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A Person-Centered Approach for Analyzing Multidimensional Integration in Collaboration Between Educational Researchers and Practitioners

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This study was conducted in the context of a development project for teacher education, establishing a collaborative format called Transdisciplinary Development Teams (TDTs). The aim of this study was to investigate (a) how participating TDT members assess focal dimensions of integration characteristics (DICs) with regard to success factors and challenging aspects. DICs are operationalized as (1a) mutual learning and (1b) knowledge integration, (2a) perceived trustworthiness, and (2b) appreciation within the team, and (3a) collective ownership of goals. In addition, they seek to (b) differentiate the types of actors characterized by particular assessment patterns. The study employs a person-centered approach (cluster analysis) and uses a data corpus with 62 response sets. Subsequently, this study offers a genuine conceptual approach to frame interorganizational collaboration in teacher education. On this basis, empirical insights that provide further practical implications to support future collaboration at the boundary of educational research and practice have been generated.

Keywords: cluster analysis, collaboration integration, research-practice partnerships, teacher education, transdisciplinarity

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INTRODUCTION

The discourse on interorganizational collaboration in teacher education has received increasing attention over the last two decades. Scholars frame such cooperative formats as powerful mechanisms for the development and transfer of didactical innovations (Einsiedler, 2010; Gräsel, 2011), while educational policy-makers and practitioners consider them as integrating factors to bridge the persistently criticized gap between educational research and practice (Hericks, 2004; Wissenschaftsrat, 2001, 14, 55). A growing body of literature offers theoretical frameworks, conceptual propositions, and empirical studies for the design as well as the analysis of such collaborative formats (Pilypaitytė and Siller, 2018; Kleemann et al., 2019). With regard to works of Loogma et al. (2013), Gräsel (2011), and others, interorganizational collaboration in teacher education may be conceptualized as socio-organizational innovation that in turn fosters the development, implementation, and transfer of didactical innovations. However, few studies have analyzed the integration of involved stakeholder groups as a key success factor for interorganizational collaboration at the boundary of educational research and practice (Straub et al., 2021).

The present article aimed to contribute to this research in two ways. First, an analytical framework that combines conceptual propositions of the Research–Practice Partnership (RPP) approach with insights into the discourse of transdisciplinarity will be offered. The RPPs approach provides a comprehensive understanding of long-term co-constructive collaboration between educational researchers and and practitioners (Penuel et al., 2015; Coburn and Penuel, 2016). Transdisciplinarity represents an integrative research and development mode that fosters the co-constructive engagement of actor groups across heterogeneous professional, organizational, and institutional backgrounds (Klein, 2014; Scholz and Steiner, 2015). Moreover, it advocates for a multidimensional understanding of integration that highlights the importance of 1) epistemic, 2) social, and 3) organizational dimensions (Jahn et al., 2012). In alignment with that, focal dimensions of integration characteristics (DICs) have been operationalized in terms of (1a) *mutual learning* and (1b) *knowledge integration*, (2a) *perceived trustworthiness*, and (2b) *appreciation within the team*, and (3a) *collective ownership of goals* (Straub et al., 2021). Second, concerning the research method, we use a person-centered approach to identify different patterns of integration characteristics within the actor groups. This allows the use of a complementary methodological perspective for the analysis of interorganizational collaboration in teacher education in general and for the investigation of multidimensional integration characteristics in particular (Straub et al., 2021).

THE CALL FOR INTERORGANIZATIONAL COLLABORATION IN TEACHER EDUCATION

The starting point for this study is a widely acknowledged critique that teacher education in Germany is understood not only as highly specialized, but also as institutionally and disciplinarily fragmented by international comparison (Blömeke, 2014). This is particularly due to the consecutive three-phased teacher education system, which comprises 1) university-based studies, 2) preservice teacher training, and 3) advanced on-the-job teacher training (European Commission/EACEA/Eurydice, 2015, p. 34; Kotthoff, 2011; Terhart, 2004). University-based teacher education aims to develop academic knowledge and competencies rooted in a wide range of disciplines. It comprises, *inter alia*, subject matter didactics, pedagogies, educational science, and psychology. Even though mandatory practical studies have largely expanded within the study curriculum during the past two decades (Weyland, 2012; Rothland and Biederbeck, 2018), the formal responsibility for the development of practical teaching competencies is situated within the second phase involving schools and teacher education colleges (German: "Studienseminare"; Lenhard, 2004). With respect to the third phase, that is, advanced teacher training, there are no uniform standards across Germany's federal state system. Therefore, advanced training might be conducted at training institutes affiliated with universities, as is the case for Lower Saxony, or else at educational administration institutes.

Institutional fragmentation may also be understood as a reinforcing element of what is commonly referred to as "theory–practice divide" in teacher education (Korthagen, 2007; Villiger, 2015). Ongoing controversies seek to provide refined conceptualizations and alternative perspectives on the interrelation, *inter alia*, "knowledge and action", "research and experience", "reflection and acting", and "distancing and engagement" (for a comprehensive overview, see Rothland, 2020). Nonetheless, various interest groups have continuously criticized the German teacher education system for its insufficient integration and coherence between academic expertise and practical skills (Arnold, 2010; Vanderlinde and van Braak, 2010). Even worse, mutual accusations and delimitation tendencies have become common knowledge within the teaching profession (Messner, 2012, p. 77). In extreme cases, the work of scholars created "in their ivory towers" is considered of limited practical relevance (Broekkamp and van Hout-Wolters, 2007), while practitioners are accused of neglecting theoretical, conceptual, and empirical knowledge (Patry, 2005).

However, in contrast to these conflicting tendencies, there are also increasing calls for interorganizational collaboration in teacher education (Gorodetsky and Barak, 2008; Straub and Vilsmaier, 2020). Those making these calls are committed to overcoming the aforementioned institutional fragmentation by pooling various bodies of knowledge and expertise across the teacher education system in order to co-construct integrative advancements within the teaching profession. Such collaborative formats are applicable, for instance, to university-based teacher education and teacher education colleges, schools, and youth welfare representatives, and among universities, schools, and extracurricular institutions (Boer et al., 2018; Kleemann et al., 2019).

The potential benefits of interorganizational collaborations are threefold: First, on an interpersonal level, interorganizational collaboration is understood as a genuine opportunity for professional development due to processes of mutual learning and knowledge integration (Korthagen, 2016; Boer et al., 2018). Second, at the organizational and institutional levels, such collaboration is understood to allow for collective capacity building and to be a driving force for organizational change (Fullan, 2016; Hartmann and Decristan, 2018). Third, the pooling of academic expertise and practical experience fosters the co-creation of didactical innovations, such as, teaching and learning arrangements, and teaching practices (Gräsel, 2011; Sewell et al., 2018). Overall, interorganizational collaborations in teacher education are discussed as powerful mechanisms to mitigate the gap between academic research and school practice.

THEORETICAL FRAMING OF INTERORGANIZATIONAL COLLABORATION IN TEACHER EDUCATION

In the context of this study, interorganizational collaboration in teacher education is conceptualized as 1) long-term interrelations among various stakeholder groups from educational research and

practice that 2) engage in mutual exchange and co-constructive processes in order to 2) jointly design, develop, establish, and reflect on didactical innovations in school-based teaching and university-based teacher education. This conceptualization draws significantly on theoretical contributions offered by the RPP approach and the discourse of transdisciplinarity.

Originating from the U.S. teacher education discourse, the RPP framework comprises a family of research and development approaches that is defined as "long-term collaborations between practitioners and researchers that are organized to investigate problems of practice and solutions for improving schools and school districts" (Coburn and Penuel, 2016, p. 48). RPP subtypes range from research alliances, over design research or design-based implementation research, to networked improvement communities (NICs) (Penuel et al., 2015; Coburn and Penuel, 2016). While each of these types focuses on joint research and development activities at the level of school practice, they differ in degree of shared goals, responsibilities, and interdependencies as well as concerning the joint decision-making competencies and ownership of the cooperation or collaboration process, respectively (Penuel and Gallagher, 2017; Straub et al., 2020). Research alliances, for instance, are characterized by mutually negotiated goals, whereas research activities fall within the responsibility of representatives of the university; while, practitioners focus on the implementation of didactical advancements (Coburn and Penuel, 2016). In contrast to this traditional role pattern, design research and design-based implementation research also highlight mutual interactions throughout the iterative research and development processes (Fishman et al., 2013; Bakker, 2018). Subsequently, networked improvement communities also resonate with design-based approaches, but seek to identify success factors and challenges for the implementation of school development activities or didactical innovations through the comparison of and exchange between different networked improvement communities (Bryk et al., 2011; Russell et al., 2017).

In contrast, the discourse of transdisciplinarity thrives on contributions from a broad variety of disciplinary backgrounds that link theoretical, conceptual, and empirical insights engaging with 1) challenges of problem-solving and transformation under the condition of 2) heterogeneous disciplinary, and institutional and organizational requirements through 3) the integration of relevant stakeholder groups in processes of mutual learning and co-construction (Straub, 2021, p. 15). Against this background, transdisciplinarity refers to an integrative research and development mode that advocates the interrelation of different bodies of knowledge and ways of knowing beyond professional, organizational, and institutional boundaries (Klein, 2014; Straub and Vilsmaier, 2020). In contrast to the RPP approach, transdisciplinary processes are committed to fostering a systemic and thus symmetrically integrative perspective toward the co-development of research and practical fields (Straub and Vilsmaier, 2020). In the context of this present study, this understanding highlights that collaboration and its outcomes should comprise both university-based teacher education and school-based teaching. Eventually, according to Nowotny et al. (2001), the integration of different sources of expertize and dedication to addressing both scientific and practical challenges, allow for the development of "socially robust knowledge". The notion of "socially robust knowledge", in turn, is linked to increased "legitimacy, ownership, and accountability" concerning the sustainable establishment of change processes and the lasting usage of didactical innovations (Lang et al., 2012, p. 26).

Despite some differences in focus, both conceptual frameworks overlap significantly. In the following, four intertwined principles will be discussed that subsume key characteristics of long-term interorganizational collaborations at the boundary of university-based teacher education and school-based teaching (Straub et al., 2020; Straub and Vilsmaier, 2020): 1) long-term collaboration perspective, 2) focus on practical problem-solving, 3) multi-perspectivity and participation, and 4) joint research and development orientation.

1) Long-term collaboration perspective: Lasting in-depth change processes and the sustainable implementation of didactical innovations require a long-term perspective (Coburn and Penuel, 2016, p. 48). First, a long-term research and development perspective allows stakeholders to comprehensively engage in co-constructive research and development activities that range from conceptual development, by way of application, and implementation to testing, evaluation, and revision, respectively (Straub and Vilsmaier, 2020). This ensures that different stakeholders contribute not only their expertise but also their respective interests and needs throughout the research and development process. Second, a continuous temporal perspective is also considered a necessary condition to build stable and trust-based social relations (Coburn et al., 2013). The recurrent experience of joint problem-solving across professional, institutional, and organizational boundaries strengthens the willingness and commitment for further collaboration. Third, a continuous partnership perspective resonates well with iterative research and development processes. In this way, research and development cycles may be interlinked, while objectives and the results can be refined stepwise or adapted to changing conditions and requirements (Straub et al., 2020).
2) Focus on practical problem-solving: The RPP approach highlights in particular the need for collaborations among researchers and practitioners to focus on issues, problems, and challenges that are considered to have immediate practical relevance (Coburn and Penuel, 2016, p. 49). Consequently, collaborative engagements ought to address tangible outcomes such as concrete teaching concepts and materials or professional development activities addressing issues of daily classroom interaction. Inspired by the discourse of transdisciplinarity, the present article encompasses a systemic perspective that comprises university-based teacher education as well as school-based teaching practice as interlinked professional practices (Straub and Vilsmaier, 2020). Thus, a broad understanding of practice is brought to fruition that extends along practical training elements and professional learning opportunities during the three phases of university-based study, preparatory service, and school

practice. This perspective also advocates a co-constructive interaction of relevant (influencing as well as affected) persons and institutions. In this way, a systemic understanding of multiple practices is also considered highly compatible with approaches seeking to overcome the static duality of the so-called theory–practice problem in teaching and teacher education (Straub, 2021).

3) Multiperspectivity and participation: A constitutive element of co-constructive collaboration refers to the comprehensive involvement of relevant stakeholder groups (Coburn and Penuel, 2016). The active participation of heterogeneous groups of actors is seen as a central prerequisite for ensuring that the outcomes reflect not only different expertise but also the needs and interests specific to the involved actor groups. From a transdisciplinary perspective, the framing of a problem and the involvement of relevant stakeholder groups in the problem-solving process have to be understood as two intertwined yet distinct requirements (Straub and Vilsmaier, 2020). As already indicated, the committed participation of the target groups' representatives is considered to increase the acceptance and thus the chance for implementation and transfer into the practical field.
4) Research and development orientation: Both RPP and transdisciplinary processes highlight the need for integrative research and development processes that balance the need for scientific credibility and practical relevance. In other words, despite a focus on issues of practical relevance, the iterative development process should be accompanied by a suitable set of formative and summative reflection, evaluation, and research activities (Straub et al., 2020; Straub and Vilsmaier, 2020). Accompanying reflection, evaluation, and research activities support the mutual adaptation of goals and development activities. They offer further insights into the implementation, transfer, and adaptation of didactical innovations and change processes to other contexts. In addition, especially the design-based implementation research approach highlights the need for integrated research and development activities that offer further theoretical, conceptual, and empirical insights about success factors of and obstacles to implementation and transfer processes (Fishman et al., 2013). Eventually, RPPs and transdisciplinary research and development approaches advocate for a broad usage of qualitative, quantitative, and mixed-methods approaches in order to use complementary perspectives and methodologies (Straub et al., 2020; Straub and Vilsmaier, 2020).

TRANSDISCIPLINARY DIMENSIONS OF INTEGRATION

Based on the theoretical outline of long-term collaborations at the boundary of educational research and practice, the integration of different stakeholders, such as practitioners, researchers, and students, within a co-constructive and participatory process is of paramount importance. Moreover, due to the professional, institutional, and organizational heterogeneity of such collaborative settings, a multidimensional understanding of integration is required (Felt, 2009; Felt and Fochler, 2012; Jahn et al., 2012; Lang et al., 2012). The present study focuses on (1) epistemic, (2) social, and (3) organizational dimensions of integration, which in turn include certain dimensions of integration characteristics. The following outline is based on the framework provided by Straub et al. (2021).

1) Epistemic integration: mutual learning and knowledge integration. Transdisciplinarity highlights the integration of different bodies of knowledge and ways of knowing through mutual learning (Scholz and Steiner, 2015; Vilsmaier et al., 2015). Mutual learning comprises behavioral capacities regarding the exchange of knowledge and expertise, co-constructive behavior, and critical reflection (van den Bossche et al., 2011). In this study, mutual learning is also understood as a focal requirement for knowledge integration. Knowledge integration, again, comprises the ability to establish a mutual understanding and common knowledge base among heterogeneous stakeholder groups (Steinheider et al., 2009).
2) Social integration: trust and appreciation. According to the multidimensional understanding of integration, mutual learning and knowledge integration are highly dependent on social integration. In particular, in-depth and long-term collaborations among different stakeholders, such as researchers, practitioners, and students, rely heavily on trust-based and appreciative relations. Trusting relationships are characterized by a reciprocal commitment to honor agreements and to engage in open and transparent communication (Costa and Anderson, 2011). In addition to trust-based relations, mutual appreciation among different stakeholder groups is understood as an important facilitating factor that helps to mitigate potential status hierarchies and to engage on an equal footing (Carmeli and Gittell, 2009). Mutual appreciation is also a necessary condition for engaging in critical debates and constructive conflicts (van den Bossche et al., 2011).
3) Organizational integration: collective ownership of goals. Trust-based and appreciative relations that promote mutual learning and co-construction of shared knowledge benefit from organizational integration. Thus, it is essential that the collaboration is characterized by participative decision-making and shared ownership of goals (Bronstein, 2002). Participation and shared responsibilities for the achievement of shared goals are powerful mechanisms to mitigate power asymmetries and allow stakeholders to express their particular perspectives and needs (Elzinga, 2008). This is also understood as a crucial prerequisite for establishing the legitimacy and acceptance necessary for the implementation of innovations (Lang et al., 2012).

RESEARCH INTERESTS

Against this theoretical backdrop, the present study seeks to provide further empirical insights into the characteristics of

interorganizational collaborations in teacher education by applying a socio-organizational innovation perspective. To do so, the study was conducted in the context of a research development project that established a collaborative format termed Transdisciplinary Development Teams (TDTs). By applying a person-centered approach, we want to identify different patterns that are crucial for transdisciplinary cooperation in teacher education. Furthermore, we wanted to determine whether the differences between the clusters (types of TDT members). Against this backdrop, the study addresses two main research questions:

1) How do the involved actors assess TDT work with respect to the successful and challenging aspects of transdisciplinary DICs?
2) Are there different types (clusters) of TDT members who differ in their perceptions of successful and challenging aspects of transdisciplinary DICs?

METHODS

Research Context

The study is based on data provided in the context of a research and development project in Lower Saxony, Germany. According to the project's mission statement, the overall vision is twofold (Ehmke et al., 2018, p. 10). First, it aims to establish a space for joint discourse and thought for various actor groups across the teacher education system, such as researchers, teachers, and student teachers, to engage on an equal footing. Second, this is supposed to foster interorganizational collaboration regarding the development, revision, and implementation of advancements in teacher education at a regional level (Straub and Vilsmaier, 2020). In this context, the eight so-called TDTs have been established to foster collaboration at the boundary of initial teacher education and school practice. Each team addresses a particular action field that represents an overarching challenge in the teaching profession, which is considered relevant to the academic and the practical fields. These so-called "action fields" refer to competence-oriented instruction, including schooling, mentoring student teachers during practical studies, and maintaining teachers' health (Straub and Dollereder, 2019).

Within the boundaries of the overall action fields, particular development teams are characterized by considerable degrees of freedom. In alignment with focal principles for transdisciplinary processes, the arrangement of 1) problem-framing and team building, 2) mutual learning, and knowledge integration, and 3) reintegration and application of TDT outcomes are subject to shared decision-making and negotiation processes among the involved actor groups (for a detailed discussion, see Straub and Vilsmaier, 2020). In addition, participation in the TDTs was based on voluntary commitment, while teachers, teacher-training educators (German: "Studienseminarleitung"), and extracurricular partners received basic expense allowance. For these reasons, the particular development teams show variations with regard to team size and team composition as well as work organization and concrete development objectives (Straub et al., 2021; for a compact overview, see Straub and Dollereder, 2019). Despite these differences, the TDTs met on a regular basis, about every three to six weeks, in order to co-constructively develop, establish, and revise didactical innovations at the boundary of university-based teacher education and school-based teaching practice (see, inter alia, Scharnberg, 2019; Waschewski, 2018; ZZL-Netzwerk, 2018).

The following two examples provide some illustrative features. At the time of the survey, the TDT on "Mentoring during Practical Studies", for instance, consisted of six team members, comprising researchers, teachers, teacher-training educators, and student teachers. Together, the team members aimed to jointly develop, establish, and revise the so-called, ProMent, advanced teacher training program. The program offers various modules that prepare teachers to mentor student teachers during their long-term school placements (Beckmann et al., 2021). In contrast, the TDT on "Competence-Oriented Instructional Design in Basic Social and Science Studies" consisted of twelve team members, including partners from extracurricular institutions (Bürgener and Barth, 2018). Moreover, the TDT was closely linked to a university-based course for student teachers and addressed two main objectives (Bürgener and Barth, 2020). The interrelation between the TDT and the university course offered 1) mutual learning opportunities for the participating actor groups and 2) teaching materials applicable for school-based teaching and extracurricular programs that have been practically tested and revised.

Sample Description

At the time of the survey, a total of $N = 77$ active team members collaborated, divided among eight development teams. To focus the study on factual teamwork settings, a cutoff criterion was applied, according to which only those persons were considered in the survey who took part in at least five development team meetings. The overall response rate of 80.5% was considered satisfactory, resulting in a factual sample size of $n = 62$.

The gender composition of the team members (male = 23.3% and female = 76.6%) largely corresponds with those of teachers in Lower Saxony in 2016 (male = 27.9% and female = 72.1%) (MK Niedersachsen, 2018). The *age-groups* represented in the development teams cover the full range, from under 30 to 59 and above years. Despite the group beeing older than 49 years (11.7%), the age-groups are approximately uniformly distributed, which again corresponds roughly with the teacher composition in Lower Saxony (MK Niedersachsen, 2018). In addition, the *professional experience* is approximately uniformly distributed and reflects various levels of expertise from novice to experienced practitioners.

The *stakeholder groups* consist of three major players: practitioners (51.6%), researchers (25.8%), students (16.1%), and "others" counting for (6.5%). Needless to say, educational backgrounds, organizational affiliations, and vocational status, are in, fact much more diverse. In particular, subgroup *practitioners* comprise teachers, principals and teacher training

TABLE 1 | Coding manual including working definition, example quotes, and inter-rater reliability measure Cohen's kappa (*K*) for dimensions of integration (DI) characteristics.

DI	Characteristic	Definition	Examples	*K*
Epistemic	*Mutual learning*	*Mutual learning* refers to behaviors including exchange, co-construction, and/or critical reflection of, for example, knowledge, experience, and concepts and materials among different actors.	"Exchange among experts"; "mutual confirmation/ complementing of ideas"	0.85
	Knowledge integration	*Knowledge integration* indicates team members' perception that the TDT is characterized by heterogeneous knowledge bases and perception, mutual perception taking, and creation of a common ground.	"Differing state of knowledge"; "creation of a shared project understanding"	0.86
Social	*Perceived trustworthiness*	*Perceived trustworthiness* applies when team members state that they rely on agreements, individual interests are transparent, and there are no hidden agendas.	"With regard to equitable cooperation, it would be conducive if there were transparency and assurance about how originators for (shared) developed ideas are documented"	0.85
	Appreciation within the team	*Appreciation within the team* stands for the acceptance and acknowledgment among the TDT members, even if their perspectives may differ from another.	"Respectful and appreciating interaction," "to take each other seriously"	0.88
Organizational	*Collective ownership of goals*	*Collective ownership of goals* indicates that TDT members participate and take on responsibility for defining and achieving joint goals.	"Everybody works toward the same goals," "shared decision-making"	0.80

Definitions are positively formulated but also apply to statements that indicate a lack, a violation, or a problematization regarding a given characteristic in order to cover challenging aspects of TDT work as well.

educators. The latter works usually part-time at teacher-training seminars and schools. *The category researchers* refers to professors and research assistants at the universities. *Students* are considered a major target group for TDT outcomes. However, student teachers are involved in only two out of eight teams and represent only a comparatively small number within the sample size. There are two possible reasons for this. First, participation at the TDTs is based on voluntary commitment, while being quite time consuming. In contrast to teachers, for instance, student teachers are not entitled to receive expense allowances according to the regulations of the funding agency. Second, since most TDTs are closely linked to university-based teaching arrangements, student teachers participate in the outcomes of the TDT work without necessarily being part of the teams. The category *others* refers to partners from extramural organizations such as foundations and public authorities. Despite the fact that they provide profound insights for the joint work in the development teams, their small number made it impossible to consider them as an independent subgroup.

Survey Instruments and Methods of Analysis

The study used data gathered through a written survey of all active TDT members. The questionnaire comprises standardized attitude scales with regard to DICs, open question formats, and a survey instrument for ego centric network analysis. The present study focuses exclusively on the analysis of data generated through the open question formats. The corresponding questions are as follows: 1) "In your own opinion, please state the three most successful aspects with regard to development teamwork?" and 2) "In your own opinion, what are the three most challenging aspects with regard to development teamwork?" The survey was conducted in German language. Therefore, these questions and items within the coding manual (see **Table 1**) were translated by the authors.

The responses were mostly expressed as key words or short half sentences, which is probably due to the considerable length of the overall survey, with an average processing time of 45 min. A mixed-methods approach was applied for data analysis, which was deemed most suitable given of the following research conditions: 1) the explorative aim of the study, 2) the lack of a prior case or subsample selection criteria, 3) the small-scale setting with a sample size of $n = 62$ response sets, and 4) the fact that the response sets comprised mostly keywords and short sentences. In particular, a complementary transfer design was used to combine qualitative and quantitative approaches for data analysis (Kuckartz, 2014, pp. 87–90; Vogl, 2017). Initially, the data corpus was coded following the procedure for a structuring qualitative content analysis (Kuckartz, 2016). The coding process was conducted by a research tandem comprising a PhD student and a student research assistant. The analytic category system was derived deductively based on the conceptual framework outlined in **Section 3**. A comprehensive coding manual was developed to establish sufficient coding reliability, including code definitions, anchor examples, and descriptive indicators such as inclusion and exclusion criteria. **Table 1** displays an overview of the category system including working definitions, reference examples, and inter-coder reliability measures. The latter were displayed by Cohen's kappa values. They range between 0.80 and 0.88, indicating excellent inter-rater agreement. Subsequent to the qualitative coding process, the data corpus has been quantified to allow for further statistical analysis.

To answer research question 1, descriptive statistics, especially proportional values, were calculated to complement qualitative data inspection. This allows for the assessment of the prevalence and distribution of statements with respect to the successful and challenging aspects of DICs.

TABLE 2 | Prevalence of dimensions of integration (DI) characteristics with respect to successful and challenging aspects.

		Successful aspects		Challenging aspects		Total
DI	**Characteristic**	***n*** **(%$_{col}$)**	**%$_{row}$**	***n*** **(%$_{col}$)**	**%$_{row}$**	***n*** **(%$_{col}$)**
Epistemic	Mutual learning	29 (41.43)	63.04	17 (24.64)	36.96	46 (33.09)
	Knowledge integration	12 (30.00)	26.67	33 (47.83)	73.33	45 (32.37)
Social	Perceived trustworthiness	2 (2.86)	40.00	3 (4.35)	60.00	5 (3.6)
	Appreciation within the team	19 (27,14)	76.00	6 (8.70)	24.00	25 (17.99)
Organizational	Collective ownership of goals	8 (11.43)	44.44	10 (14.49)	55.56	18 (12.95)
	Total	70	50.36	69	49.64	139

Research question 2 was approached by applying a hierarchical cluster analysis and a nonparametric ANOVA using van der Waerden's test statistics to distinguish different response patterns from the TDT members. Cluster analysis represents a person-centered approach, which is why the dataset used to answer research question 1 was dichotomized previously. Subsequently, the value "1" indicates that a respondent made at least one statement about a certain DIC. In contrast, "0" indicates that no statement was made. Moreover, differentiation between successful and challenging aspects was maintained. To calculate the cluster analysis, the simple matching similarity measure was used in combination with the complete linkage clustering algorithm. This configuration is considered preferable in the case of qualitative data as the source of origin (Kuckartz, 2016, p. 238).

Moreover, a nonparametric ANOVA using van der Waerden's test statistic was applied, which is considered to be fairly reliable under test conditions such as dichotomous data, homogenous variances, unbalanced and comparable small subsample sizes (Luepsen, 2018). The tests were performed in R using the RStudio (ver. 1.2.1335) and Package PMCMRplus (Pohlert, 2018). All other calculations were performed using the IBM SPSS Statistics (ver. 26.0).

FINDINGS

Assessment of Dimension of Integration Characteristics

To investigate research question 1, how TDT members assess teamwork with regard to DICs, descriptive statistics have been combined with a qualitative inspection. The total number of codings with respect to successful or challenging aspects regarding DICs was 139. This number also contains potential multiple mentions of a person regarding a particular DIC. **Table 2** provides an overview of the prevalence of statements concerning the successful and challenging aspects of transdisciplinary DICs.

The overall number of mentions was equally distributed among successful (50.36%) and challenging aspects (49.64%). Both epistemic dimensions of integration characteristics show the highest percentages of *mutual learning* (successful: 41.43%; challenging 30.00%) and *knowledge integration* (successful: 24.43%; challenging 47.83%), while perceived trustworthiness was the least mentioned characteristic (successful: 2.86%; challenging: 4.35%). When the proportions for each characteristic was inspected, it becomes apparent that *mutual learning* and *appreciation with the team* feature particularly successful aspects of the development teamwork, with 63.04% and 76.00%, respectively. In contrast, *knowledge integration* and *perceived trustworthiness* mainly contain challenging statements (with 73.33% and 60.00%, respectively). However, *collective ownership of goals* shows a relatively moderate proportion with regard to the overall number of statements (12.95%) and is also almost equally distributed according to successful and challenging mentions.

In addition to the analysis of the proportional distributions of the team members' statements, a qualitative inspection of the DICs shows some differences with respect to the variety of facets and the depth of elaboration. Although *mutual learning* was coded quite frequently, most answers referred literally to the aspect of exchange. For the most part, there were no further specifications, but if so they indicated mainly intellectual exchange, for instance, exchange of opinions or experiences, in contrast to the exchange of materials or products. In addition, only a few statements indicated co-constructive discussions and interactions. "Challenging aspects" referred to, in addition to exchange, aspects of reflection.

As indicated above, statements regarding *knowledge integration* were mostly stated as challenging. These can be differentiated into three groups. The first indicates, in general, considerable heterogeneity in understanding and perspectives, which have to be addressed during the development teamwork. Second, the need for mutual perspective taking has been addressed, while the development of common ground with regard to problem understanding and solution approaches comprises the third challange. Mentions of *knowledge integration* as successful resemble similar sub-facets but occur less often.

The characteristic *perceived trustworthiness* has seldom been mentioned. However, it becomes apparent that while positive mentions consist only of single keywords such as "trust" and "reliability," problematizing statements were considerably more elaborated. For instance, one criticism was that an initial arrangement regarding the compensation of teacher's engagement could not be fulfilled as initially agreed in terms of compensatory hours (German: "Anrechnungs-bzw. Entlastungsstunden") but had to be replaced with monetary compensation. Another statement problematized the lack of transparency about the authorship of co-constructed ideas and concepts and the potential risk that single persons might earn gratitude for collective efforts.

In contrast to *perceived trustworthiness*, the characteristics *appreciation within the team* was predominantly considered a successful attribute of development teamwork. For the most part, these statements referred plainly to keywords such as "appreciation", "respect", or "equal footing", but offered little explanation of which aspects in particular reflect appreciation. Also counted were aspects,

which occurred less often. However, these referred, for instance, to the mitigation of hierarchies and the involvement of students.

Finally, *the collective ownership of goals* comprises equally successful and challenging aspects. With regard to successful aspects statement pointed mostly at "shared goals", challenging statements were a bit more diffuse, ranging from the lack of shared commitment among different actor groups or joint engagement with research and development activities.

Types of Development Team Members

Following dichotomization, the dataset comprised 106 occasions in which a development team member made at least one statement with respect to one of the DICs. This allows to perform a cluster analysis in order to identify types of development team members who can be distinguished by characterizing patterns of DIC expressions.

A visual inspection of the dendrogram for the hierarchical cluster analysis indicated that the potential cluster solutions were quite similar to each other. Nonetheless, differentiating the dataset into a set of four clusters represents the greatest differences among them. Accordingly, the resulting subsample sizes for each cluster were as follows: cluster A, $n = 18$ (29.0%), cluster B, $n = 12$ (19.4%), cluster C, $n = 13$ (21%), and cluster D, $n = 19$ (30.6%). **Table 3** displays the frequencies, nonparametric test statistics based on van der Waerden's test, and respective effect sizes measured with *Cramer's V* for differences among clusters A, B, C, and D regarding successful and challenging aspects of DICs.

The results indicate group differences with regard to *mutual learning* (s), *mutual learning* (c), *knowledge integration* (c), *perceived trustworthiness* (s), *appreciation within the team* (s), *collective ownership of goals* (s), and *collective ownership of goals* (c), with p values ranging between < 0.01 and 0.03. The corresponding effect sizes range between 0.38 and 0.78, indicating medium to large differences among the clusters on a general level. In contrast, no statistical differences were found for *knowledge integration* (s) ($p = 0.088$), *perceived trustworthiness* (c) ($p = 0.135$), and *appreciation within the team* (c) ($p = 0.056$).

In addition, *post hoc* tests were calculated to identify which clusters differed from each other in particular (see column to the far right). On this basis, it is also possible to further characterize the four clusters based on genuine DIC expressions.

Cluster A: Indifferent Members

According to *post hoc* tests, team members in cluster A only show occasional statements with regard to DIC. Therefore, this group is referred to as "Indifferent Members". At this point, however, it should be noted that the framework of analysis focused exclusively the deductive category system. Thus, members of this group may have made statements to the contrary, which were not included in the present study.

Cluster B: Integration Critics

Cluster B is referred to as "Integration Critics" since the corresponding team members' statements problematize in particular that heterogeneous levels of expertise and knowledge within the development teams were an obstacle with which they had to cope. This does not necessarily imply that the importance of heterogeneity in terms of different professional backgrounds, organizational affiliations, and work experience itself was denied as an influencing factor. This interpretation is supported by the fact that respondents were significantly more likely to state that the collaboration was characterized by mutual appreciation than members of clusters A and D.

Cluster C: Learning Critics

Cluster C is likewise characterized by the perception of mutual appreciation but, more importantly, it features significantly higher proportions with regard to critical aspects of *mutual learning*. Therefore, this group is referred to as "Learning Critics". Accordingly, members of this cluster are more likely to articulate challenging or problematic aspects with respect to the exchange of experiences, reflections, or co-construction of new ideas, concepts, or materials. However, on a descriptive level, they also are slightly inclined to mention positive aspects with regard to *mutual learning*. Therefore, *mutual learning* seems to be in general of importance to this cluster, even though it is regarded as critical. Finally, there is also a significant tendency for *Learning Critics* to state successful aspects with regard to *collective ownership of goals*, which indicates the perception of equivocal cooperation among the different team members.

Cluster D: Committed Learners

The final cluster D, was labeled "Committed Learners". On the one hand, respondents within this cluster are characterized by a significantly higher probability of assessing *mutual learning* as a successful aspect of the teamwork. On the other hand, they are more likely to articulate perceptions with regard to any DICs in general. For instance, they also share rather critical views on aspects of *mutual learning* such as the learning critics do. However, they also make approving statements toward successful exchange, joint reflection, and co-constructive processes. Nonetheless, members within this cluster are significantly more likely to express concerns about aspects of the *collective ownership of goals*. Since they did not mention any aspects related to *appreciation within the team*, this might indicate that they have experienced somewhat unbalanced situations with regard to an uneven division of responsibility rather than unequal participation. **Figure 1** illustrates the cluster profiles with regard to the proportion of statements made to the successful or challenging aspects of the respective DICs.

DISCUSSION

The present article outlines the importance of integrating focal stakeholder groups as a paramount success factor for the effective and sustainable establishment of interorganizational collaborations in teacher education. To substantiate this proposition, an analytical framework inspired by the discourse on transdisciplinarity was applied (Straub et al., 2021). The framework highlights a multidimensional understanding of integration comprising 1) epistemic, 2) social, and 3) organizational factors such as (1a) *mutual learning* and (1b) *knowledge integration*, (2a) *perceived trustworthiness*, (2b) *appreciation within the team*, and (3a) *collective ownership of goals*.

TABLE 3 | Frequencies and nonparametric ANOVA for clusters A, B, C, and D.

Characteristics	Cluster a (n = 18)		Cluster B (n = 12)		Cluster C (n = 13)		Cluster D (n = 19)					
	$n_{(0)}$	$n_{(1)}$	$n_{(0)}$	$n_{(1)}$	$n_{(0)}$	$n_{(1)}$	$n_{(0)}$	$n_{(1)}$	*vdW*	*P*	*V*	Post hoc
Mutual learning (s)	15	3	10	2	9	4	2	17	25.77	<0.01	0.64	D > A,B,C
Mutual learning (c)	18	0	12	0	4	9	15	4	26.04	<0.01	0.65	C > A,B,D
Knowledge integration (s)	14	4	12	0	12	1	13	6	6.54	0.09	0.32	A,B,C,D
Knowledge integration (c)	17	1	0	12	13	0	8	11	37.91	<0.01	0.78	B > D > A,C
Perceived trustworthiness (s)	18	0	10	2	13	0	19	0	8.74	0.03	0.38	A,B,C,D
Perceived trustworthiness (c)	17	1	10	2	13	0	19	0	5.56	0.14	0.30	A,B,C,D
Appreciation within the team (s)	15	3	6	6	6	7	18	1	13.37	<0.01	0.46	B,C > A,D
Appreciation within the team (c)	14	4	12	0	13	0	18	1	7.57	0.06	0.35	A,B,C,D
Collective ownership of goals (s)	18	0	9	3	9	4	19	0	12.11	<0.01	0.44	C > A,B,D
Collective ownership of goals (c)	17	1	11	1	13	0	11	8	14.15	<0.01	0.48	D > A,B,C

n(0) indicates that no statement was made to a given characteristic, and n(1) indicates that a statement was made. (s) refers to statements indicating successful aspects and (c) refers to statements indicating challenging aspects. vdW = van der Waerden's test statistic. V = Cramer's V. The column labeled post hoc *indicates significant differences for multiple pairwise comparisons at a* $p < 0.05$ *level.*

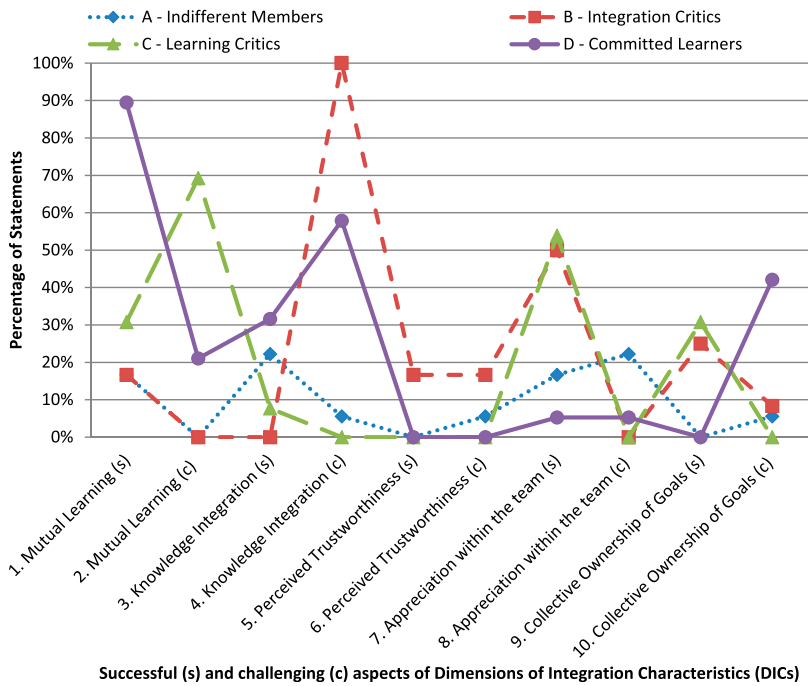

FIGURE 1 | Percentage of statements according to successful (s) and challenging (c) aspects of dimensions of integration characteristics (DICs).

Against this theoretical backdrop, descriptive findings regarding research question 1 reveal that the TDT members are ambivalent in their assessment of epistemic characteristics. Generally speaking, *mutual learning* is considered mostly a successful aspect of cooperation, whereas *knowledge integration* is referred to as rather challenging. In addition, qualitative inspection revealed that *mutual learning* mostly referred to processes of exchange of expertise and experiences, while reflection and co-constructive interactions were rarely mentioned. However, it would be overly simplistic to assume that these collaborative forms did not occur or would otherwise be considered problematic. On the contrary, this emphasizes the particular challenges inherent in interorganizational collaboration. In addition, these findings resonate to some extent with the results of a representative study on teacher collaboration, which indicates that elaborated practices such as joint reflection and co-construction are less likely than less demanding forms of cooperation, such as an exchange of experiences and materials (Richter and Pant, 2016, p. 20).

Regarding to social DICs, it becomes apparent that *appreciation within the team* is an important factor for actors working together across their original professional backgrounds. In contrast, the statements regarding *perceived trustworthiness* were marginally comparable in numbers. However, qualitative inspection showed that the respective statements were noticeably elaborated, which again indicates their significance for the respondents. This also implies some conceptual considerations. So far, the literature on

collaboration in teacher education has focused especially on the role of trust (Bartmann et al., 2012; Kappauf and Kolleck, 2018). Consequently, it is argued that further research would benefit from increasing attention toward appreciation and its interrelation with trust as significant social factors (see, e.g., Kulin, 2019).

In comparison to epistemic and organizational DICs, the assessment of *collective ownership of goals* representing organizational principles of cooperation was again rather ambiguous. This is again understood as an indicator that the negotiation of participation opportunities, distribution of responsibilities, and decision-making processes have to be understood as inherent challenges of interorganizational cooperation.

With regard to research question 2, we used a person-centered approach to identify different response patterns concerning the challenges and success factors for transdisciplinary cooperation in teacher education. Four different response patterns from TDT members have been identified to be characterized by a particular set of assessments toward successful and challenging aspects of DICs. In comparison, cluster A, the Indifferent Members, showed the lowest response rates toward the integration characteristics. This does not mean that they are indifferent toward interorganizational collaboration as such. However, due to the present study's focus on DICs, statements not applicable to the deductive category system remain untouched. Future investigation of these statements might offer some additional insights toward Indifferent Members' attitudes about TDT work and may eventually lead to an alternating characterization.

Clusters B and C refer to actors who are characterized by problematizing challenges regarding epistemic aspects, *knowledge integration* and *mutual learning*. Throughout the qualitative analysis, it became apparent that the respective actors did not question the significance of *knowledge integration* or *mutual learning* as a crucial factor for successful interorganizational collaboration. Instead, at a conceptual level, their statements underscore the demanding nature of both epistemic processes with regard to temporal resources and personal commitment. In addition, these statements offer some practical implications for the potential support of TDT work organizations. The establishment of collective feedback and reflection opportunities could, for example, allow TDT members to articulate potential demands that might help to identify effective support mechanisms.

Finally, cluster D refers to *Committed Learners*. They are characterized by their engagement with regard to epistemic dimensions of integration characteristics. In particular, the perceived *mutual learning* and especially the exchange of knowledge and experience are a successful aspect of TDT work. In contrast, they assess *knowledge integration* in terms of the development of shared understanding and joint common ground as beeing rather challenging. Again, this finding is not understood as the denial of *knowledge integration* as an important success factor for the TDT work but as an indicator of its complexity and difficulty. As already suggested, deliberate reflection on this issue might help to develop productive insights for future teamwork. In addition, *Committed Learners* tend to problematize *collective ownership of goals*. Qualitative data inspection suggests that they embrace equal participation, but in contrast, they also demand more equal distribution of responsibilities. However, further research is needed to substantiate this assumption.

The Limitations of this study can be seen in how we collected the perceptions of TDT members. This was done using a questionnaire as part of the evaluation of the development project. It is possible that not all members expressed negative feelings about challenges in collaborative work. Furthermore, it is possible that the TDT members who did not participate in the study had experiences as part of collaboration that they did not want to share with others. Against this background, a suggestion for further research is to analyze the qualitative processes of the knowledge construction of TDT members using other methods such as interviews or group discussions. A second recommendation is to analyze the different motivations of status groups. It can be anticipated that there are specific intrinsic and extrinsic motivations between the status groups that influence the level of engagement of the TDT members and their perceptions of collaborative work.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

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