis (LCA) technique in Mplus (cf. Geiser et al. 2006), which also yielded a three-class solution. These optimal clusters were based on Schwarz's Bayesian information criterion (BIC). To compare the clusters for *team learning behaviours* to *team affective reactions* and *team affective traits*, we conducted an analysis of variance (ANOVA) at the cluster level.

Qualitative Analysis

The observation data for the 28 team meetings were analysed using qualitative content analysis (cf. Flick 2014) to identify team members' affective reactions in real time during team meetings. The data were categorised using Bales' (2002) well-established system, especially since this was originally used to analyse the direct observations of team interactions. Initially, we focused exclusively on two affective categories: (1) positive affective reactions and (2) negative affective reactions. However, to match the categories with the data, we modified the original categories into subcategories to reflect their unique characteristics: solidarity, cheerfulness and agreement (positive affects) and antagonism, tension and disagreement (negative affects). Furthermore, we added a category for (3) neutral reactions. Affective reactions were identified as belonging to a specific subcategory when a person verbally or non-verbally expressed indications of the subcategory's characteristics. While the adapted category system was theoretically driven (Bales 2002), it has not yet been operationalised for subcategories, including the different characteristics (see Appendix 2 Table 5 for further details). The category system developed by the first author of this study was further adapted and used during the second author's coding training phase. Cohen's k was calculated by identifying an affective reaction and classifying it in a subcategory. The two authors separately analysed the same randomly selected team meeting of one team. The interrater reliability was at first poor (Cohen's $k = .32$; $p < .01$; Neuendorf 2002), and disagreements about coding results were discussed in depth. After a second meeting was coded (with Cohen's $k = .79$; $p < .01$; Neuendorf 2002) and discussed in depth, agreement was achieved on the coding scheme, the subcategories and the codings of the two meetings. The remaining video data for the team meetings were coded by the

first author using MAXQDA, which allowed for direct coding while watching the videos. Data were summarized at the team level as the means to study *team affective reactions*.

Results

Differences in Team Learning Behaviours

To answer the first research question, cluster analyses were performed. The three-class solution implied different patterns in team learning behaviours for each cluster. The results of Scheffé's post-hoc test, which was conducted after the ANOVA, revealed significant differences regarding their team learning behaviours. Table 1 shows the ANOVA results, the mean and standard deviation for each variable and the results of the control measures for each cluster. All three clusters showed higher values than the 5-point Likert scale mean of 3. Thus, all teams exhibit high engagement in team learning behaviours.

Each of the three clusters reflects a different type of team learning behaviours, such that the clusters differ in terms of their patterns in team learning behaviours. Cluster 1 was labelled 'active all-round teams', as teams in cluster 1 highly engaged in all four team learning behaviours. However, the mean values for all team learning behaviours cluster in 1 were lower than those for team learning behaviours in clusters 2 and 3. While the teams in cluster 1 frequently shared, stored and retrieved knowledge, they engaged less in reflection and external communication. Cluster 2 was labelled 'very active all-round teams' because the teams in this cluster exhibit the highest engagement in team learning behaviours. That is, these teams frequently shared stored and retrieved knowledge; reflected on the strategies, aims or processes of teamwork; and communicated with individuals outside the team. Compared to teams in clusters 1 and 2, teams in cluster 3 had mid-range mean values for all team learning behaviours, indicating a

Table 1 Results of ANOVA and descriptive statistics of team learning behaviours and control measures

Variable				Cluster 1		Cluster 2		Cluster 3	
	<i>F</i> (2,114)	<i>p</i>	η^2	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Knowledge sharing [*]	95.83	.00	.63	3.57	.44	4.62	.19	4.31	.49
Team reflection [*]	65.92	.00	.54	3.30	.42	4.25	.17	3.58	.23
Storing and retrieving ^{**}	12.10	.00	.18	3.68	.58	4.49	.38	3.80	.67
Boundary spanning [*]	32.57	.00	.36	3.41	.37	4.31	.36	3.76	.40
Team stability ^{(1) ***}	4.45	<.01	.07	4.02	.41	4.44	.49	4.20	.54
Length of team membership ^{(2) ****}	7.18	<.01	.11	47	47	50	34	26	18
Age of team ^{(2) *****}	2.86	.06	.05	100	229	72	75	37	31

Range: 1 = never; 5 = very often⁽¹⁾; Range: 1 = totally disagree; 5 = totally agree⁽²⁾. Means and standard deviation are reported in months. ^{*} Significant differences between all clusters. ^{**} Significant differences between clusters 1 and 2 and clusters 2 and 3. ^{***} Significant difference between clusters 1 and 2. ^{****} Significant differences between clusters 1 and 3 and 2 and 3. ^{*****} Significant difference between clusters 1 and 3; η^2 = Eta squared means the effect size of the ANOVA

higher engagement in team learning behaviours (more than the teams in cluster 1, but less than the teams in cluster 2). Cluster 3 teams primarily demonstrated knowledge sharing, which had a mean value much higher than those for team reflection, storing and retrieving and boundary spanning. This cluster was labelled ‘active teams with high knowledge sharing’ because its teams shared knowledge frequently and stored and retrieved knowledge, engaged in reflection and communicated externally more often than teams in cluster 1.

Differences in Team Learning Behaviours by Cluster Characteristics

Regarding the control variables, the data indicated that the members of the ‘very active all-round teams’ had known each other the longest and existed longer as teams than those of the ‘active all-round teams’ and the ‘active teams with high knowledge sharing’. Each cluster had a mean team size of five members, with no significant differences. However, the clusters varied in terms of the number of teams they contained: Cluster 1 included 32 teams, cluster 2 contained 19 teams and cluster 3 contained 66 teams. No differences in age were identified across the clusters. Instead, all three clusters included teams with variances in age, both high and low. Regarding gender distribution, clusters 1 and 2 contained more male-dominated teams than cluster 3, which contained more female-dominated teams (teams composed of more than 50% females).

In sum, the ‘very active all-round teams’ had stable compositions over time and had members who had worked together ($M = 72$, $SD = 75$) and known each other ($M = 50$, $SD = 34$) for long periods of time. Although the ‘active all-round teams’ were not as stable over time, they had existed longer than the other types of teams ($M = 100$, $SD = 229$), and their members had known each other for a substantially long period of time ($M = 47$, $SD = 47$). Finally, ‘active teams with high knowledge sharing’ were stable over time, but had shorter lifespans ($M = 37$, $SD = 31$).

Differences in Team Learning Behaviours by Differences in Team Affective Reactions and Traits

We answered our second research question using the results of the survey study. We measured affective traits as the relevance of affects for both in teams and for teamwork. We also measured affective reactions as (1) team members’ self-estimations of their own affective reactions and (2) team members’ estimations of affective reactions within their teams. The results of Scheffé’s post-hoc test conducted after the ANOVA showed significant differences among the three clusters for all variables except affective traits and negative affective reactions within the team. Table 2 presents an overview of the ANOVA results, mean values and standard deviations for each cluster.

Thus, affects for both in teams and for teamwork were of higher relevance for cluster 2 teams than teams from clusters 1 and 3.

The results showed congruent findings for both measurements of team affective reactions (see above mentioned (1) and (2)). The nearly equal mean scale values (two for positive, two for negative) support both the interpersonal and intrapersonal characteristics of affects. The ‘very active all-round teams’ had the highest mean values for positive team affective reactions and the lowest mean values for negative team affective

Table 2 Results of ANOVA and descriptive statistics of team affective reactions and team affective traits

Variable			Cluster 1		Cluster 2		Cluster 3		
	<i>F</i> (2,114)	<i>p</i>	η^2	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Affective traits ^{(1) **}	2.60	.08	.04	3.77	.31	4.02	.43	3.87	.38
Own positive affective reactions *	18.40	<.01	.24	3.61	.53	4.33	.30	3.88	.37
Own negative affective reactions *	17.24	.04	.23	1.74	.48	1.20	.18	1.42	.28
Positive affective reactions within the team *	19.83	<.01	.26	3.50	.47	4.10	.17	3.78	.28
Negative affective reactions within the team ***	9.15	<.01	.14	2.14	.57	1.64	.32	1.83	.38

Range: 1 = never; 5 = always; ⁽¹⁾ Range: 1 = totally disagree; 5 = totally agree. * Significant differences between all clusters. ** Significant difference between clusters 1 and 2. *** Significant difference between clusters 1 and 2 and 1 and 3

reactions. This implies, of all the teams, the teams in this cluster tended to experience positive team affective reactions most frequently. In particular, they experienced happiness or confidence more often than frustration, anger or irritation. ‘Active teams with high knowledge sharing’ experienced positive team affective reactions more often than ‘active all-round teams’, but not as often as ‘very active all-round teams’. Negative team affective reactions occurred rarely, if at all, for all clusters. However, ‘active all-round teams’ experienced more negative affective reactions and engaged less actively in team learning behaviours.

Differences in Team Learning Behaviours by Differences in Observed Team Affective Reactions

We also used observation data to answer our second research question by obtaining an objective estimation of team members’ affective reactions during teamwork. Table 3 presents an overview of the team affective reactions identified across all observed team meetings at the team and cluster levels. Nearly all categorised affective reactions could be identified in the data. Positive team affective reactions were observed in all six teams across a total of 5719 instances. The teams exhibited cheerfulness, solidarity and agreement in their meetings. Team members often expressed happiness or made jokes about or with colleagues. They also laughed or smiled during their teamwork. In line with cheerful behavioural patterns, team members often engaged in solidary behaviours, such as giving assistance to each other, being cooperative or raising other team members’ status. The ‘very active all-round teams’ exhibited more positive affective reactions than the teams from clusters 2 and 3. We observed far fewer negative team affective reactions (538 instances). Furthermore, ‘very active all-round teams’ expressed antagonism, tension or disagreement more often than teams in other clusters. Team members occasionally exhibited antagonistic behavioural patterns, such as defending their own statuses when colleagues were confronted by another team member or interrupting other members while they were speaking. In addition, tense behaviours were coded when team members expressed displeasure or frustration. If team members were sceptical or critical of a colleague’s statement or behaviour, this was coded as

Table 3 Frequencies (*f*) of team affective reactions over the entire observation period

Team ⁽¹⁾	Positive affective reactions (5719)			Negative affective reactions (538)			Neutral reactions	Σ
	Solidarity	Cheerfulness	Agreement	Antagonism	Tension	Disagreement	Neutral	
1	120	355	51	33	23	28	24	634
2	200	1047	20	21	16	9	37	1350
3	104	646	46	22	41	23	29	911
4	197	893	83	55	35	44	65	1372
5	80	846	44	47	44	29	54	1144
6	199	751	37	20	28	20	32	1087
Σ	900	4538	281	198	187	153	241	6498

⁽¹⁾ Teams 1 and 2 = Cluster 1 (1923); Teams 3 and 4 = Cluster 2 (2189); Teams 5 and 6 = Cluster 3 (2145)

disagreement. Neutral team reactions, which occurred in 241 instances, were reactions that could not be clearly categorised as positive or negative, such as exclamations of ‘Oh my god’.

In sum, regarding differences in affective interactions (positive, negative), the cluster-level analyses revealed that the ‘very active all-round teams’ (teams 3 and 4) exhibited the most team affective reactions (2189), whether positive or negative. The ‘active teams with high knowledge sharing’ (teams 5 and 6) exhibited 2145 team affective reactions, and the ‘active all-round teams’ (teams 1 and 2) exhibited 1923 team affective reactions.

Discussion

This study has attempted to identify differences in the team learning behaviours of work teams. It has also investigated whether these differences could be explained by team affective reactions.

Types of Team Learning Behaviours

To explore the first research question (How do work teams differ in their team learning behaviours?) we selected a sample of interdisciplinary work teams in the field of vocational education because such teams work on knowledge-intensive tasks and are characterised by interdisciplinarity. Vocational educators’ interactions during collaboration significantly impact their ability to manage complex tasks and function effectively as teams (e.g. Truijen et al. 2013). In addition, such teams have a broader range of task-relevant knowledge and skills (Van Knippenberg et al. 2004) that can provide potential for increased learning of teams. The cluster analysis ($N=117$) revealed significant differences in patterns in team learning behaviours across the three identified clusters. We therefore labelled the clusters according to their different patterns in team learning behaviours: ‘very active all-round teams’, ‘active all-round teams’ and ‘active teams with high knowledge sharing’. The fact that all teams highly engaged in team learning behaviours suggests that learning is common in interdisciplinary teams. Thus,

cognitive diversity can act as a trigger for team learning (Piaget 1977). This is in line with the findings of studies investigating team diversity in combination with, for example, team processes and outcomes (e.g. Bouncken et al. 2016; Van Knippenberg et al. 2004). In addition, our results show that ‘active teams with high knowledge sharing’ had a shorter lifespan than teams assigned to the other two clusters. Thus, we can assume that knowledge sharing plays a particularly important role at the beginning of the existence of teams. This is a finding that could be investigated in further studies. Particularly interesting for further research on team learning are our findings concerning the characteristics of interdisciplinary teams, such as age or gender, as our results indicate differences between male- and female-dominated teams. In addition, the length of team membership, the duration of team existence and other team characteristics, such as team structure (e.g. Vangrieken et al. 2015), should all be considered for further investigation of interdisciplinary teams. In this respect, our findings revealed that teams that comprise approximately five persons, have stable compositions over time, have longer life spans (more than 70 months) and have team members who have known each other for longer periods (more than 47 months) engaged actively in all four team learning behaviours. Our finding also support earlier studies indicating a tendency for smaller interdisciplinary teacher teams (6 to 10 members) to be more effective (e.g. Truijen et al. 2013). Finally, when forming teams, it is important to consider team size, as larger teams might involve more complicated interactions (Wijnia et al. 2016).

Differences in Team Affective Reactions and Traits by Types of Team Learning Behaviours

Our second research question (Can these differences in team learning behaviours be explained by team affective reactions?) focused on whether differences between team learning behaviours could be explained by team affective reactions. This research question addressed the limitations of previous studies (e.g. Truijen et al. 2013; Zoethout et al. 2017), which have failed to analyse the potential relationship between affects and team learning behaviours. The answer to this research question was based on the argumentation that cognitive conflicts as trigger for team learning can be either supported by negative affects (De Dreu and Weingart 2003) or accompanied by positive affects (Cahour 2013), such as when teams have fruitful discussions (Decuyper et al. 2010). All interdisciplinary vocational educator teams experienced positive team affective reactions more often than negative team affective reactions. Since all teams highly engaged in team learning behaviours, our assumption that teams that show positive affective reactions have higher tendencies toward action is confirmed (cf. the broaden-and-build theory; Frederickson 2004). Nevertheless, the cluster-level ANOVA ($N = 117$) revealed significant differences between the clusters in nearly all team affective reactions and team affective traits. ‘Very active all-round teams’ experienced positive team affective reactions most frequent and negative team affective reactions least. In addition, affects for both in teams and for teamwork were of higher relevance for these teams than for teams in other clusters. This finding suggests that cognitive conflicts within interdisciplinary teams are likely to be supported by positive affects, which stimulate engagement in team learning behaviours. In addition, our results show that ‘active all-round teams’ had lower levels of engagement in team

learning behaviours but experienced negative team affective reactions the most. This finding suggests that cognitive conflicts can be accompanied by negative affects: a result that is consistent with our second assumption that negative affective reactions, such as anger or frustration, can lead to less engagement in team learning behaviours (cf. Walter and Van der Veegt 2013).

In addition, the qualitative analyses of the observation data on the six teams' affective interactions provided in-depth insights into team affective reactions in real time team meetings. The findings of the observation study provided additional information to answer our second research question (Can these differences in team learning behaviours be explained by team affective reactions?). All types of team learning behaviours exhibited positive team affective reactions frequently and negative team affective reactions less frequently. Thus, we can also confirm our assumption that teams that show positive affective reactions frequently have higher tendencies to engage in team learning behaviours (cf. the broaden-and-build theory; Frederickson 2004). However, the findings revealed that 'very active all-round teams' who exhibited the most positive team affective reactions also showed the most negative team affective reactions. This finding contradicts the survey finding which revealed that 'very active all-round teams' exhibited negative team affective reactions the least.

The results of the observation study imply that teams with more team affective interactions (positive and negative) demonstrate high engagement in team learning behaviours. Therefore, we can conclude that also teams' negative affective reactions can trigger the engagement in team learning behaviours. This conclusion is in line with Cahour (2013), who recognized that both positive affects (e.g. empathy) and negative affects (e.g. disagreement) can be fruitful for learning within teams.

Limitations and Future Research

This study has five main limitations that should be considered when interpreting the findings. First, although our results can be generalised to other comparable professions in which teams work on complex, knowledge-intensive tasks, we need to be careful with generalising the results. Caution should especially be used in comparing the selected teams with teams working on routine tasks. Replication studies in different professions are needed to explore in detail which findings are caused by profession-specific characteristics. Second, the present study focused on the team and cluster levels regarding analysing the data and presenting the findings. Thus, the intra-team level was not considered in detail. The results of the present study are congruent to previous studies showing associations of affects and learning at individual (e.g. Cahour 2013; Näykki et al. 2014; Walter and Van der Veegt 2013) and team level (e.g. Van Kleef and Fischer 2016); however, future studies should consider intra-team-level effects when investigating the combination of team learning and team affects. Third, the researchers' interpretations may have affected the qualitative analysis of the affective reactions. To offset potential subjectivity in the ratings, the second author coded the observed data of two team meetings, and interrater reliabilities were calculated. Fourth, this study assessed only observable affective reactions: those that the study participants were

prepared to make public, and which were often expressed with a specific goal during team meetings (Wosnitza and Volet 2005). To compensate for this limitation, we investigated the team members' affective reactions in the first part of the study using a self-report method. Following Uitto and colleagues' (2015) suggestion, to gain a more holistic understanding of the phenomena (team learning behaviours) related to teachers and affect, future studies should use different methodological approaches (mixed-methods). Fifth, any comparison between the observed teams should be treated with caution. We assume that team characteristics, such as team size and the length of team meetings, have distorting effects. Of the observed teams, four had 5 members, one had 7 members and one had 11 members at the beginning of the observation period. During the observation period, one team grew to include 30 members. In addition, the team meetings had different durations.

Further research is necessary to test and extend the present findings and to gain better insight into interdisciplinary work teams' affects and their relationships with learning behaviours and team characteristics (Vangrieken et al. 2015). In particular, longitudinal studies examining the dynamic aspects of team learning and behavioural changes (Decuyper et al. 2010; Kozlowski 2015) and their determinants are important (Leicher and Mulder 2016). Future research could also focus on the role of the team leader, as strong team leadership is an important condition for successful learning (Truijen et al. 2013). Bouwmans et al. (2017) suggested that, by applying a transformational leadership style, team leaders can stimulate teachers to engage more in team learning. Zoethout et al. (2017) recommended analysing team learning behaviours in relation to team performance to assess the effectiveness of team learning behaviours.

Conclusions

The present study contributes to the extant research by providing new insights into team learning. Our work answers prior calls to (1) focus on professional development, such as team learning (Kunst et al. 2017), and (2) use a mixed-methods design to investigate affects and learning in the context of educators (Uitto et al. 2015). We chose to focus on vocational educator teams because these teams are interdisciplinary and work on knowledge-intensive tasks. In particular within such teams, cognitive conflicts can occur that can act as triggers for learning (Piaget 1977), increasing the chances of team learning. By using a mixed-methods design and conducting a team-level cluster analysis, we were able to gain insights into the relationships between team affective reactions and team learning behaviours of work teams. Our findings concerning the three different types of team learning behaviours answer our first research question by showing that vocational educator teams differed in their patterns in team learning behaviours and engaged in team learning behaviours at different levels. Regarding the second research question, and similar to other study results showing a relationship between affect and learning in teams (e.g. Cahour 2013; Näykki et al. 2014; Walter and Van der Vegt 2013), the findings of the survey study confirmed a positive relation between positive team affective reactions and

team affective traits and high levels of engagement in team learning behaviours. In particular, our assumptions could be confirmed: (1) positive team affective reactions were accompanied by high engagement in team learning behaviours (cf. Frederickson 2004); (2) negative team affective reactions led to less engagement in team learning behaviours (cf. Walter and Van der Vegt 2013). In addition, through our observation study, we gathered in-depth insights into experiences in team meetings indicating that negative affective reactions can lead to high engagement in team learning behaviours (cf. Cahour 2013). Thus, our observation study provides additional information that not only positive but also negative team affective reactions can stimulate the engagement in team learning behaviours. On the basis of the study results we are able to suggest practical implications in order to foster team learning and development in practice which is needed for work teams to meet future challenges. In this respect, we suggest that team members should express positive affective reactions by, for instance, raising other team members' status or being cooperative. Such reactions can lead to experiences of positive affective reactions, such as being happy or confident during teamwork. Moreover, all team members should be aware of and the team leaders should foster awareness about the relevance of affects for both in teams and for teamwork.

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Compliance with Ethical Standards

Conflict of Interest The authors do not have any interests that might be interpreted as influencing the research.

Appendix 1

Table 4 Items to measure the relevance of affects for both in teams and for teamwork (affective traits)

It is quite natural that affects occur in teams.
It is important to comment on unpleasant affects in teams.
It is important to show pleasant affects in teams.
Affects may influence teamwork.
It is important to comment on pleasant affects in teams.
Affects may influence results of teamwork.
It is important to show unpleasant affects in teams.
Affects can be used for teamwork.

Range: 1 = totally disagree; 5 = totally agree; Cronbach's $\alpha = .79$; self-developed

Appendix 2

Table 5 Category system of affective reactions of team members

Category	Sub-Category	Characteristics	Description	Example	
(1) Positive affective reactions	Solidarity	Empathy	Specific indication of mamerly consideration for the other, or that the actor is sensible to others	I most certainly understand your disappointment	
		Trust	Specific indication that the actor confides others or entrusts the self to others	If a team member gives private information to the others	
		Greetings	Specific indication that actor is greeting, hailing others; welcoming, or saying goodbye to others	Hi, I warmly welcome all of you to the todays meeting	
		Cooperativeness	Specific indication that actor is affiliative, comradely; specific indication of good will, or that the actor is friendly, or encourages the others	I please you to review the documents; A team member is asking if he/she is allowed to give a comment	
		Raising or enhancing others status	Specific indication that actor praises, approves or rewards somebody else; In the sense of that the actor is esteeming, or respectful to others	I think you did a very good job; I find your idea is a good idea	
		Gratitude	Specific indication that actor is grateful, appreciative, or thankful	Thank you for your help	
		Assistance	Specific indication that actor assists, gives support, advices, helps, or offers contribute time, energy or other resources	We can talk later and I can explain it to you more precisely	
		Apology	Specific indication that actor makes an excuse in a positive meaning	Sorry for being late	
		Interest	Specific indication that actor is interested in someone's comment, report etc.; Some other matter of common interest for the other	It's pretty interesting	
		Surprise	Specific indication that actor is surprised about something, in a positive sense	Oh really	
		Cheerfulness	Pleasure	Specific indication of happiness, enthusiasm, or enjoyment	I am happy to see that
			Joking	Specific indication that actor is joking, trying to amuse, or entertain; Specific jovial, humorous, funny, 'silly' remark	If a team member is joking about a colleague
			Laughing	Specific indication that actor is laughing, smiling, grinning, or chuckling	If a team member is laughing or smiling
		Contentment	Specific indication of satisfaction or contentment	I am glad I could help	

Table 5 (continued)

Category	Sub-Category	Characteristics	Description	Example
	Agreement	Confirmation	Specific indication that actor confirms by repetition or affirmation in response to preceding acts of decision	I fully agree with you; of course
		Compliance	Specific indication that actor complies with a request or suggestion	I agree with you but I would like to add
		Understanding	Specific indication that actor agrees with a report, analysis, or facts which others have made: that are beliefs, confirmations, convictions	I understand your concerns
		In the sense of admission	Specific indication that actor admits an error etc.	Oh yes, you are right, that was my mistake
(2) Negative affective reactions	Antagonism	Autocratic control	Specific indication that actor controls, regulates, governs the other; Specific demand or commands	Stop; Wait stop; wait just a second
		<i>Autonomy*</i>	<i>Specific indication that actor is non-compliant, rejects, refuses, or authoritative requests</i>	
		Status deflating	Specific indication that actor is interrupting or interfering the other with his speaking; Specific indication of ridiculing, making fun of the other (in ironical way)	Stop it. You are wrong
		Status defending	Specific indication that actor defends the self against criticism, assault or blame in an ego-involved way; Specific indication of self-justification or exculpation	No, that was not my intention; It was merely a question
		Status seeking	Specific indication that actor is conspicuous, or attempts to attract attention: includes attempts to excite, amaze, intrigue, or amuse the other as a means of raising one's own status	In case a team member often gives comments in order to emphasize his/her personal meaning
		Diffuse Aggression	Specific indication that actor is cranky, uncongential, annoyed, intolerant, jealous, or speaks in a threatening manner	It just irritates me so much
	Tension	Diffuse Tension	Specific indication that actor is strained, restless, on edge, or agitated	Yes, that's the reason we talk about it
		Diffuse Anxiety	Specific indication that actor is startled, disconcerted, or dismayed; Specific verbal expression of anxiety, worry, or fear	The only thing I am worried about is
		<i>Shame and guilt*</i>	<i>Specific indication that actor is embarrassed, sheepish, or ashamed</i>	
		Frustration	Specific indication that actor is frustrated, disappointed, or discouraged	I really do not understand you

Table 5 (continued)

Category	Sub-Category	Characteristics	Description	Example
		Displeasure	Specific indication that actor is unhappy, unsatisfied, or annoyed	No, that's impossible (actor is annoyed)
		Asking for help	Specific indication that actor begs or beseeches the other for some favour; Specific indication that actor asks for help, or asks for some favour	Can you please tell me where to look
		Surprise	Specific indication that actor is surprised about something, in a negative sense	What, at this specific date
(3) Neutral reactions	Disagreement	Doubts	Specific indication that actor appears to be sceptical, critical, or dubious about accepting something	I also do not agree with you that
		<i>Withholds resources*</i>	<i>Specific indication that actor is possessive, secretive, or denied something requested</i>	
			Other indications which are not assignable to positive or negative categories; Specific expressions without any clear articulation of what somebody feels	Okey dokey;oh my god

*Not identified in the data

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