Utilizing, co-constructing and sharing knowledge in collaborative teacher learning

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Chapter 4
Knowledge sharing of research-based teacher learning groups: Three case studies

Abstract
Co-constructed knowledge in teacher learning groups (TLGs) is not always shared within schools. For collective learning to take place in schools, it is crucial for such knowledge and expertise to be shared amongst colleagues and connected to school development. In a case study, we examined how co-constructed knowledge in three research-based TLGs was shared within the schools to which they were attached, and whether and how these knowledge-sharing activities informed other teachers’ teaching and understanding thereof. Data were gathered by means of a questionnaire, group interviews with TLG participants, and focus group interviews with team leaders from the relevant schools. We used Anderson and Herr’s (1999) typology of validities to analyze the TLG’s knowledge-sharing activities, and their effects on teaching and understanding of teaching in the school. Most of their sharing activities were categorized as contributing to democratic validity. We found indications of changes in teaching and understanding thereof among the TLG participants’ colleagues (catalytic validity) and indications that the outcomes contributed to ongoing learning (process validity). However, few sharing activities that bring about such catalytic and process validity were structurally organized. Our findings suggest that knowledge sharing should be seen as a process instead of as an activity.

1. Introduction
Teacher learning groups (TLGs) are increasingly being set up to support a professional school culture. In TLGs, teachers play an active role in collaborative knowledge construction, and the aim is to link teacher learning and school development (e.g. Coburn & Russell, 2008). Practice-based research in TLGs is seen as a promising approach to collaborative teacher learning (Vrijnsen-De Corte et al., 2013). In research-based TLGs, teachers co-construct knowledge about the causes and consequences of their actions, seek answers to specific practical problems and questions, and try to gather evidence of what works in practice and why (Cochran-Smith & Lytle, 2015). However, sharing knowledge and insights that are co-constructed in TLGs with other colleagues in the school appears to be challenging and scarcely happening (e.g. Meijer, Oolbekkink, Meirink, & Lockhorst, 2013). Yet few researchers have focused on the processes and activities through which knowledge from TLGs is and can be shared with other colleagues. This article aims to contribute insight into these processes and activities by focusing on how research-based teacher learning groups share their co-constructed knowledge and insights with colleagues in the schools at which they teach.

2. Theoretical framework
2.1 Schools as professional learning organizations: the need for collective learning
The topic of how research-based teacher learning groups share their co-constructed knowledge and insights with colleagues in school aligns with the development of seeing schools as professional learning organizations (Admiraal, Schenke, de Jong, Emmelot & Sliigte, 2019; Giles & Hargreaves, 2006) or learning communities (Stoll & Kools, 2018). Admiraal et al. (2019) identified TLGs as interventions that help move schools toward a culture of professional learning and collaboration. They also found that the sustainable impact of TLGs depended on the extent to which they were embedded in the organizations and cultures of the schools to which they were attached. Stoll and Kools (2018) argue that the aspect of community should be seen as the heart of the school as a learning organization. Learning by the community as a whole, that is, the learning of all the staff at all levels in a school, is referred to as “collective learning.” Collective learning thus goes beyond collaborative learning, which refers to the learning of individuals in groups within an
organization or community, such as TLGs. For collective learning, the development of knowledge and expertise in TLGs is not sufficient; it is crucial that this knowledge and expertise be shared amongst colleagues and connected to broader school developments (e.g. Coburn, Russel, Kauffman, & Stein, 2012).

2.2 Knowledge sharing: from collaborative to collective learning

Collective learning is considered a major characteristic of a school as a professional learning organization (Admiraal et al., 2016; Roy & Hord, 2006). The capacity to learn collectively is characterized by Stoll (2010) as a quality that allows people to routinely learn from differing knowledge sources in the world around them. Learning capacity exists in individuals, such as teachers (personal capacity), in groups within organizations, such as TLGs (group capacity), and in whole organizations, such as schools (collective or organizational capacity). Marks and Louis (1999) refer to the latter as the capacity for organizational learning; organizations learn in a way that transcends the aggregated learning of their individual members and groups. This requires a process in which knowledge such as findings from research activities in TLGs are shared with colleagues within the organization. The authors argue that processes of knowledge sharing are critical for organizational learning, and that a professional learning organization can be a vehicle for such knowledge processing.

The current view of teacher learning, which strongly emphasizes learning as a collective process of constructing new knowledge and insights (e.g. Stoll & Kools, 2018; Van Schaik, Volman, Admiraal & Schenke, 2019), aligns with what Hargreaves (1999) calls the “knowledge-creating school,” in which teachers’ individual professional knowledge and experiences (personal capacity), and knowledge that was co-constructed in TLGs (group capacity) are articulated as shareable knowledge with other colleagues within the school. The quality of the articulation of new knowledge of research-based TLGs can be designated with the five criteria distinguished by Anderson and Herr (1999). These criteria, or types of validity, were developed as an indication of the quality of practitioner research in the context of the school: 1) outcome validity; 2) democratic validity; 3) catalytic validity; 4) dialogic validity; and 5) process validity. Although they were not originally intended for this purpose, Meijer et al. (2013) and Oolbekkink-Marchand et al. (2013) used these criteria
to assess the outcomes of practitioner research for the teachers themselves, their colleagues, and schools. The first, outcome validity concerns the question of whether the co-constructed knowledge solves the initial problem and thus leads to relevant outcomes for teachers and for the school. Secondly, democratic validity concerns the question of how and to what extent all the stakeholders who have an interest in the co-constructed knowledge are involved. Multiple perspectives are considered, such as those of teachers and school leaders. Thirdly, catalytic validity concerns the question of the extent to which all stakeholders have come to a better understanding of the topic that has been studied, and how this leads to a change in teaching behavior, teaching beliefs, and understanding of teaching. Fourthly, dialogic validity concerns the question of how and to what extent critical dialogue with peers is sought as a means to guarantee the quality of the co-constructed knowledge. Lastly, process validity concerns the question of the extent to which the outcomes of research activities in the TLGs permit ongoing individual, collaborative, or collective learning.

Stoll (2010) argues that methods, structures, and activities are needed to bring knowledge to life such that others can engage with the knowledge, connect insights to their own contexts, expertise, experiences, and prior knowledge, and construct new knowledge that can be used to develop their practice. A core activity in this respect is knowledge sharing (Stoll, 2010). In this case study, we examined how the knowledge that was co-constructed in three research-based TLGs was shared in the school with other colleagues, and to what effect. Following Meijer et al. (2013) and Oolbekkink-Marchand et al. (2013), we used the typology of the validities of Anderson and Herr (1999) in our analysis. The following two research questions guided our study:

I. Which activities are undertaken to share co-constructed knowledge from research-based TLGs in the school?
II. How do these activities inform colleague’s teaching and understanding of teaching?

3. Method
3.1 Cases and participants
The study comprised an examination of three TLGs that utilized a research-based approach, which implied that the participating teachers collaboratively
conducted practice-oriented research in the context of their own school on, for example, the evaluation of an innovation, training, or a new series of lessons. Each one was attached to a secondary school in the Netherlands. The schools will be referred to in this paper pseudonymously as The Waterfront Secondary School, The Crossroads Secondary School, and the Trinity School. The three TLGs are accordingly referred to as the Waterfront TLG, the Crossroads TLG, and the Trinity TLG. The Waterfront TLG consisted of six teacher-researchers, of which three participated in this study. The Crossroads TLG consisted of four teacher-researchers and the Trinity TLG of three teacher-researchers, all of whom participated in this study. All the teacher-researchers participated in the current research voluntarily.

Furthermore, from each of the three schools in which the TLGs were based, four colleagues who did not participate in the TLG participated in a focus group per school; all the focus group participants were team leaders. They were selected because they were expected to be informed about the aims, activities, and the cross-curricular knowledge that was co-constructed in the TLGs. Furthermore, they were expected to be responsible for the professional development of their teachers, their teams, and their departments. An overview of the participants and methods of data collection is provided in Table 1.

### 3.2 Data collection

The data for this study was gathered by means of a digital questionnaire, group interviews with TLG participants, and focus group interviews with team leaders. Firstly, all the TLG participants were invited to complete a digital questionnaire. The latter included questions concerning general information, such as the frequency of meetings, topics, and when the TLG was formed. Furthermore, questions were asked concerning how the teachers shared their knowledge, and with whom. An example question is “To what extent did you share new knowledge with direct colleagues?” The questionnaire also included three statements concerning the perceived impact of their co-constructed knowledge, such as “Our TLG deepens the discussions about teaching and learning in our school.” All the questions and statements in the questionnaire were answered or rated using a five-point Likert-scale.

Secondly, in each of the three schools, the TLG participants participated in a semi-structured 45–60-minute group interview. The first aim of the group
interview was to examine how and with whom the teacher-researchers shared their knowledge and insights, and to what extent they were satisfied with their knowledge sharing. An example question is “In what way do you share the new knowledge from your research group (=TLG)?” The second aim was to examine whether and how the knowledge and insights influenced practice in their schools. Therefore, we asked, for example, “How do you notice whether your colleagues apply the shared knowledge from your research group?” Notes were made during the group interviews and processed afterwards.

Table 1. Participants and data collection

<table>
<thead>
<tr>
<th></th>
<th>Questionnaire participants</th>
<th>TLG interview participants</th>
<th>Focus group participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterfront TLG</td>
<td>2 teacher-researchers, 1 team leader / teacher-researcher</td>
<td>2 teacher-researchers, 1 team leader / teacher-researcher</td>
<td>2 team leaders upper secondary education, 2 team leaders lower secondary education</td>
</tr>
<tr>
<td>Crossroads TLG</td>
<td>3 teacher-researchers</td>
<td>4 teacher-researchers</td>
<td>2 team leaders upper secondary education, 2 team leaders lower secondary education</td>
</tr>
<tr>
<td>Trinity TLG</td>
<td>3 teacher-researchers</td>
<td>3 teacher-researchers</td>
<td>3 team leaders upper secondary education, 1 team leader lower secondary education</td>
</tr>
</tbody>
</table>

Note: 1. One of them is also a teacher in his or her department. 2. This participant is also a teacher in his or her department.

Thirdly, 12 team leaders participated in three focus-group interviews (one per school). The semi-structured 45–60-minute focus-group interviews had three aims. The first was to examine whether colleagues were informed about the aims and activities of the TLGs, and whether they were informed about the content of the knowledge and insights that were co-constructed in the TLGs. Therefore, we asked questions such as “To what extent are you aware of the goals and activities of the research group?” The second aim was to examine whether the new knowledge and insights impacted their practices. To this end, the participants were asked questions such as “To what extent do you apply this knowledge from the research team in your own practice?” Two focus-group interviews were digitally recorded and later transcribed. Notes were made during the third focus-group interview and processed afterwards.

3.3 Data analysis

Each TLG was considered a unit of analysis. To answer the first research question, for each TLG we examined which activities they used for sharing knowledge and insights with other colleagues. Therefore, we analyzed the
quantitative questionnaire data using descriptive statistics. Furthermore, all the fragments from the group interviews with the teacher-researchers and the focus group interviews concerning knowledge-sharing activities were selected and analyzed using the typology of validity based on Anderson and Herr (1999), Meijer et al. (2013), and Oolbekkink-Marchand et al., (2014) (see Table 2).

Secondly, to answer the second research question, all relevant fragments from the group interviews were selected that provided information about the extent to which the teacher-researchers perceived that their colleagues were informed about the knowledge that had been co-constructed in the TLGs. Likewise, all relevant fragments from the focus group interviews were selected that provided information about the extent to which the colleagues of the teacher-researchers were informed about the aims and activities of the TLGs, and the knowledge that was co-constructed therein. Subsequently, we compared the two sets of fragments, searching for patterns and themes that were characteristic of each TLG, resulting in a description per TLG.

Table 2. Types of validity according to Anderson and Herr (1999) and of co-constructed knowledge of research-based TLGs

<table>
<thead>
<tr>
<th>Type of validity</th>
<th>Description according to Anderson and Herr (1999)</th>
<th>Knowledge-sharing activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome validity</td>
<td>The extent to which actions occur that lead to a resolution of the problem that led to the study.</td>
<td>Activities that contribute to the co-constructed knowledge to solve a problem, thus leading to positive outcomes for individuals and school.</td>
</tr>
<tr>
<td>Democratic validity</td>
<td>The extent to which research is done in collaboration with all parties who have a stake in the problem under investigation to guarantee that the results are relevant to local settings.</td>
<td>Activities that consider multiple perspectives by involving all colleagues who have an interest in the co-constructed knowledge, such as those of other colleagues and school leaders.</td>
</tr>
<tr>
<td>Dialogic validity</td>
<td>The extent to which dialogue with peers is sought in the research process, for instance in the form of a critical friend or by collaborative inquiry.</td>
<td>Activities that entail critical dialogue with peers and/or stakeholders, such as other colleagues and school leaders.</td>
</tr>
<tr>
<td>Catalytic validity</td>
<td>The degree to which the research process reorients, focuses, and energizes both researchers and participants toward knowing reality in order to change their understanding or their view of their roles.</td>
<td>Activities that lead to a change in teaching and understanding of teaching for all the colleagues involved, based on the co-constructed knowledge.</td>
</tr>
<tr>
<td>Process validity</td>
<td>The extent to which problems are framed and solved in a manner that facilitates the ongoing learning of the individual or system.</td>
<td>Activities that enhance ongoing individual, collaborative, and collective learning, based on the co-constructed knowledge.</td>
</tr>
</tbody>
</table>

4. Results

This section starts with general information about and similarities in the TLGs, after which we describe each of the three cases studies. The results are
followed by a cross-case analysis in section 5.1, in which we explicitly discuss the five types of validity.

4.1 General information and similarities in the three research-based TLGs

The three research-based TLGs had similar goals, composition, and facilitation. They all aimed to gain shareable insights into and contribute to the development of cross-curricular subjects in their schools by conducting practice-oriented research. Based on their research activities, they tried to contribute new knowledge and insights to their schools. Examples of the topics they focused on were continuous learning lines for students (Waterfront TLG), future-oriented education (Crossroads TLG), and knowledge utilization (Trinity TLG). These topics were determined jointly with the school leaders. The TLGs were composed of three to six teacher-researchers who taught differing subjects. Each teacher-researcher was provided with time, and all three TLGs met one to two hours weekly. These meetings were scheduled into the teachers’ weekly timetables. Each TLG was externally supported by a researcher in the first few years, who guided the teacher-researchers primarily in research skills. In the questionnaire and the group interviews, all the teacher-researchers indicated that they had developed professionally due to their participation in their TLGs. They reported having come to a better understanding of the investigated topics and problems, that they had shaped and sharpened their vision on education, teaching, and learning, and, lastly, that they had developed their research skills. Reported skills included, for example, conducting and processing interviews, selecting relevant academic literature, and analyzing data. Another similarity of the three TLGs was the indicated importance of and satisfaction with the mutual learning with and from each other, and the situatedness and contextualized character of the topics and problems examined. Concerning the outcomes of their activities, in their questionnaire responses the participants from all three TLGs rated the applicability, the contribution to innovations, and the deepening of dialogue about teaching and learning the new knowledge and insights in their school as being relatively high in their schools (see Table 4).

The questionnaire responses also indicated similarities between the three TLGs with respect to sharing the TLGs’ co-constructed knowledge and insights with others (see Table 5). What stood out was that most categories had average to low scores, and that sharing knowledge via informal contacts was
done the most. Furthermore, knowledge sharing by the TLGs occurred mostly in the category of direct colleagues (see Table 6). The group interviews revealed that these direct colleagues included mainly members from the school management, such as team and school leaders. Table 3 provides an overview of the results that we will refer to in the three case descriptions.

4.2 The Waterfront TLG

4.2.1 General information
The research-based Waterfront TLG was formed in 2014. At the time of the study it comprised six teacher-researchers and a team leader. In addition, the head of the student administration was closely involved. Their team meetings were scheduled weekly for one hour each. All the participants were facilitated with 70 hours on a yearly basis. The TLG conducted practice-oriented research on cross-curricular questions that were asked in the school to which they were attached, and monitored school innovations through research activities. Recent topics at the time of the study were continuous learning lines, positive behavioral support, and the influence of mentoring on students’ well-being. The TLG was trained and guided in research skills in the first two years, but they had been operating on their own for two years at the time the study was conducted. The school principal participated in the first year of the training program. The data from the questionnaires and the group interview with the TLG participants indicated that sharing knowledge occurred mainly within the TLG and, to a much lesser extent, with colleagues outside the TLG. The participants indicated that they learned a lot from each other, especially because some members had master’s degrees in education, and shared their knowledge and insights within the TLG.

4.2.2 Activities for sharing knowledge and insights
The Waterfront TLG participants shared their knowledge and insights with other colleagues in a variety of activities (see Table 5). They also shared their knowledge with a greater variety of colleagues than the Crossroads and the Trinity TLGs: they organized a yearly research market, occasionally presented the outcomes in the various school teams, and inputted their knowledge and insights into a database that was accessible to other colleagues. The focus group participants often used a combination of the latter two. However, more publicity should be given to the school’s database, so that more colleagues
can find their way to the database as soon as results that are relevant to them become available.

Since the previous year, they had applied three interventions to make their knowledge and insights more meaningful for other colleagues. First, they started to share the results in a more targeted way by examining closely to whom the findings of their activities would be relevant, and therefore which colleagues to involve. This is an example of an activity that contributes to democratic validity. Secondly, the TLG started to work with “commissioners”, who commissioned a research assignment or presented a specific topic to the TLG. The commissioners were subsequently regularly involved in the TLG activities and the progress of the research process, and discussed the (interim) findings with them (dialogic validity). Thirdly, instead of providing answers, solutions, or conclusions, the TLG members started to provide their colleagues with results, with the intention that their colleagues would make sense of the results themselves, and would collaboratively determine the practical implications in terms of changing or adapting their teaching, or their understanding of the problem (democratic and dialogic validity).
Table 3. Colleagues’ awareness of aims, activities, topics, and outcomes of the TLGs, and how they were informed and reported changes

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Aims</th>
<th>Activities</th>
<th>Topics</th>
<th>Outcomes</th>
<th>In what ways informed</th>
<th>Reported changes in teaching and/or understanding of teaching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterfront TLG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Presentations in team</td>
<td>1) teachers started teaching differently;</td>
</tr>
<tr>
<td>Team leader</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
<td>Via colleague team leader who participated in the TLG</td>
<td>2) cross-curricular programs were adjusted;</td>
</tr>
<tr>
<td>Team leader</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
<td>Individual conversations with TLG participants</td>
<td>3) subject teams started discussing their curricula and</td>
</tr>
<tr>
<td>Team leader</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>Via colleague team leader who participated in the TLG</td>
<td>assessments in the light of the research groups' results.</td>
</tr>
<tr>
<td>Team leader</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>Team leader of one of the TLG participants</td>
<td></td>
</tr>
<tr>
<td>Crossroads TLG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Individual conversations with TLG participants</td>
<td></td>
</tr>
<tr>
<td>Team leader</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>Individual conversations with TLG participants</td>
<td></td>
</tr>
<tr>
<td>Team leader</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>Member of the management team that monitored the TLG</td>
<td></td>
</tr>
<tr>
<td>Trinity TLG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Participated in one of the TLG’s research activities</td>
<td></td>
</tr>
<tr>
<td>Team leader</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team leader</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team leader</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Participated in one of the TLG’s research activities.
Despite the variety of activities, the focus group participants perceived that knowledge sharing happened mostly informally via direct personal and social connections with one (or more) of the TLG members in their school, and not in a structured and organized way (see also Table 5). The focus group participants could easily get in contact with these members because they shared a study room, or because they had one or more teacher-researcher in their team. The focus group participants suggested that the TLG participants should share their findings more actively and more frequently with a wider range of colleagues, and the group should be more visible as a TLG.

Furthermore, one of the team leaders participated in the TLG. She appeared to be an important connection between the TLG and the other team leaders. She regularly discussed the (interim) findings of the TLG in team leader meetings and suggested to the team leaders that they should become involved in particular TLG subjects, which indicates democratic validity.

Table 4. Scores for how the teachers perceived the applicability, contribution to innovations and deepening of discussions about teaching and learning in their schools in relation to the new knowledge and insights.

<table>
<thead>
<tr>
<th>TLG</th>
<th>The knowledge and insights from our TLG are directly applicable in our school</th>
<th>The knowledge and insights from our TLG contribute to innovations in my school</th>
<th>Our TLG deepens the discussions about teaching and learning in our school</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterfront</td>
<td>3.67</td>
<td>4.67</td>
<td>4.00</td>
</tr>
<tr>
<td>Crossroads</td>
<td>3.67</td>
<td>4.33</td>
<td>4.00</td>
</tr>
<tr>
<td>Trinity</td>
<td>3.00</td>
<td>4.33</td>
<td>4.33</td>
</tr>
<tr>
<td>Total</td>
<td>3.50</td>
<td>4.44</td>
<td>4.12</td>
</tr>
</tbody>
</table>

Table 5. Means for how teachers shared their new knowledge and insights.

<table>
<thead>
<tr>
<th>TLG</th>
<th>Presentations to colleagues</th>
<th>Input during work meetings</th>
<th>School newsletter</th>
<th>Workshops</th>
<th>Informal contacts with colleagues</th>
<th>Journal article</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterfront</td>
<td>2.33</td>
<td>2.67</td>
<td>2.00</td>
<td>2.00</td>
<td>3.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Crossroads</td>
<td>1.00</td>
<td>2.67</td>
<td>1.33</td>
<td>1.67</td>
<td>2.33</td>
<td>1.00</td>
</tr>
<tr>
<td>Trinity</td>
<td>1.33</td>
<td>1.67</td>
<td>1.00</td>
<td>1.00</td>
<td>2.33</td>
<td>1.00</td>
</tr>
<tr>
<td>Total</td>
<td>1.55</td>
<td>2.33</td>
<td>1.44</td>
<td>1.75</td>
<td>2.55</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Table 6. Scores for whom teachers shared their new knowledge and insights with

<table>
<thead>
<tr>
<th>TLG</th>
<th>Direct colleagues</th>
<th>Other colleagues in school</th>
<th>Colleagues from other locations within the school organization</th>
<th>Colleagues from other schools</th>
<th>My students</th>
<th>Parents</th>
<th>Family and friends (in private setting)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterfront</td>
<td>3.00</td>
<td>2.33</td>
<td>1.50</td>
<td>1.00</td>
<td>1.67</td>
<td>1.00</td>
<td>2.33</td>
</tr>
<tr>
<td>Crossroads</td>
<td>2.33</td>
<td>2.33</td>
<td>1.00</td>
<td>2.00</td>
<td>2.33</td>
<td>1.67</td>
<td>2.00</td>
</tr>
<tr>
<td>Trinity</td>
<td>2.00</td>
<td>1.67</td>
<td>1.33</td>
<td>1.67</td>
<td>1.00</td>
<td>1.33</td>
<td>1.33</td>
</tr>
<tr>
<td>Total</td>
<td>2.44</td>
<td>2.11</td>
<td>1.25</td>
<td>1.63</td>
<td>1.67</td>
<td>1.38</td>
<td>1.89</td>
</tr>
</tbody>
</table>
4.2.3 Informing colleagues’ teaching and understanding of teaching

The TLG participants indicated that they thought the outcomes of their TLG activities were fairly invisible to their colleagues. They mentioned two main reasons: firstly, the overload of information in the school, and, secondly, the lack of perceived relevance of the results to their colleagues. One of the TLG participants mentioned: “Many colleagues could be aware of the outcomes of our activities; however, many colleagues ignore them because they perceive the results as not directly relevant to them at that specific moment.” Moreover, they had noticed a decreasing participation in the yearly research market. Because of the gap between the relatively long period of time that is needed for doing research and the sense of urgency to learn the desired outcomes, such as answers, solutions, or results, as soon as possible, they experienced only limited involvement.

The conversation in the focus group revealed, firstly, that two team leaders were only informed about the TLG’s research topics; they were not aware of the broader aim of the TLGs, their activities, or findings (see also Table 6). They suggested that they should consult the teacher-researchers more often themselves, and invite them more often to present and discuss the outcomes in their team meetings. Nevertheless, the other two team leaders noticed that the knowledge and insights from the TLG had contributed to three changes in teaching in their departments, which suggests the catalytic validity of the findings: 1) a number of teachers had started teaching differently; 2) cross-curricular programs had been adjusted; and 3) subject teams had started discussing their curricula and assessments in the light of the outcomes of the research activities in the TLG. The team leaders suggested that the latter two changes might be the result of the TLGs’ presenting results to teams and colleagues and discussing the findings with each other, instead of providing clear-cut or conceptual knowledge and conclusions. Therefore, these interventions seem to have contributed to several types of validity; the research activities led to outcomes for other colleagues (outcome validity), and the outcomes led to perceived changes in teaching and understanding of teaching (catalytic validity). Moreover, the focus group participants viewed their own personal interpretations of the research results from the TLG as very important, suggesting democratic validity.
4.3 The Crossroads TLG

4.3.1 General information

The research-based TLG from the Crossroads Secondary School, established in 2008, was the longest-existing TLG in this study. It was composed of four teacher-researchers who met weekly for two-and-a-half hours. Each teacher-researcher is provided with 120 hours on a yearly basis. During the previous year, the TLG had examined two topics. Firstly, two TLG participants examined whether a coaching teacher role led to increased student motivation in one of their school departments. Secondly, the other two TLG participants monitored the introduction and progress of peer consultation in another school department. The research topics were determined in consultation with the school leader.

4.3.2 Activities

The findings of the Crossroads TLG’s research were shared with other colleagues in four ways. Firstly, for each topic, one TLG participant involved the school leader monthly by informing her about the progress and results (democratic validity), and discussing the (interim) outcomes with her (dialogic validity). Secondly, the TLG participants occasionally informed other colleagues by presenting their findings in various work meetings, such as department team meetings. According to the TLG participants, this was not organized in a structured way. Thirdly, the TLG participants involved the team leaders occasionally by discussing their knowledge with them informally (see Table 5) due to the close social connections between them. However, this informal form of knowledge sharing occurred almost always on the TLG participants’ initiatives; the team leaders never took the initiative. The TLG participants suggested that they should actively inform and involve the team leaders more often themselves. Likewise, other colleagues, such as teachers who taught the same subject, were involved only occasionally and informally (see also Table 5). The TLG participants mentioned that they should use an easily accessible platform to inform all their colleagues about their findings. Fourthly, the TLG participants used to regularly inform other colleagues via the school newsletter. However, the newsletter had been abolished the previous year. Apart from the knowledge sharing with the school leader, the other three knowledge-sharing activities were characterized as occasional and unstructured, and were mostly initiated by the TLG participants. Therefore, the TLG participants suggested that, together with the school management, they...
should carefully consider how to organize knowledge sharing of research results more structurally and involve all relevant colleagues, so that their findings could contribute to ongoing learning in the school. They stressed the important role of the school leader and team leaders, who should prioritize and support the sharing of knowledge from the TLG with all relevant colleagues, and organize discussion and dialogue about the (interim) findings. One of the teacher-researchers underlined this by saying: “Two months ago, in a meeting of one of the department teams, we discussed the results concerning peer consultation in the presence of the school leader. For us, her presence and involvement in the dialogue about how the results could lead to team outcomes underlined and supported the importance of the topic and the results of our activities for the team.”

4.3.3 Informing colleagues’ teaching and understanding of teaching

The TLG to inform them about the outcomes of the TLG activities. The TLG participants mentioned four reasons. Firstly, some colleagues saw some topics as not being directly relevant to their needs, while the TLG participants were convinced that the catalytic validity depended greatly on colleagues’ perceived relevance. Secondly, they suggested that their research question about coaching was not the right one; they were not able to provide results, because coaching was still a “work in progress.” Thirdly, they mentioned organizational reasons, such as senior teachers not being available for data collection because of their busy daily schedules. Fourthly, they noticed that the team leaders did not prioritize involving or informing other colleagues. For example, time reserved for sharing and discussing research progress or results (democratic validity) and how these results could lead to positive outcomes for their colleagues (dialogic validity) was often spent on other agenda items. Moreover, the school leader sometimes replaced time reserved for discussing the outcomes of the TLG’s research activities with another agenda item in the general staff meeting. This constituted missed opportunities to increase the catalytic validity of the TLG’s work. As a result, no further actions or follow-up activities were undertaken and their research activities did not lead to outcomes for other colleagues in terms of coming to a better collective understanding of the examined problems or a subsequent change in practice or policy (catalytic validity). Therefore, the TLG participants characterized their knowledge-sharing activities as “knowledge notification.” According to them,
this was due to a lack of time, prioritization, and effective management of knowledge sharing.

Although the TLG participants suggested that most of the team leaders were informally informed, in the focus group conversation only one team leader clearly confirmed that she was informed about the aims, activities, topics, and outcomes of the research activities in the TLG (democratic validity) (see Table 3). According to her, this was due to her supervisory role in monitoring the research team. The other team leaders indicated that they were aware of the TLGs’ topics (see Table 3) only because these topics were included in the school’s development plan. The focus group conversation also revealed that the school leader never reported her monthly updates and discussions with the teacher-researchers about their progress, results, and (interim) outcomes to her team leaders. It appeared that the TLG’s role in the school was not clear for most of the team leaders. Nevertheless, contrary to the perception of the TLG participants that their activities did not lead to outcomes for other colleagues and collective learning, the focus group conversation revealed that the knowledge and insights from the TLG positively influenced the process of peer consultation. The team leaders were of the opinion that the colleagues involved in peer consultation were coming to a better understanding of peer consultation (catalytic validity). According to the team leaders, this stimulated an important school-wide ongoing development (process validity).

4.4 The Trinity TLG
4.4.1 General information
The research-based Trinity TLG was formed in 2014, and was guided in its first two years by a university researcher. The TLG comprised three teacher-researchers who met weekly for one hour. Each teacher-researcher was provided with 70 hours on a yearly basis. The aim of the TLG was to contribute to sustainable school development through practice-oriented in-school research activities. Its most recent research topics had been how to establish a research culture in its school and how to better utilize knowledge and insights in the school. Although the school leader approved these topics, they were mainly suggested by the TLG participants themselves, because of their personal interest in them.
General information

The Trinity TLG was based Trinity TLG was formed in 2014, and was guided in its first school's development plan. The focus group conversation also revealed that the school leader never reported her monthly updates and (interim) outcomes to her team leaders. It appeared that the team leaders in the focus group conversation indicated that their involvement in sharing activities was limited; none of them took the initiative to be informed about the outcomes of the research activities in the TLG. They suggested that they should do so more actively from now on.

4.4.2 Activities

The outcomes of the Trinity TLG were hardly shared with other colleagues in a structured or organized manner (see also Table 5). The TLG participants indicated that they discussed their results occasionally and informally, mainly with the school leader. Because of their dissatisfaction with the limited involvement of the school management, in the previous year the TLG participants had started to proactively involve the school leader. They regularly invited him to their research meetings to discuss the progress of the research. This is an example of dialogic validity. In these meetings, they also discussed how the school leader could use the outcomes of their research in his practice and in the school’s policy, for example to strengthen a research culture in which colleagues more regularly asked reflective questions and critically evaluated their lessons and curricula.

The team leaders in the focus group conversation indicated that their involvement in sharing activities was limited; none of them took the initiative to be informed about the outcomes of the research activities in the TLG. They suggested that they should do so more actively from now on.

4.4.3 Informing colleagues’ teaching and understanding of teaching

The TLG participants perceived an increased involvement of the school leader with their research topic, activities, and findings after they started to invite him to their TLG meetings. As a result, they perceived that he became better informed about their findings, and came to a better understanding of the problems addressed in their research (catalytic validity). However, this had not yet led to further changes in the school that were related to the research topic. The TLG participants suggested that this was probably because the research topics were not directly relevant, at least in a recognizable manner, to the daily practices of a wide range of colleagues. Therefore, they suggested that new research topics should be more relevant to their colleagues’ daily teaching practices. The data indicated that the TLG participants were not satisfied with the extent to which their knowledge made sense to others in their school (see also Table 5); the discussions and critical dialogues with the school leader about their findings did not lead to further actions or outcomes for other colleagues or the school, and had no effect on practice or policy. Therefore, they characterized their knowledge sharing as “occasional and informal mail delivery.”
The focus group conversation revealed that two team leaders were aware of the topics of the research team because they had participated in one of the research activities. However, they were not able to specify the TLG’s aims, activities, or outcomes. The other focus group participants were not informed about the aims, activities, topics, or (see Table 3). Consequently, they did not indicate that the TLG’s outcomes changed or influenced their practices or policy. Both the TLG participants and the team leaders in the focus group conversation agreed that they needed to cooperatively create a clear and shared vision of why and how to integrate research-based teacher learning, such as that which occurs in the TLG, and ongoing school development, and how the research activities in the TLG could lead to outcomes for colleagues and school innovation. Although the team leaders were barely informed about the outcomes of the TLG, they did recognize its importance for teacher learning and school development.

5. Discussion and conclusions
In this case study, we examined how knowledge that was co-constructed in three research-based TLGs was shared with other colleagues in their schools and with what effect. We analyzed which activities contributed to five types of validity: outcome validity, democratic validity, dialogic validity, catalytic validity, and process validity.

With respect to the first research question, “Which activities are undertaken to share the co-constructed knowledge from research-based TLGs in school?”, we found the following activities. Firstly, with respect to the outcome validity of the co-constructed knowledge, the three TLGs examined questions that led to outcomes for teachers and/or the school, or were at least intended to do so. Activities that were undertaken to identify problems in the school for investigation, which should therefore lead to relevant outcomes for teachers, included determining research topics in consultation with the school leader, aligning activities with topics in school development plans, and (in the Waterfront TLG) working with commissioners.

Most of the sharing activities of the TLG participants in this study were aimed at enhancing democratic validity. These activities were mostly aimed at involving school leaders and team leaders who were interested in the research process in an informal way. Other colleagues, such as teachers, were mostly involved after the research process by informing them through presentations
in teams, information in newsletters, or results in an online environment. These activities were aimed at informing other colleagues about outcomes rather than involving them in the research process. The TLG participants also perceived these sharing activities as knowledge dissemination rather than considering the perspectives of other colleagues. They can therefore hardly be seen as enhancing democratic validity.

We see dialogic validity as a next step in striving for the validity of the outcomes of research-based TLGs; that is, discussing (interim) findings, and the results or their quality in a critical dialogue with stakeholders. As with democratic validity, these activities were mostly focused on school leaders, such as critically discussing (interim) findings in dialogue with the school leader, and the participation of a team leader in the Waterfront TLG. Moreover, dialogic validity was sought by critically discussing findings with colleagues in teams. The presence of the school leader on such occasions was considered important. However, such activities were organized only occasionally and were not prioritized by the team leaders. A successful activity for attaining dialogic validity was found in the Waterfront TLG: working with commissioners in combination with providing results and discussing their implications for the commissioners' own practice instead of providing them with clear-cut conclusions.

Knowledge-sharing activities contributing to catalytic validity were found in the Trinity TLG. These activities involved only the school leader. He was invited to the TLG meetings regularly, where the research topics and the practical implications for the school were discussed with him proactively.

Lastly, we found activities contributing to process validity in the Crossroads and Trinity TLGs. The Crossroads TLG monitored and evaluated two key topics that were part of the school development plan. The Trinity TLG discussed how the school leader could use the outcomes to strengthen a research culture in the school. Both activities were aimed at ongoing learning, which characterizes process validity.

The second research question, “How do these activities inform colleague’s teaching and understanding of teaching?”, specifically concerned catalytic and process validity. In the Trinity TLG, we found an indication of catalytic validity that concerned only the school leader: pro-actively informing and discussing outcomes with him led to a better understanding of the
research topics, though not to a changed practice on his part, because the research topics were not yet directly recognized as relevant to the daily practices of a wide range of colleagues. In the Waterfront and the Crossroads TLGs, indications of catalytic validity also extended to other colleagues; it appeared that teachers started teaching differently and teaching programs were adjusted (Waterfront TLG), and teachers came to a better understanding of peer consultation, which positively influenced the peer consultation process (Crossroads TLG). It was not clear, however, which sharing activities led to these changes. It might be that the greater variety of sharing activities for democratic and dialogic validity in these TLGs than in the Crossroads TLG contributed to catalytic validity. Also, the mostly informal and social interactions might have contributed to catalytic validity.

We found indications of process validity in the Waterfront and Crossroads TLGs. Using the outcomes findings of the research activities in the Waterfront TLG, colleagues started discussing their curricula in teams, an indication of ongoing learning in these teams. The research process of the Crossroads TLG contributed to further development and a better understanding by other colleagues, such as teachers, of peer consultation, which was an important topic in the school development plan. However, as with catalytic validity, it remained unclear which specific activities led to process validity.

The added value of this study is that it reveals ways in which collaborative teacher learning, such as in TLGs, can contribute to collective learning capacity in a school. The perspective of the five validities appears to be a fruitful lens to examine knowledge-sharing activities in schools and their effects on teaching and understanding of teaching. The findings of this study suggest that most sharing activities (research question 1) are aimed at the democratic validity of the research topics and results; they include involving school leaders in determining research topics, and informing colleagues about the findings. Furthermore, topics and/or (interim) findings were critically discussed with colleagues. These were sharing activities aimed at dialogic validity, which is considered basic to the quality of practitioner research, such as in TLGs (Oolbekkink-Marchand et al., 2013). An increase in activities aimed at dialogic validity could increase the quality of the research activities because of the critical dialogue with and involvement of more stakeholders.
Although, as an answer to research question 2, we did find perceived changes in teaching and understanding of teaching (catalytic validity), and indications that the outcomes contributed to ongoing learning (process validity), we found few specific formal sharing activities that were structurally organized that could facilitate catalytic and process validity. It might be that the occasional presentations in the teams and the informal discussions in their schools led to ongoing learning in their school, in combination with what Cornelissen, McLellan, and Schofield (2017) call “the informal, social dimension of collegial interacting around research activities and outcomes.”

All the participants in this study recognized the importance of sharing the co-constructed knowledge of the TLGs; the main suggestion of all three TLGs was to reconsider how to organize the process of knowledge sharing so that they could contribute to the ongoing learning of their colleagues (individual learning) and teams (collaborative learning), and contribute to school development (collective learning). In other words, through knowledge-sharing activities, the TLG members want to contribute to their schools’ capacity for organizational or collective learning (Marks & Louis, 1999). Although knowledge-sharing activities are interpreted in many studies as following knowledge creation activities (e.g. Coburn et al, 2012; Stoll, 2010), our study supports the view that knowledge sharing should be seen as a process. In this process, attention is paid to activities in advance of the co-construction of knowledge, such as determining research topics with other colleagues or the school leader. Although this cannot yet be seen as a sharing activity, it does contribute to democratic validity.

Moreover, in this process attention is paid to activities after the co-constructed knowledge is shared. For example, a TLG participant who has become an expert in the examined topic could join team meetings in which colleagues exchange experiences or learn together based on the TLG results, or visit teachers who apply the outcomes in their lessons. Although these are not necessarily sharing activities, they can still contribute to catalytic validity. Consequently, seeing knowledge sharing as a process instead of as an activity is probably in itself the most important contribution to process validity.

5.1 Limitations and directions for further research
The first limitation of our study concerns process validity. We did find indications of process validity, in the sense that aims, sharing activities or
suggestions for improving knowledge sharing permitted ongoing learning. However, Meijer et al. (2013) suggest that measuring process validity requires data collection over a longer period of time. Future research could therefore follow the knowledge-sharing process for a longer period.

A second limitation is that, although we were able to find indications of catalytic and process validity, we were not able to identify which activities were significant, and thus which underlying mechanisms led to these validities. We found indications that teachers changed their teaching practices, but not which activities motivated them to do so. In further research, the underlying processes could be analyzed in order to provide additional insights into changes in teaching and understanding of teaching by using observations of lessons combined with in-depth interviews with teachers who do not participate in TLGs.

5.2 Implications for practice

In line with other studies (e.g. Cornelissen et al., 2017; Godfrey, 2016; Van Schaik, Volman, Admiraal, & Schenke, 2019, 2020) our study underlines the important role of the school leader in leading learning in schools; for instance, by participating in making decisions about what topics can be studied by teacher researchers or by tasking TLG participants with specific assignments. When the role, research process, and the activities of TLGs are not embedded in the culture and structure of the school as a learning organization, learning from each other through sharing knowledge remains challenging. Yet, our study also indicates that the responsibility for collective learning through knowledge sharing should not lie with school leaders alone. Apart from school leaders, the TLG participants also saw a role for themselves in improving knowledge sharing, and wanted to be, to some extent, involved in the process of collective learning.

The typology of validities proved to be a useful framework for analyzing how the knowledge sharing of TLG outcomes was undertaken in schools. It can also function as a framework for planning knowledge-sharing activities. To achieve outcome validity, TLG participants can examine problems that are perceived to be relevant to teachers’ everyday practices, or questions that are related to the school development plan. For democratic validity, all relevant stakeholders should be informed of any interim results and the research procedure during the entire process, such as by informing colleagues.
structurally via the school’s online systems or regularly updating colleagues during team meetings. These interactions could also contribute to dialogic validity when critical dialogue is sought with colleagues, such as team leaders, teachers, or even students. To support catalytic validity, team leaders and teachers could discuss the implications for their practices, formulate agreements about how changes in teaching practice will be implemented, and monitor the implementations. Finally, process validity can be achieved when such monitoring leads to further questions, and new problems and topics for TLG activities that can contribute to the collective learning capacity in the school.