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Vertical or shared? When leadership supports team learning for educational change

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Abstract
University teacher teams can work toward educational change through the process of team learning behavior, which involves sharing and discussing practices to create new knowledge. However, teachers do not routinely engage in learning behavior when working in such teams and it is unclear how leadership support can overcome this problem. Therefore, this study examines when team leadership behavior supports teacher teams in engaging in learning behavior. We studied 52 university teacher teams (281 respondents) involved in educational change, resulting in two key findings. First, analyses of multiple leadership types showed that team learning behavior was best supported by a shared transformational leadership style that challenges the status quo and stimulates team members' intellect. Mutual transformational encouragement supported team learning more than the vertical leadership source or empowering and initiating structure styles of leadership. Second, moderator analyses revealed that task complexity influenced the relationship between vertical empowering team leadership behavior and team learning behavior. Specifically, this finding suggests that formal team leaders who empower teamwork only affected team learning behavior when their teams perceived that their task was not complex. These findings indicate how team learning behavior can be supported in university teacher teams responsible for working toward educational change. Moreover, these findings are unique because they originate from relating multiple team leadership types to team learning behavior, examining the influence of task complexity, and studying this in an educational setting.

Keywords Team learning · Higher Education · Teacher teams · Team leadership behavior · Shared leadership · Task complexity

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Introduction

Higher education institutions are under pressure to modify and reinvent their educational programs to prepare students for an increasingly complex world. These institutions are progressively challenged to become more attuned to students' needs by improving their employability and better preparing graduates for emerging jobs (Lehtinen et al. 2014). Moreover, greater workplace complexity has led to calls for new interprofessional programs that equip students with the necessary technical skills and cognitive competences (e.g., Klaassen 2018). This requires institutions to not only rethink the nature of their educational offerings but also to reconsider how education is organized and to bring university teachers[1] together across classic disciplinary boundaries (Kezar 2011; Klaassen 2018). This suggests that teachers need to work in teams and engage in dialogue and inquiry.

Many modern organizations make explicit use of teams because teamwork allows professionals to combine their unique individual expertise to perform complex tasks (Kozlowski & Ilgen 2006). Cohen and Bailey (1997) defined teams as "a collection of individuals who are interdependent in their tasks, who share responsibility for outcomes, who see themselves and who are seen by others as an intact social entity embedded in one or more larger social systems" (p. 241). Working in teacher teams differs from simply working together in the same group or department; it requires teachers to share responsibility for "the design or implementation of a curriculum innovation in the form of (re)design of a course or entire curriculum and/or the improvement of teaching" (Gast et al. 2017, p. 737).

Team learning behavior is a key process that enables teams to manage such complex tasks. It occurs when team members share their individual knowledge and ideas with each other and discuss and integrate what is shared at the team level (Kozlowski & Ilgen 2006). This requires negotiating each other's input, challenging other's ideas, and vocally disagreeing with different views when necessary. Team members who engage in team learning behavior can yield new shared understandings that help them adapt ideas and build new solutions, which greatly contributes to team performance (Van den Bossche et al. 2006). Moreover, purposefully identifying different viewpoints can help university teacher teams move beyond daily routines, allowing them to develop new knowledge and solutions together (Bronet al. 2018). Correspondingly, many scholars have found that team learning behavior is an important predictor for team performance (Hoch 2014; Kozlowski & Ilgen 2006; Lee et al. 2010; Somech 2006).

However, engaging in team learning behavior is difficult because individuals are inclined to avoid disagreement and conflict in a team. Adequate support is therefore essential to encourage negotiation of new ideas and avoid silence in a group (Edmondson 1999). Leadership may help university teachers seek controversy and debate with colleagues (Furco & Moely 2012). Koeslag-Kreunen, Van den Bossche, Hoven, Van der Klink, & Gijselaers (2018) observed that university teacher teams do not necessarily recognize a need to change and construct new knowledge together. This may be because university teachers are accustomed to working independently (Klein & Falk-Krzesinski 2017). Moreover, they tend to ignore new ideas if they do not see a connection to their

[1] University teachers are defined here as professional educators who work at higher education institutions and educate undergraduate or graduate students for a specific profession (Houle, Cyphert, and Boggs, 1987).

practice, if they feel insecure about ideas, or if they sense a lack of support (Furco & Moely 2012).

Leadership has often been recognized as an important factor in facilitating processes such as team learning behavior in higher education (Bryman 2007; Kouzes & Posner 2019). Leadership is generally defined as "the process of influencing others to understand and agree about what needs to be done and how to do it, and the process of facilitating individual and collective efforts to accomplish shared objectives" (Yukl 2010, p. 8). There are many approaches to further defining processes of influencing and facilitating others. This study builds on that variety and focuses on different *types* of team leadership behavior concerning two different *sources* and three different *styles* of team leadership behavior.

The *styles* we focus on represent a broad range of effective team leadership behaviors as synthesized by Burke et al. (2006). Specifically, this study concentrates on two person-focused styles—transformational (i.e., stimulating creativity) and empowering (i.e., emphasizing collaboration)—and one task-focused style—initiating structure (i.e., structuring processes). These leadership styles can originate from two *sources* of leadership: the vertical and the shared source. The *vertical source* of leadership refers to team leadership behaviors performed by the individual team leader who is formally appointed to lead the team (Pearce & Sims 2002). The *shared source* of leadership (i.e., shared leadership) refers to team leadership behaviors performed by multiple team members and emerges when they influence each other (Nicolaides et al. 2014). Pearce and Conger (2003) defined shared leadership as "a dynamic, interactive influence process among individuals" (p. 1). It can especially help teams with complex tasks because it utilizes all the team members' leadership capacities and allows them to influence each other regardless of formal positions (Hairon & Goh 2015). As such, understanding team leadership behavior in practice is helped by identifying which styles are performed by which sources instead of only focusing on how leadership is formally organized in terms of positions (Bouwmans et al. 2019; MacBeath 2005).

It appears that both sources of team leadership behavior can support team learning behavior. Formal team leaders (i.e., the vertical source) can, for example, challenge team members to share ideas (Bucice et al. 2010). Team members (i.e., the shared source) can also stimulate each other, for instance by instructing one another on how to approach the task (Hoch 2014). In any case, the team's task influences which style of team leadership behavior specifically supports team learning behavior (Koeslag-Kreunen, Van der Klink, Van den Bossche, & Gijselaers, 2018). Team tasks differ in terms of complexity: low-complexity tasks require adaptation of existing knowledge while high-complexity tasks require the creation of new knowledge (Ellström 2001). Koeslag-Kreunen, Van der Klink et al. (2018) showed that person-focused styles support learning behavior in teams dealing with low- and high-complexity tasks because they encourage communication and creativity. However, task-focused styles only support learning behavior in teams with low-complexity tasks because they emphasize what needs to be done and how (Koeslag-Kreunen, Van der Klink et al. 2018).

Despite these empirical insights, it remains unclear how team leadership behavior supports team learning behavior for educational change. More than 95% of the studies in the meta-analysis of (Koeslag-Kreunen, Van der Klink et al. 2018) were conducted outside educational settings, such as in healthcare, business, or R&D teams. Furthermore, leadership research in (higher) education largely lacks outcomes of shared leadership (Kezar & Holcombe 2017), mostly studies vertical and shared sources of leadership separately (Tian et al. 2016), and does not focus on supporting learning behavior in teams (Gast et al. 2017). There is also little research in other settings that relates multiple team

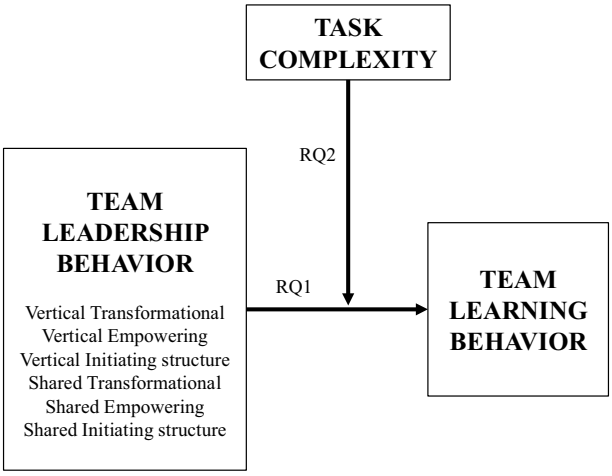

Fig. 1 Conceptual model with two research questions

leadership styles to team learning behavior; it mainly involves only one or two styles (Koeslag-Kreunen, Van der Klink et al. 2018). Moreover, team leadership research rarely includes task characteristics, despite evidence showing that the specific team task influences the effect of different leadership styles (Koeslag-Kreunen, Van der Klink et al. 2018; Nicolaides et al. 2014). It is particularly important that research includes task perceptions of university teacher teams to understand how team leadership behavior can support team learning behavior since university teachers may not immediately recognize new elements in their task or the need to bring about change together (e.g., Furco & Moely 2012).

For these reasons, the current study aims to deepen understanding of when team leadership behavior can support teacher team learning behavior. Multiple types of team leadership behavior will be included: to explore (RQ1) which types relate to team learning behavior in university teacher teams that need to work toward change, and to examine (RQ2) whether task complexity moderates a relationship between different types of team leadership behavior and team learning behavior. In doing so, this study builds upon previous team and educational research. Figure 1 presents this study's conceptual model.

Developing educational change through team learning behavior

To work toward educational change, teacher teams need to create new ideas and knowledge together. Team learning behavior is a key process that allows university teacher teams to do so (Bron et al. 2018). Team learning behavior is defined as the collective discourse activities of team members that enable teams to question traditions collectively, seek controversy, and use multiple inputs (Edmondson 1999).

Van den Bossche et al. (2006) identified three team learning behaviors: sharing, co-construction, and constructive conflict. These behaviors enable teams to shape individual interpretations of ideas and knowledge into a deeper understanding, which contributes to team performance. *Sharing* means exchanging ideas, knowledge, and experiences (Faraj & Sproull 2000). *Co-construction* is defined as building on what is shared by refining statements, modifying previous ideas, and adapting ideas (Baker, 1994).

Constructive conflict involves openly acting upon diversity and discussions that may occur by asking critical questions and integrating opposing ideas into an (dis)agreement (Van den Bossche et al. 2006). These team learning behaviors can be combined in university teacher teams for educational development, but doing so requires adequate support from team leadership behavior (Koeslag-Kreunen, Van den Bossche et al. 2018).

Team leadership behavior for overcoming barriers to engaging in team learning behavior

Teachers need the support of team leadership behavior to engage in team learning behavior. Teachers tend to work independently and avoid change (Furco & Moely 2012; Klein & Falk-Krzesinski 2017). To identify which types of team leadership behavior are particularly supportive, this study focuses on three *styles* of leadership behavior that can originate from vertical and shared *sources*. The *vertical source* of leadership represents behaviors of the formal team leader that influence and facilitate team processes (Pearce & Sims 2002). The *shared source* of leadership involves behaviors performed by multiple team members that influence and facilitate each other, regardless of their formal role (Nicolaides et al. 2014).

Focusing on both the vertical and shared sources of team leadership behavior supports views that leadership in education is performed by both formal and informal leaders (Bouwmans et al. 2019; Young, 2017). In other words, every team member—not only formal leaders—can show team leadership behavior regardless of their position (MacBeath 2005; Young, 2017). Indeed, both vertical and shared sources of team leadership behavior appear to co-exist in teacher teams (Koeslag-Kreunen, Van den Bossche et al. 2018). Bouwmans et al. (2019), for instance, identified teacher team members in vocational education who jointly coordinated their task and had formal team leaders who set visions. Högfeldt et al. (2018) showed that both sources supported educational development: the vertical source provided structure for collaboration, and the shared source emphasized the input of all university teacher team members. These findings indicate that both sources of team leadership behavior may promote team learning behavior among university teachers as well.

Consequently, focusing on the leadership behaviors of both leaders and team members, rather than solely concentrating on formal roles or the distribution of power or tasks, may increase understanding of leadership practices (Bouwmans et al., 2019; MacBeath, 2005; Tian et al., 2016). Accordingly, this study considers which styles of leadership behavior are performed by leaders and members of university teacher teams. The aim is to understand which types (i.e., sources and styles) of leadership behavior directly relate to team learning behavior. Pearce and Sims (2002) showed that a vertical source and a shared source can use multiple styles of team leadership behavior. The present study includes transformational, empowering, and initiating structure as styles of team leadership behavior that have been found to support team learning behavior in various disciplines (Koeslag-Kreunen et al., 2018).

Transformational team leadership behavior involves motivating team members to move beyond their own interests and stimulating their creativity to change routines and solve problems (Bass & Avolio 1994). More particularly, it is important to challenge the status quo and provide intellectual stimulation to trigger the learning behavior of university teacher teams that need to develop new knowledge together. Bucic et al. (2010) showed that formal leaders who performed these specific transformational behaviors supported learning in university teacher teams because they encouraged members to dare to learn

and seek alternative approaches. Van Ameijde et al.(2009) showed that sharing such team leadership behaviors can build trust and ownership, for example by "actively involving one another in the process of sense-making" (p. 775). This motivates university teachers to contribute and build new knowledge collaboratively (Van Ameijde et al. 2009). Accordingly, transformational team leadership behavior from both vertical and shared sources that challenge the status quo and provide intellectual stimulation may support the learning of university teacher teams engaged in educational change.

Empowering team leadership behavior is defined as actively developing the team's self-management skills (Burke et al. 2006). Empowerment can be displayed in behaviors such as setting participative goals and encouraging teamwork (Pearce & Sim 2002). Encouraging teamwork can support teams in perceiving teamwork as an opportunity for learning instead of an unknown obstacle (Pearce & Sims 2002); this may be important for team learning among university teachers because of their independent work tradition (Klein & Falk-Krzesinski 2017). Indeed, Bryman (2007) concluded that effective leaders in higher education encourage communication, participative decision-making, and collaboration. In addition, Koeslag-Kreunen, Van den Bossche et al. (2018) indicated that team members who discussed individual issues at the team level instead of keeping those issues at an individual level seemed to contribute to integrating knowledge at the team level. For these reasons, we assume that empowering team leadership behavior from both sources supports team learning behavior among university teacher teams by encouraging them to engage in teamwork.

Initiating structure involves assigning team tasks, working methods, and goals (Burke et al. 2006). Initiating structure from the vertical source may support team learning behavior among university teacher teams because it can serve as a strategy for focusing the interaction (Somech 2006). Organizing structure together, the shared source, can support the involvement of all team members (Högfelt et al., 2018). For instance, team members can do this by telling each other what to do and how (Hoch 2014).

In sum, we suggest that vertical and shared sources of leadership behavior can promote team learning behavior through transformational, empowering, and initiating structure styles. Still, it is not clear which types of team leadership behavior relate to team learning behavior in university teacher teams. This could be because the different leadership sources and styles have mostly been studied separately (Tian et al. 2016) or have been mainly related to team performance instead of team learning behavior (Burke et al. 2006; Nicolaides et al. 2014), and such concepts are rarely studied in educational settings (Koeslag-Kreunen, Van der Klink et al. 2018). As a result, we formulated the first research question:

Research question 1. Which types (i.e., sources and styles) of team leadership behavior relate to team learning behavior in university teacher teams that need to work toward change?

The moderating role of task complexity

The perception of task complexity among university teacher teams may influence which specific types of team leadership behavior support their learning behavior. This study defines task complexity as the perceived level of difficulty and the absence of standard solutions (Cooke et al. 2001). If team members perceive that a task has a low level of complexity, they may assume it is sufficient to use and adapt existing knowledge and routines (Ellström 2001). Perceiving a task as highly complex indicates that team members

sense they cannot rely on their existing knowledge (Cooke et al. 2001). They recognize the need to develop new knowledge together to manage the difficulty and create new solutions (Ellström 2001). Koeslag-Kreunen, Van der Klink et al. (2018) showed that team learning behavior for tasks with both low- and high-level complexity is supported by transformational and empowering vertical leadership behavior because those styles focus on dealing with uncertainties and encouraging interactions. Team learning behavior for tasks with low-level complexity is supported by vertical leadership behavior that initiates structure because it focuses on reinforcing routines and using protocols (Koeslag-Kreunen, Van der Klink et al. 2018). It is unclear how task complexity moderates the influence of shared team leadership behavior, since previous research does not differentiate between specific shared team leadership behaviors or does not relate leadership behavior to team learning behavior (Koeslag-Kreunen, Van der Klink et al. 2018; Nicolaides et al. 2014). As such, the second research question is:

Research question 2. Does the perceived task complexity moderate a relationship between team leadership behavior and team learning behavior?

Methods

Setting, sampling, and procedure

This study was conducted at a Dutch university of applied sciences that uses a team approach to develop educational innovations. This institution is organized in nine domain-specific professional schools (e.g., technology, business, arts) headed by a board of governors and a monitoring supervisory board. Each school is led by a management team consisting of one managing director and several operational managers. The schools offer undergraduate tracks, professional bachelor's and master's degrees, and post-graduate programs for specific professions (e.g., hotel managers and physiotherapists). The main task of the university teachers working in these programs is teaching for professional practice and advancing the knowledge and practice of professions through practice-based research and development (Houle et al. 1987). Their work is mostly organized in various forms of collaboration.

Members of each school's management teams were invited to help identify teams for this study. They were asked to identify teams of university teachers who share responsibility for an innovative or new task that contributes to educational change, such as adapting curricula to new professional qualifications. The team had to include between three and 20 members and have a minimum team age of at least 2 months to ensure sufficient occurrence of team interactions. The presence of a formal leader who was appointed to lead the team was not a selection criterion; teams with and without formal team leaders were selected.

We used a three-step selection process to identify teams for this study. First, we identified 86 teacher teams who were engaged in educational change projects. We then approached the team leader and/or team members to request their participation in this study. We explained the study's purpose and assured confidentiality. Second, we asked these teams to describe their team task to ensure we selected teams with innovative tasks. Teams that did not meet these criteria were excluded from further study. Third, we selected teams representing different disciplinary domains: arts, business and economics, educational sciences, engineering, health, law, management, and social studies.

Team tasks varied, but all contained goals to work toward educational change. These ranged from developing new curricula, conducting multidisciplinary research, developing a different educational management strategy, and implementing new interprofessional courses to evaluating and redesigning existing assessment forms. Of the 86 teams we contacted, 25 teams did not participate for different reasons: *no response/follow-up* = 8; *no time for participation* = 3; *did not meet criteria of shared responsibility for an innovative or new task* = 8; *did not participate* = 6. This resulted in a sample of 61 teams (319 participants).

Teams with a representative response of at least two thirds of their members were selected for analyses (Van Mierlo et al. 2008). Using these criteria, we selected 52 (281 participants) of the initial 61 teacher teams, with a mean team age of 1.52 years (*SD* = 2.01, *range* = 0.25 to 12.5 years) and an average team size of 7.76 members (*SD* = 5.38, *range* = 2 to 20). On average, the participants (50% female) were 46.44 years old and had worked at this university for 11.22 years. Forty-three teams had a formally appointed leader who each led one team in our sample, enabling analyses of both shared and vertical leadership behavior in those teams.

Instruments

A questionnaire was used to measure team learning behavior, team leadership behavior, and task complexity. We used measures taken from published and validated questionnaires to evaluate each team construct.

Team learning behavior was measured with the nine-item scale used by Van den Bossche et al. (2006). Example item: "Team members elaborate on each other's information and ideas." A record error caused one dysfunctional item.

Team leadership behavior was assessed using three scales from Pearce and Sims (2002) that measure three styles of team leadership behavior: (1) *Transformational leadership* (eight items: three items on "Challenging the status quo," five items on "Intellectual stimulation"), (2) *Empowering* (three items on "Encouraging teamwork"), and (3) *Initiating structure* (six items: three items on "Assigned goals," three items on "Instruction and command"). Example items: "My team leader/members is/are non-traditional type(s) that 'shake(s) up the system' when necessary" (transformational), "My team leader/members encourage(s) me to work together with other individuals who are part of the team" (empowering), and "When it comes to my work, my team leader/members give(s) me instructions on how to carry it out" (initiating structure). We used the method Pearce and Sims (2002) applied to measure each style for the vertical and shared sources of team leadership behavior. This method measured the items twice for each specific style of team leadership behavior: "once for their team leader (vertical leadership) and once for their team members as a whole (shared leadership)" (Pearce & Sims, 2002, p. 179). Nine teams in our sample indicated they had no formally appointed team leader, so their questionnaire did not include the vertical leadership items.

Perceived *task complexity* was measured with the five-item scale used by Sarin and McDermott (2003). Example item: "The development process associated with the product was relatively simple" (reverse scored). These items were accompanied by the following short definition of complexity: "Complexity is defined here as the level of difficulty and the absence of standard solutions."

Team size and team age were included as *control variables*.

The questionnaire was sent digitally to the individual participants and asked questions about the participant's team. We first asked which team the participant belonged to (and its size and age) and then asked about team learning behavior, team leadership behavior, and task complexity. The scale items started with the instruction: "Please indicate to what extent you agree with the following statements regarding this team." The response scale ranged from 1 (strongly disagree) to 7 (strongly agree). The internal consistencies of the scales were sufficiently high based on Cronbach α values (ranged from 0.82 to 0.94) calculated based on the initial sample of 319 participants. Table 1 presents the descriptives, correlations, and internal consistencies.

Multiple source ratings and data aggregation

The team constructs were self-rated by team members and leaders who were considered capable of reflecting on and offering multiple perspectives on performed team behaviors (Atwater, Waldman, & Brett, 2002). No differentiation was made between the individual scores of the formal leader and the members per team. These individual data points were considered as repeated measures per construct, since these scores are interdependent and related to the team level of the judged construct, and are therefore only meaningful for interpretation when aggregated at the team level (Van Mierlo et al., 2008).

Three measures were used to assess whether this data aggregation was reliable (Dixon & Cunningham, 2006). First, we assessed the level of agreement among the raters and corrected it for the number of items per scale by computing the $r_{WG(J)}$ multiple item estimate of James, Demaree, and Wolf (1984). Per variable, the median was taken based on the $r_{WG(J)}$s per team; $r_{WG(J)} > 0.71$ is considered a strong and $r_{WG(J)} > 0.91$ a very strong agreement (LeBreton & Senter, 2008). Second, the intra-class correlations (*ICC1*) were calculated to assess whether the data was nested in teams, meaning that ratings depend on the team rather than being independent of the team, with > 0.50 as the cutoff point (LeBreton & Senter, 2008). Following Cohen and Dovey (2005), the formula for unequal group sizes in an unbalanced design was used. Third, the extent to which the teams differ from each other was assessed by calculating interclass correlations (ICC2). We used Bliese's (2000) ICC2 formula with > 0.50 as the cutoff point (LeBreton & Senter, 2008). Table 2 presents the three aggregation indices per team construct. Based on these indices, we concluded that it is sufficiently reliable to aggregate the individual ratings at the team level.

Analyses

The data analyses involved several steps. Missing data on team age for three teams were substituted by the mean. Skewness and kurtosis values indicated a normal distribution of the data. Next, the correlation matrix (see Table 1) was scanned to check for multicollinearity to ensure meaningful interpretation (Field, 2009). The correlation between team learning behavior and shared transformational team leadership behavior was above $r > 0.80$ ($r = 0.84$), for which variance inflation factors (VIFs) were calculated. Their VIF reached a maximum of 5.19. To ensure the independence of these scales, their eigenvalues per factor were examined by running principal axis factoring. The eigenvalues ranged from 0.665 to 0.899 for team learning behavior and from 0.510 to 0.885 for shared transformational team leadership. One item of shared transformational leadership (i.e., "My

Table 1 Descriptives, correlations, and internal consistencies among team-level variables

	M	*SD*	1	2	3	4	5	6	7	8	9	10
1. Team size	5.40	3.64										
2. Team age (years)	1.52	2.01	0.70**									
3. Team learning behavior	5.72	0.67	− 0.39**	− 0.18	(0.91)							
4. Vertical transformational leadership	5.73	0.67	− 0.04	0.02	0.49**	(0.94)						
5. Vertical empowering leadership	5.51	0.73	− 0.13	− 0.07	0.26	0.67**	(0.87)					
6. Vertical initiating structure leadership	4.60	0.91	0.03	− 0.03	0.25	0.52**	0.23	(0.90)				
7. Shared transformational leadership	5.48	0.67	− 0.30*	− 0.12	0.82**	0.41**	0.25	0.14	(0.92)			
8. Shared empowering leadership	5.14	0.66	− 0.23	− 0.15	0.66**	0.45**	0.48**	0.15	0.78**	(0.82)		
9. Shared initiating structure leadership	4.52	0.68	− 0.25	− 0.31*	0.58**	0.20	0.07	0.14	0.64**	0.76**	(0.88)	
10. Task complexity	5.62	0.81	− 0.08	− 0.14	0.22	0.30*	0.26	− 0.01	0.26	0.33*	0.16	(0.85)

$N = 52$ teams ($N = 43$ teams for vertical team leadership). Scale reliabilities are in parentheses along the diagonal ($N = 319$)

*$p < 0.05$; **$p < 0.01$ (two-tailed)

Table 2 Aggregation indices per team construct

		$R_{WG(J)}$	*ICC1*	*ICC2*
Team learning behavior		0.97	0.81	0.77
Vertical team leadership behavior	Transformational	0.94	0.66	0.49
	Empowering	0.84	0.58	0.26
	Initiating structure	0.94	0.57	0.23
Shared team leadership behavior	Transformational	0.95	0.75	0.66
	Empowering	0.79	0.67	0.51
	Initiating structure	0.86	0.68	0.53
Task complexity		0.89	0.77	0.71

$R_{WG(J)}$ multiple item median within group agreement, *ICC1* intra-class correlations for unequal group sizes examining total variance due to team variance, *ICC2* intra-class correlations examining distance between variance and within variance

team members emphasize the value of questioning team members") was excluded from this scale because it had a factor loading of 0.757 on the team learning factor and only 0.442 on the shared transformational leadership factor. After this exclusion, the correlation remained high ($r = 0.82$, as displayed in Table 1), but their VIF decreased to an acceptable 3.28. This indicated that multicollinearity is not expected between these variables (Field, 2009).

Next, two sets of regression analyses were conducted to answer the two research questions. First, a multiple linear regression analysis was conducted to test which leadership types relate to team learning behavior (RQ1). Then, we conducted six separate series of moderator analyses as described by Hayes (2013), using PROCESS for SPSS version 2.16.3 as a computational tool. These series tested whether perceived task complexity moderates a relationship between team leadership behavior and team learning behavior (RQ2). If there was an interaction effect, task complexity was divided into two equal groups with the mean score as the cutoff point (i.e., low = < 5.62 and high = > 5.62) to specify the effect.

Results

The results are presented in three sections. The first section presents bivariate correlations (see Table 1). The second section presents the results from the two sets of multiple linear regression analysis to answer the first research question: which types (i.e., sources and styles) of team leadership behavior relate to team learning behavior in university teacher teams that need to work toward change? The third section involves the moderator analyses that answer the second research question: does the perceived task complexity moderate a relationship between team leadership behavior and team learning behavior?

First, the correlation matrix (Table 1) shows significant positive correlations between the shared transformational team leadership behaviors and team learning behavior ($r = 0.82$ for transformational; $r = 0.66$ for empowering; $r = 0.58$, $p < 0.01$ for initiating structure). Vertical transformational team leadership behaviors also correlated with team learning behavior ($r = 0.49$, $p < 0.01$). Furthermore, team size was negatively correlated with team learning behavior ($r = -0.39$, $p < 0.01$) and shared transformational team leadership

Table 3 Multiple linear regression analysis of the effects of team leadership styles and sources on team learning behavior

	Team learning behavior				
	Adj. R^2	$F(34)$	β	t	p
	0.642	10.427			0.000**
(Constant)				1.886	0.068
Team size			− 0.237	− 2.006	0.053
Team age			0.046	0.381	0.705
Vertical transformational leadership			0.283	1.813	0.079
Vertical empowering leadership			− 0.126	− 0.772	0.445
Vertical initiating structure leadership			0.050	0.445	0.659
Shared transformational leadership			0.567	3.454	0.001**
Shared empowering leadership			0.011	0.043	0.966
Shared initiating structure leadership			0.090	0.483	0.632

Standardized betas are reported. $N = 43$ teams

*$p < 0.05$; **$p < 0.01$ (two-tailed)

Table 4 Moderator effect of task complexity on the influence of vertical empowering team leadership on team learning behavior

	Team learning behavior				
	R^2	$F(37)$	β	t	p
	.348	3.954			0.006**
(Constant)				0.287	0.775
Team size			− 0.395	− 2.706	0.010**
Team age			0.055	0.374	0.710
Task complexity			− 0.007	− 0.050	0.960
Vertical empowering leadership			0.118	0.871	0.389
Vertical empowering leadership × task complexity			− 0.322	− 2.691	0.011*
R^2 change due to interaction	0.128				
$F(37)$ due to interaction	7.241				
p	0.011*				

Reported coefficients are based on standardized variables. $N = 43$ teams

*$p < 0.05$; **$p < 0.01$ (two-tailed)

behavior ($r = -0.30$, $p < 0.05$). Team age was negatively correlated with shared initiating structure ($r = -0.31$, $p < 0.05$).

Second, with regard to research question 1, the multiple linear regression analysis (see Table 3) on the influences of all measured styles and sources of team leadership behavior on team learning behavior showed that shared transformational leadership behavior predicts team learning behavior significantly ($\beta = 0.567$, $p = 0.001$, adj. $R^2 = 0.642$).

Third, with regard to research question 2, six series of moderator analyses (displayed in Table 4) revealed that task complexity moderates a relationship between vertical

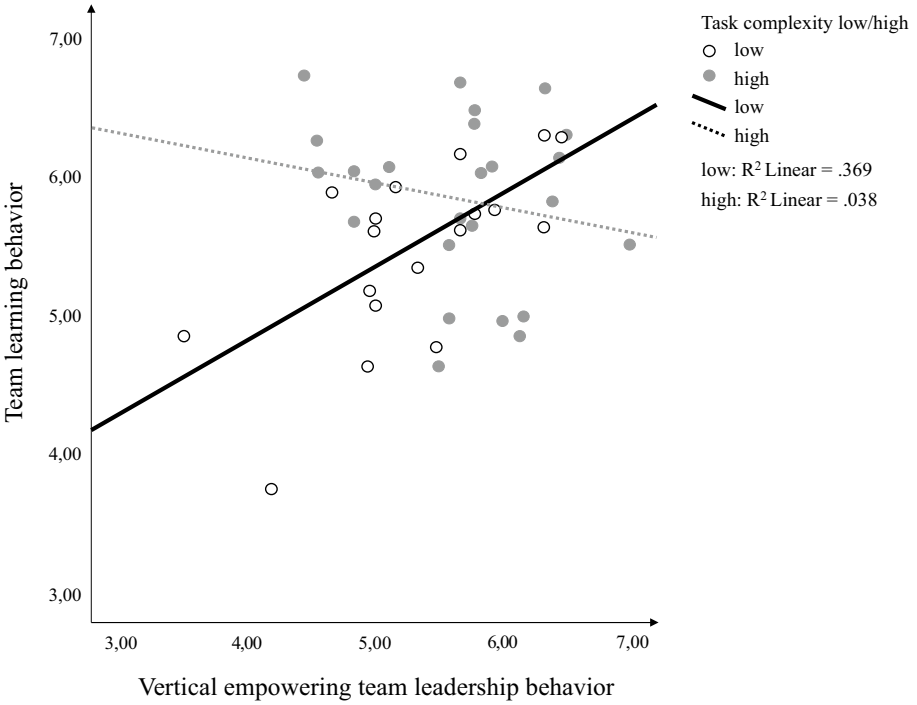

Fig. 2 Plot of moderation effect of task complexity

empowering team leadership behavior and team learning behavior ($\beta = -0.322$, $p = 0.011$).

An interpretation of this interaction effect, as presented in Fig. 2, shows specifically that vertical empowering team leadership behavior positively influences team learning behavior when task complexity is low ($\beta = 0.559$, $p = 0.005$). Vertical empowering team leadership behavior is not related to team learning when task complexity is high ($\beta = -0.219$, $p = 0.243$).

Conclusion and discussion

This study examined how team leadership behavior can support teacher teams working toward educational change. In particular, we were interested in which types of team leadership behavior support team learning behavior to achieve change. Two sets of regression analyses—including transformational, empowering, and initiating structure styles of team leadership behavior from vertical and shared sources—tested which leadership types relate to team learning behavior (RQ1). Six series of moderator analyses tested whether the perceived task complexity moderates a relationship between team leadership behavior and team learning behavior (RQ2). Our analyses resulted in two key findings.

Firstly, considering all six types of team leadership behavior, our findings reveal that learning behavior in teams is best supported by a transformational team leadership behavior

style originating from a shared source (RQ1). Challenging the status quo collaboratively and stimulating each other's intellect strongly contribute to team learning behavior. This finding confirms earlier research that showed a need for transformational vertical leadership behavior when teams are responsible for developing innovative services or products (e.g., Bucic et al., 2010). Our findings add a new and detailed interpretation to shared leadership in higher education and its outcomes (Kezar & Holcombe, 2017). The learning behavior of the university teacher teams in our sample needed mutual transformational support *more* than the empowering and initiating structure styles *and* more than the support of their formal team leaders. This finding leads to an advanced perspective on how to support university teachers who need to overcome a tendency to avoid change and a preference for working and learning individually (Furco & Moely, 2012; Klein & Falk-Krzesinski, 2017; Koeslag-Kreunen, Van den Bossche et al., 2018).

The present study observed team leadership behavior in a new way. We examined which styles belong to particular sources supporting team learning behavior. In this respect, it differs from established methods that solely focus on single styles or sources (e.g., Tian et al., 2016) or on how leadership is organized in terms of positions (Bouwmans et al., 2019; Hairon & Goh, 2015). Moreover, our research collected evidence on outcomes of shared leadership (Kezar & Holcombe, 2017). Finally, we did not exclude the formal team leader when measuring shared team leadership behavior. Data aggregation indices showed it was reliable to aggregate the individual ratings of team members and leaders per team at the team level (Van Mierlo et al., 2008), which confirms views that any member can show team leadership behavior, regardless of their formal position (MacBeath, 2005; Young, 2017).

Our findings indicate that when teams utilize the leadership capacities of all team members regardless of formal positions, they overcome their habits and influence and encourage each other to take a chance on team learning behavior. This first key finding shows that *all* team members should engage in the specific behavior of challenging the status quo and stimulating intellect that keeps the team in motion rather than basing their actions on one single team leader.

Secondly, our results show that vertical empowering team leadership behavior positively influences team learning behavior when team members perceive task complexity as low (RQ2). This result is based on moderator analyses that tested whether the perceived task complexity moderates a relationship between team leadership behavior and team learning behavior. It appears that the relationship between empowering team leadership behavior and team learning behavior depends on the perceived task complexity. This second key finding contributes to understanding the moderating role of the specific team task (Koeslag-Kreunen, Van der Klink et al., 2018). Specifically, it signifies that formal team leaders who empower teamwork only affected team learning behavior if their teams perceived that their task was not complex.

So, while the first key finding emphasizes the importance of transformational team leadership behavior as a shared activity of all members (including the formal leader), this second finding reveals when and which specific team leadership behavior of solely formal team leaders is important. Observing the influence of task complexity provides innovative directions for how to support team learning when teachers do not necessarily recognize new elements in their task, which is likely to occur (e.g., Furco & Moely, 2012). The teams in our sample were explicitly selected based on the shared responsibility to work toward educational change, which is considered a highly complex task because standard solutions are absent. However, although their task may be objectively complex, team members might experience the task complexity as low and might feel that relying on existing knowledge

and adapting or using known working methods will be enough to succeed (Ellström, 2001). These teams could be considered "at risk" because they may not automatically sense that they need each other's input to develop new knowledge by engaging in team learning behaviors. In such cases, our findings show that it is essential that team leaders demonstrate behavior that encourages teamwork, interaction, and the coordination of individual efforts at the team level.

In sum, this study concludes that (1) team members should encourage each other to challenge the status quo and not avoid constructive conflict about new ways of designing education, and (2) vertical empowering team leadership behavior is only effective when team members perceive task complexity as low.

Limitations, future research, and implications

The two key findings contribute substantially to understanding when leadership does indeed support teacher team learning behavior. This study built upon current team and educational research by comparing the influence of six types of team leadership behavior on team learning behavior in university teacher teams working toward educational change. The findings enrich current team leadership literature, which rarely addresses multiple types of team leadership behavior (Tian et al., 2016), relates team leadership behavior mainly to team performance (Burke et al., 2006; Nicolaides et al., 2014), and is largely conducted outside educational contexts (Koeslag-Kreunen, Van der Klink et al., 2018).

The findings offer two directions for further understanding complex social interactions related to learning and leadership behavior in teams.[2] First, we suggest that future studies take a longitudinal approach to specify which type of team leadership behavior is needed in which team phase to advance understanding of how to support team learning behavior over time, as our cross-sectional approach limits such a comprehensive understanding. For example, we included team age as a control variable in this study and we found that it was inversely related to shared initiating structure. This may imply that younger teams focus on structuring processes collaboratively more than older teams. Along similar lines, Lorinkova, Pearsall, and Sims (2012) showed that team leaders' structuring behaviors support teams in the early stages and that empowering leaders are more important as team processes evolve over time. We recommend not only including multiple types of leadership behavior as this study did, but also examining its influence on team learning behavior over time to understand how learning and leadership behaviors in teams evolve and influence each other.

We also recommend that perceived task complexity is included in these longitudinal approaches. By examining the influence of perceived task complexity, this study was able to specify when which type of team leadership behavior was important to fuel team learning behavior. Longitudinal studies may provide new insights about what influences the task perception of teams (e.g., How does perceptions of task complexity change? Or how does leadership behavior influence these changes?).

A second recommendation for future research is related to our self-report questionnaire methodology. This approach enabled us to analyze data that reflected on and combined

[2] We thank an anonymous reviewer for suggesting referring to the current study as "stage one in trying to understand these complex social interactions."

multiple perspectives on performed team behaviors (Atwater et al., 2002). Furthermore, using multiple informants per team (consisting of at least two thirds of the team members, including the team leader) and assessing the reliability of data aggregation per team allowed us to draw conclusions based on repeated measures per construct (Van Mierlo et al., 2008). Nevertheless, future studies that apply a mixed methods approach (e.g., observations and interviews) may support a fuller exploration of team leadership dynamics and what exactly is happening there.[3]

To conclude, our results provide directions for how to support team learning behavior in university teacher teams that are responsible for working toward educational change. This study showed that leadership behavior in university teacher teams stems from both vertical and shared sources, which contributes to views that leadership in education is distributed and performed by both formal and informal leaders (Bouwmans et al., 2019; Young, 2017). This was further specified by exploring which type of team leadership behavior is important for supporting team learning behavior. We found that—given the different types of leadership behavior in teams—team members who challenge routines and encourage one another to seek alternatives supported each other in sharing unique ideas and expertise, co-constructing new knowledge, and acting upon differences. This indicates that university teacher teams should not wait for directions from formal leaders who pave the way for them. Instead, we recommend that they overcome their routines together.

At the same time, this study revealed that it is unlikely that all university teacher teams will automatically recognize that they need to work and learn together to develop change. Such teams need leaders to empower their learning behavior by emphasizing teamwork. Consequently, we conclude that bringing about educational change in higher education is a shared responsibility of both team leaders and team members, which is shaped around processes that affect how they influence and stimulate each other given the task they face and using all available leadership capabilities and expertise.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

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[3] We thank an anonymous reviewer for this recommendation.

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