Stay on topic: Topical (mis)alignment between lesson study research activities and its relationship with teachers' perceived learning

I. Uffen, S. de Vries, S.L. Goei, and N. C. Verhoef

Abstract

Lesson study (LS) is a collaborative inquiry-oriented approach to teachers' professional development. Teachers choose a research topic based on a problem they have observed in their students' learning. During LS, teachers should ideally stay with their research topic to build on it further during all research activities, a process we refer to as 'topical alignment'. However, in reality, teachers tend to drift away from their research topic. We posit that teams that adhere to their research topic experience more meaningful and profound learning. We explore how novice LS teams topically aligned their research activities and how (mis)alignment could relate to perceived teacher learning. The findings of a cross-case analysis of five audiotaped LS cycles, as well as questionnaire data on teacher learning (n = 17), show that topically aligning research activities is challenging for teams. This study provides concrete practical implications, including a checklist to help LS teams ensure they are maintaining topical alignment.

Keywords topical alignment, lesson study, teacher learning, teacher research, inquiry learning

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1 Introduction

Lesson study (LS) is a collaborative inquiry approach to teacher professional development during which small teams conduct research on their own classroom practices (Fernandez & Yoshida, 2004; Murata, 2021; Takahashi & McDougal, 2016). In an LS team, members embark on several research activities, usually starting by choosing their own research topic, ideally based on a problem of practice regarding student learning experienced by all participants. As with any research, when conducting LS research activities, connecting all research activities with the teams' research topic is critical. If the selected research topic remains constantly on the team's agenda throughout the process, the team can continually build on it during various research activities, which provides the opportunity to deepen team members' knowledge on the topic. That is, the team needs to remain focused on and reflect on how the undertaken activities actually connect to their research topic (Murata, 2021). We refer to this process as 'topical alignment'.

To the best of our knowledge, no LS studies have explicitly investigated the concept of topical alignment, nor is it mentioned in existing LS protocols. Murata (2021) presumes that teams need to align their lesson goals, lesson activities, and data collection to experience deeper teacher learning. Chokshi and Fernandez (2004) suggest that LS participants benefit from aligning LS research activities with their research question. Furthermore, several studies have proposed that a topical focus can better support teachers in analysing their students' learning, leading to deeper and more meaningful learning (e.g., Choy & Lee, 2021; Choy et al., 2017). However, maintaining a focus on the research topic is not easy in practice. As several empirical studies have shown, LS teams easily and frequently shift their focus from their research topic to unrelated practicalities or instructions (e.g., Amador & Weiland, 2015; Bjuland & Mosvold, 2015; Fernandez & Chokshi, 2002; Lewis, 2016; Wood, 2008), such as classroom and time management. We anticipate though that LS research activities provide more meaningful and deeper learning if teams adhere to their chosen research topic and that teachers will thus perceive LS as more valuable for their learning. This exploratory study draws on audiotaped LS cycles from five beginner LS teams that varied in their perceived teacher learning, as determined through questionnaire responses. Using a cross-case analysis, we investigate how these LS teams topically (mis)aligned their LS research activities with their research topic. Furthermore, we explore how the extent of topical (mis)alignment relates to perceived teacher learning.

2 Theoretical framework

The studied LS cycles occurred in the Netherlands and were informed and guided by a handbook on conducting LS in education (De Vries et al., 2016). The Dutch LS

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approach is mainly based on Stepanek et al.'s (2007) LS model, developed in the United States, and also borrows from Dudley's (2014) LS model, developed in the United Kingdom. All the research activities mentioned correspond to the four LS phases defined by Lewis et al. (2019): study, plan, teach, and reflect. Most teams spend at least 10 hours, some 20 hours or even more, per LS cycle. Ideally, teams should spend a substantial part of this time in the study phase, which establishes a knowledge base that the team can build on in subsequent phases (The Lesson Study Group at Mills College, 2022). In the following sections, we describe the research activities in each LS phase (see Table 1) and illustrate topical alignment with an example. Appendix A provides an overview of the example.

Table 1

Research activities during LS

LS phase	Research activities
Study	Choosing … - long-term goal - a research topic - a class - a subject matter goal - a research goal - a research question - inclusion criteria case students Studying curriculum and content
Plan	Formulating learning goals research lesson Defining an experienced difficulty Detailed description research lesson Preparing data collection on student learning of case students: - observation - interview questions - additional data
Teach	Teaching the research lesson Collecting data on student learning (optional) Re-teaching the research lesson and re-collecting data on student learning
Reflect	Engaging in a post-lesson discussion: - Discussing research lesson and collected data on student learning (optional) Adjusting the research lesson (optional) Engaging in a second post-lesson discussion Discussing collected data on student learning Reflecting on what is learned

Notes. Based on De Vries et al. (2016), Lewis et al. (2019), and Choy et al. (2017).

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2.1. LS research activities

2.1.1 Study

During the study phase, the LS participants first collaboratively explore the concerns and difficulties they have experienced in student learning during their daily teaching practice. They choose a general long-term goal for student learning that is relevant to all team members, and then participants distil a research topic related to their students' learning that they aim to learn more about. For example, participants who experience students often giving unsubstantiated opinions and uncritically accepting other people's unfounded opinions (concerns) might aim to help students become critical thinkers (long-term goal). To encourage this behaviour, they could focus on how students can substantiate their viewpoints (research topic).

The team then chooses a class suitable for examining the specified research topic – for example, a class that has begun practicing debate. Next, the LS participants formulate a subject matter goal related to the research topic – for example, that students can substantiate their own viewpoints. Team members then clarify their research goal, or the phenomenon they want to understand better. Continuing with our example, this goal could be learning how to support students' learning to substantiate their viewpoints. A research question should combine the research topic and goals, such that it asks how teachers can learn to support the desired student learning. For example, a first draft of a research question may read: "How can we help students in learning to substantiate their viewpoints?"

After defining these goals and aims, participants choose inclusion criteria for 'case students' (i.e., students who represent groups with distinctive educational needs; Dudley, 2014). Throughout subsequent research activities, LS participants should aim to keep approximately three of these case students in mind during the plan and reflect phases. Doing so helps participants learn about the research topic by considering various learning needs and styles (Goei, Norwich, et al., 2021).

Throughout the study phase, LS participants deepen their knowledge and understanding to make use of one another's expertise and study of curriculum and content, which entails investigating a variety of resources and expertise (e.g., teaching materials, research, standards, curriculum, student thinking, learning tasks) or consulting a knowledgeable other (Takahashi, 2014). This investigation is crucial for the team to gain new knowledge and perspectives (Choy & Lee, 2021) and fine-tune what they want to investigate. For example, participants might discover that they can provide students with information about forms of argumentation that would help them substantiate their viewpoints. The team can then formulate a more specific research question, such as "How does it help students support their point of view if we let them process information about different forms of argumentation?" (e.g., De Vries et al., 2016; Goei, Van Joolingen, et al., 2021; Lewis et al., 2019).

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2.1.2 Plan

During the plan phase, the LS participants design a research lesson to address their research question. The lesson design is recorded in a lesson plan containing three focal points: (1) a learning goal for the students; (2) students' experienced difficulty in reaching this goal, particularly the difficulties experienced by the case students; and (3) a detailed description of all the activities during the research lesson (Choy et al., 2017). These three focal points must be topically aligned with the research topic; in other words, they must be designed in such a way that they can provide the team with new perspectives on their research topic. For example, an LS team might decide to learn how students substantiate their viewpoints and, more specifically, whether learning about specified forms of argumentation will help their students. Therefore, in the research lesson, team members incorporate an activity to process information about and practice several forms of argumentation.

Next, LS participants prepare for data collection, usually at least an observation protocol and a guideline for a short case student interview (De Vries et al., 2016). Regarding the observation protocol, participants operationalise anticipated student responses, particularly for the case students. They do so by predicting student behaviour in relation to the lesson's overall learning goal and within each phase of the planned research lesson; in other words, they predict what each case student will need to have done, said, written, or drawn to indicate that the case student can move on to the next phase of the lesson (Dudley & Lang, 2021). Interviews with the case students ideally should be held at the end of the research lesson and address students' perceptions about what helped or hindered them from learning during the research lesson, as well as what might be changed in the lesson and why (De Vries et al., 2016; Dudley, 2014). Participants can also collect complementary data, such as written assignments or student feedback. Again, all prepared forms of data collection should be tailored closely to the teams' research topic. For example, the team could prepare strategies for observing conversations among students to recognise what forms of argumentation or fallacies they use when substantiating their viewpoints.

2.1.3 Teach

During the teach phase, one teacher from the LS team teaches the research lesson, and the other participants collect data on student learning as prepared. The teacher who teaches the lesson follows the detailed lesson plan as scripted during the plan phase. In theory, doing so increases the chances that student learning the teachers want to investigate actually occurs. The other participants focus on observing the operationalised, predicted student learning and collecting other data, as prepared.

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2.1.4 Reflect

The reflect phase involves a post-lesson discussion in which LS participants interpret their collected data on student learning and consider adjustments to the research lesson. When adjusting the research lesson, the team can choose to return as far as necessary in the LS cycle. For example, they may adjust their research question or study other literature streams.

With the Dutch LS approach, participants can adjust the lesson plan, reteach the research lesson to a different class, and repeat the discussion of data on student learning in a second post-lesson discussion. In terms of topical alignment, teachers predominantly focus on answering the research question that specifies what the team wants to learn about its research topic. For example, teachers can discuss the forms of argumentation students use and the fallacies with which they continually struggle.

Finally, participants reflect on what they have learned as individuals and as a team (Dudley, 2015; Fujii, 2016). For example, they could discuss the implications of certain fallacies in their instruction. During this last part of the reflect phase, participants might discuss any 'side effects' they have learned – that is, learnings that do not necessarily topically align with the previous phases.

2.2 Perceived teacher learning from LS

In Japan, where LS has its origins, teachers often say that LS 'develops the eye to see children' (Lewis, 2011). Several studies indicate that, after participating in LS, teachers perceived increased insight into and ability to observe students' learning, which they believed helped them respond to individual students' needs more effectively (e.g., Bruce et al., 2016; Norwich & Ylonen, 2015). Theoretically, the LS research activities explained previously provide logical connections that enable these learning experiences (e.g., Dudley, 2014; Lewis et al., 2019). That is, LS research activities guide teachers in making their students' learning visible and simultaneously help them investigate and develop their knowledge of the subject matter and didactics. Furthermore, LS is intended to encourage teachers to connect long-term goals for students to their daily practice (e.g., Lewis et al., 2019). Our assumptions are as follows: (1) if LS research activities are aligned with a team's research topic (i.e., all research activities contribute to learning about the chosen research topic), teachers will perceive enhanced teacher learning regarding observing and understanding student learning, teachers' knowledge on subject matter and didactics, and ability to connect long-term goals to school development; and (2) teachers whose teams' research activities drift away from their original research topic and thus are misaligned do not perceive these aspects to the same extent.

2.3 Research questions

As noted previously, our main aims are to investigate how LS teams topically

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(mis)align their research activities and how topical (mis)alignment could be related to their perceived teacher learning. The following questions and subquestions arise:

1. How do LS teams topically align their research activities?
   a. Which research topic do the teams choose?
   b. How are the teams' research activities topically (mis)aligned with their chosen research topic?
2. How does the topical (mis)alignment of the research activities relate to perceived teacher learning in a given LS team?

3 Method

3.1 Research design

We used both qualitative and quantitative methods, though we place more emphasis on the qualitative method and empirical data, in the form of verbal conversations. A qualitative analysis of verbal conversations arguably should enable us to gain an optimally close view of what is happening with the research topic in terms of topical (mis)alignment. Using a quantitative approach, we also gathered data on teacher learning to rank the teams according to their perceived teacher learning. We then compared the teams in terms of topical (mis)alignment using a cross-case analysis.

3.2 Participants and procedure

We conducted this study in a pre-vocational secondary school that implemented LS as an innovative, school-wide approach to teachers' professional development. In total, 32 people participated: 17 teachers, three educational assistants, two student teachers, and 10 facilitators. The participants were divided into five teams.

All teachers, educational assistants, student teachers, and half of the facilitators came from the participating school (hereafter referred to as 'internal facilitators'). Four of the other five facilitators ('external facilitators') worked at various Dutch universities, and the last worked as a teacher at another secondary school. All 10 facilitators received LS facilitator training, in which they learned to guide teachers through the LS cycle. Guiding topical alignment was not explicitly mentioned as a facilitator's task during training; this concept has not been in use previously. Therefore, we did not include the facilitators' role in the analysis. The second author and one of the course developers provided the training, which was developed by Vrije Universiteit Amsterdam (Bosma et al., 2019). We assigned the external facilitators to support the internal facilitators, who had no experience in facilitating an LS team apart from the training. The facilitator duos were free to decide how to delineate their roles. Each duo

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supported one LS team.

Participants taught different subjects (i.e., languages, economics, mathematics, and music), resulting in cross-curricular teams. Teams received an instruction manual with worksheets based on De Vries et al.'s (2016) LS handbook, which thoroughly explains the research activities, as described in Table 1. All participants (N = 32) provided active informed consent, and the research team obtained ethical clearance from the ethics board of [name University and Department].

3.3 Quantitative data and data analysis

For our quantitative analysis, we obtained questionnaire data from 13 teachers, three teacher assistants, and one student teacher (five participants did not complete the questionnaire), representing all five LS teams. The questionnaire solicited their perceptions of teacher learning using a six-item scale that was developed and validated by De Vries et al. (2017) and based on Lewis (2005). We measured the items using a five-point Likert scale ranging from 1 ('strongly disagree') to 5 ('strongly agree'). The items covered knowledge of subject matter and didactics, observation skills, understanding of students' learning and thinking, better connection between long-term goals and teachers' daily teaching practice, lesson quality, and student learning outcomes.

We analysed the questionnaire data using SPSS 26 at the team level, with descriptive statistics. Table 2 provides the means per team at the scale level, which we used to rank the teams from lower (LTL) to higher (HTL) perceived teacher learning1. In the Kruskal–Wallis test, we observed no significant differences in perceived teacher learning among the teams (p = .191). An analysis of the differences across separate teams revealed that teams A and E differed significantly from each other (p = .022). We used these indications to distinguish between team A as the LTL team and team E as the HTL team, and we refer to the other teams as 'middle perceived teacher learning' (MTL) teams. Perceived teacher learning varied the most in team A_{LTL} (SD = 1.08), whereas teams B_{MTL} (SD = .31) and E_{HTL} (SD = .00) showed the least variation. Teams C_{MTL} and D_{MTL} showed some degree of variation in comparison with the other teams. Team E_{HTL}'s perceived teacher learning score relied on relatively little data (50% response); one teacher who did not respond appeared sceptical about the value of LS during the recorded meetings. We note that a response from this teacher would most likely have ranked the team lower.

Finally, all teams except team C_{MTL} contained one respondent who was an educational assistant or student teacher. Although these respondents perceived relatively high levels of learning (M = 3.24, SD = .41) compared with in-service teachers (M = 2.84, SD = .83), their teams' rankings did not change when we removed their responses. This factor explains the relatively high variation in perceived teacher learning, particularly in team A_{LTL}.

Table 2

Overview of perceived teacher learning on team level

Team	Total response, n	Teachers	Educational assistants/ student teacher	Missing	Mean	SD	Indication perceived teacher learning
A	4	3	1	0	2.21	1.08	LTL
B	4	3	1	1	2.86	.31	MTL
C	3	3	0	1	2.90	.54	MTL
D	4	3	1	1	3.25	.72	MTL
E	2	1	1	2	3.71	.00	HTL

3.4 Qualitative data and data analysis

3.4.1 Data collection
The qualitative part of our study drew on transcribed audio recordings from five LS meetings per team. We incorporated the study, plan, and reflect phases into the data collection; we omitted the teach phase because Dutch legislation regarding privacy made it impossible to comply with ethical requirements related to student participation during this phase.

   The first author collected data during spring and early summer of 2018. We transcribed the audio recordings using light editing to remove irrelevant distractions (e.g., word repetition, background speaking). We obtained a total of 34 hours and 4 minutes of audio material.

3.4.2 Data analysis
The first author, in collaboration with two research assistants, analysed the transcripts, which were uploaded in ATLAS TI 9.1. The first author had four years of experience in attending, observing, and co-facilitating LS in various settings. The research assistants were new to LS but had read relevant literature (e.g., De Vries et al., 2016; Lewis et al., 2019).

3.4.2.1 Indicating research activities and topical decisions
First, we identified when a team engaged in specific research activities, using Table 1 as a guide to distinguish which LS activity was in play. Next, the first author and two research assistants described the topical decisions made during every research activity – for example, what the team decided their research question to be or what to observe regarding student learning during the research lesson. During the reflect phase, we perceived topical decisions as discussed themes regarding the research lesson and student learning, adjustments to the research lesson, and reflections on what team members learned (for an overview of all topical decisions made in each team, see

Appendices B, C, and D). To ensure credibility, the first author and research assistants repeatedly calibrated insights about when a team engaged in a specific research activity and the nature of the topical decisions, until saturation was reached.

3.4.2.2 Indicating topical alignment
To determine how the LS teams topically aligned their research activities (Research Question 1), we used the descriptions of the topical decisions to indicate topical alignment. First, we determined the teams' research topic (Subquestion 1a), which all teams explicitly decided on except team D_{MTL}. For this team, we determined the research topic according to the concepts that they began to refer to as their research topic. Second, we identified the occurrence of topical alignment among the research activities with these research topics (Subquestion 1b). We considered topical alignment to be achieved if (1) the research topic literally appeared in the topical decision of a research activity or (2) a different concept was the focal point in a topical decision but team members explained why they thought this concept aligned with the research topic. Third, we identified misalignment between the research activity and the research topic if a different concept was the focal point in a topical decision and either (1) the team did not explain how this other concept aligned with its research topic or (2) the team stated that the concept aligned but did not provide any further reasoning. We did not evaluate the adequacy of the teams' reasoning for why they thought the concepts were related.

3.4.2.3 Exploring the relation between teacher learning and topical alignment
To address Research Question 2, pertaining to the possible relationship between topical alignment and perceived teacher learning, we compared the results regarding how the teams topically aligned their LS research activities (Research Question 1) among the LTL, MTL, and HTL teams.

4 Results

We next report our findings. First, we report on the teams' chosen research topics. Second, we elaborate on the identified topical alignment. Third, we elaborate on the research activities that we ultimately determined to be misaligned. Fourth, we explore the relationship between the identified topical (mis)alignment and perceived teacher learning.

4.1 The teams' chosen research topics
All the teams formulated research topics reflecting students' behavioural engagement: "involvement of students" (A_{LTL}), "activation and motivation"

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(B_{MTL}), "executive functioning skills by using the BBB2 method" (C_{MTL}), "group dynamics and students' insight of group dynamics" (D_{MTL}), and "keeping attention during the instruction" (E_{HTL}). Note that, unlike the other teams, team C_{MTL} narrowed its research topic from the start of the LS. Although team E_{HTL} initially indicated a specific part of the research lesson to focus on (the instruction part of the lesson), team members eventually discussed the entire research lesson because they considered this focus too limited.

4.2 How the teams topically (mis)align their research activities
We observed an overall pattern of the original research topic that remained on the agenda of four of the five teams; misaligned research activities occurred increasingly as they progressed through the LS phases. Furthermore, throughout several research activities, three teams adopted one or two additional foci that were parallel to their research topic. We defined these additional topical threads as substantial if the teams maintained the additional focus during at least three research activities. This assumption resulted in two additional threads of topical alignment, either starting from the set learning goals for students or related to observing student learning. Table 3 presents an overview per team of the identified patterns of topical (mis)alignment with the research topic, as well as the additional threads found (for a more detailed overview, including the indicated topical decisions based on topical [mis]alignment, see Appendices B, C, and D).

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Table 3
Overview of LS teams' topical (mis)alignment of their research activities

	LS research activities		The observed topical (mis)alignment				
			Team A_LTL^a	Team B_MTL	Team C_MTL	Team D_MTL	Team E_HTL
Study	Choosing a	a long-term goal	misaligned	ART	ART	ART	ART
		a research topic	ART	ART	ART	ART	ART
		a subject matter goal	n.a.	ART	ART	ART	ART
		a research goal	ART	n.a.	ART	ART	ART
		a research question	ART	ART	ART	ART	ART
		a class	misaligned	misaligned	misaligned	misaligned	ART
		criteria case students	ART	ART	misaligned	ART	misaligned
	Study of content and curriculum		n.a.	n.a.	n.a.	n.a.	n.a.
	Learning goals (LG) research lesson (RL)	First LG	n.a.	ALG	ART	ART	ART
		Second LG	n.a.	ALG	ALG	ART	ALG
		Third LG	n.a.	ALG	n.a.	n.a.	n.a.
		Fourth LG	n.a.	ALG	n.a.	n.a.	n.a.
		Fifth LG	n.a.	ALG	n.a.	n.a.	n.a.
	Experienced difficulty		n.a.	n.a.	ART	n.a.	ART
	Structure of the RL	Start	n.a.	ALG	ART	ART	ART + ALG
		Assignment(s)	misaligned	ALG	ART + ALG	misaligned	ALG
		End	n.a.	ALG	ART	misaligned	ALG
Plan	Prepared observational data (OD), foci	First focus	misaligned	ARTc	ART	ART	ART
		Second focus	misaligned	n.a.	ART	ART	ART
		Third focus	misaligned	n.a.	ART	ART	AOD
		Fourth focus	misaligned	n.a.	AOD	ART	AOD
		Fifth focus	misaligned^db	n.a.	n.a.	n.a.	misaligned
	Prepared interview questions	Example book	misaligned	n.a.	misaligned	misaligned	misaligned
	Own questions	n.a.	n.a.	n.a.	misaligned / ART	ART	+ ALG
	Prepared additional data		n.a.	ALG	ART	ART	n.a.

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Phase	Discussed themes	Theme					
First post-lesson discussion	Discussed themes relating the RL and data on student learning	First theme	misaligned	ART	ART	ART	ART
		Second theme	misaligned	ART	AOD	ART	ALG
		Third theme	n.a.	ALG	misaligned	misaligned	AOD
		Fourth theme	n.a.	misaligned	n.a.	n.a.	AOD
		Fifth theme	n.a.	misaligned	n.a.	n.a.	misaligned
		Sixth theme	n.a.	n.a.	n.a.	n.a.	misaligned
		Seventh theme	n.a.	n.a.	n.a.	n.a.	misaligned
	Discussed themes relating to adjustment made to the RL	First theme	n.a.	misaligned	ART	ART	ART
		Second theme	n.a.	misaligned	ART	ART	ART + ALG
		Third theme	n.a.	misaligned	ALG	misaligned	misaligned
		Fourth theme	n.a.	n.a.	misaligned	misaligned	n.a.
		Fifth theme	n.a.	n.a.	n.a.	misaligned	n.a.
Second post-lesson discussion	Discussed themes relating the RL and data on student learning	First theme	n.a.	ART	ART	ART	ART
		Second theme	n.a.	ART	ART	ART	misaligned
		Third theme	n.a.	ALG	ALG	misaligned	misaligned
		Fourth theme	n.a.	misaligned	AOD	n.a.	misaligned
		Fifth theme	n.a.	misaligned	misaligned	n.a.	misaligned
		Sixth theme	n.a.	n.a.	misaligned	n.a.	n.a.
Reflecting on what was learned		First theme	misaligned	ART	n.a.	n.a.	ART
		Second theme	n.a.	misaligned	n.a.	n.a.	n.a.
		Third theme	n.a.	misaligned	n.a.	n.a.	n.a.
		Fourth theme	n.a.	misaligned	n.a.	n.a.	n.a.

Reflect

Notes. Topical alignment is indicated as either ART, ALG or AOD, meaning that research activities either align with the research topic (ART), the set learning goals for students (ALG), or prepared observational data (AOD). The contrasting grey colours correspond to the different kinds of topical alignment. Misalignment is indicated as misaligned, meaning either 1) the research activity did not align with the research topic, or 2) the additional discussed foci did not appear within at least three other research activities. N.a. means 'not applicable': the team did not engage in the specified research activity and/or did not choose an additional learning goal, nor did it discuss an additional focus or theme.

a During data analysis, we found that team A_{LTL} discarded early topical decisions from the study phase they further built on during the plan phase. The team quit the original plan phase and started with a new and shortened study and plan phase. Therefore, the results presented herein reflect their revised LS cycle.
b Team A_{LTL} discussed nine misaligned foci in total in preparing the observations.
c Team B_{MTL} discussed during the study phase more extensively how "active behaviour" could be made visible, but how they used this earlier discussion in preparing the observations remains unclear.

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4.2.1 Topical (mis)alignment with the original research topic
Whereas Team A_{LTL} deviated from its research topic from the plan phase onwards, the other teams kept topical alignment throughout the entire LS cycle between their research topic and at least some research activities (team B_{MTL} maintained alignment with 11 research activities; teams C_{MTL}, D_{MTL}, and E_{HTL} maintained topical alignments with respectively 19, 21 and 16 research activities[3]). The further these four teams progressed through the LS cycle, the more they deviated from their research topics. Some research activities were partly aligned and partly misaligned with the research topic. For example, the research topic of team E_{HTL}, "keeping attention during the instruction", topically aligned with their prepared foci regarding what they planned to observe (e.g., "whether students are attentively involved during the instruction and the research lesson"), but three of the prepared foci did not align (e.g., "how they work together within the group"). We elaborate on the misaligned research activities of the teams in the discussion of each LS phase.

Regarding the study phase, teams A_{LTL}, B_{MTL}, C_{MTL}, and D_{MTL} chose a class according to whether the team members knew the students instead of considering their research topic. In contrast, team E_{HTL} chose a class in which the participants experienced difficulties "keeping the students' attention", which literally aligned with their research topic. When choosing the inclusion criteria for case students, teams C_{MTL} and E_{HTL} chose criteria unrelated to their research topics. For example, team E_{HTL} prepared to observe case students who differed regarding their "learning level", but their research topic was "keeping attention during the instruction". Although learning levels might relate to this research topic, the team did not make explicit what they meant or the connection between the topics. In contrast, the other teams topically aligned their inclusion criteria with their research topics. For example, team B_{MTL} chose to observe case students who differed in terms of being active, which literally aligned with its research topic, "activation and motivation".

Regarding the plan phase, team A_{LTL} intended to collect observational data from multiple foci, which misaligned with their research topic "involvement of students". For example, team members prepared to observe whether students were skilled in English. Some prepared foci could be construed as relevant to "involvement of students", but the team did not agree how or why the foci would relate; for example, they intended to observe whether students were withdrawn. Furthermore, teams A_{LTL}, C_{MTL}, and D_{MTL} prepared interview questions taken from the example questions in the provided manual, which by definition did not align with specific research topics of the teams; they were not developed for specific teams.

Regarding the reflect phase, teams B_{MTL}, C_{MTL}, and E_{HTL} in particular showed increased misalignment during their post-lesson discussion, such that the number of discussed concepts unrelated to their research topic or

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other research activities grew. For example, team E_{HTL}'s research topic was "keeping attention during the instruction". During the post-lesson discussion, they discussed role division within the group and the clarity of the assignment. Although these aspects could be a relevant focus for specific team members, they deviate from the stated research topic. Overall, participants spent much of their available time discussing what they noticed during the research lesson in general, rather than topics prompted by their preparations.

Although team D_{MTL} discussed themes during the post-lesson discussion that topically aligned with its research topic, this topic was relatively broad: "group dynamics and students' insight of group dynamics". Team members discussed many aspects of group dynamics, such as how well students worked together, their role division, how they fit into the group, and their self-image in relation to what the teachers thought of their students.

Furthermore, during the reflect phase, team B_{MTL} was the only team that made adjustments to the research lesson unrelated to the research topic (e.g., "providing the students with a manual for Kahoot!4"). The other teams displayed a mix of adjustments related to the research topic and those unrelated to the research topic. Finally, team A_{LTL} quit the post-lesson discussion after 10 minutes due to a team member's expressed negative attitude toward LS.

4.2.2 Additional topical thread with the learning goals

From the plan phase onwards, in two MTL teams (B_{MTL} and C_{MTL}) and the HTL team (E_{HTL}), some research activities that deviated from the research topic began to align topically with the learning goals they formulated for students. Team B_{MTL} set five learning goals that deviated from their research topic "activation and motivation" by addressing "communication skills", such as "students need to name and apply four forms of non-verbal communication". When developing the research lesson, the team planned an assignment for students to learn about communication skills, and team members observed and discussed students' communication skills. Thus, the team shifted its focus from predominantly learning how to activate and motivate students (research topic) to learning about students' communication skills (learning goals). Although the team briefly stated that students were active and motivated if they achieved these learning goals, team members did not substantiate this statement further. As a result, exactly how they investigated activating and motivating students by shifting their focus to students' communication skills remains unclear.

Teams C_{MTL} and E_{HTL} both set two learning goals, one topically aligned with their research topic and the other not aligned, with added unrelated subject matter. For example, team E_{HTL} set the learning goal "students can better understand the similarities between waves of sound and water", which added subject matter that deviated from their research topic "keeping attention during the instruction". Both teams framed some research activities according to

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additional subject matter (e.g., team E_{HTL} discussed how students learned about sound and water waves).

In contrast, team C_{MTL} showed the clearest example of topical alignment between the research topic and its other learning goal: "students learn to receive 'delayed attention'". They defined 'delayed attention' as "not reaching out to the teacher before trying out other resources first", which aligned with their research topic "executive functioning skills by using the BBB method". By reasoning how the BBB method would lead to delayed attention, which would in turn lead to enhanced executive functioning skills, the team reflected clear topical alignment with the research topic. The team discussed the use of the BBB method during the reflect phase.

4.2.3 Additional topical thread with the prepared observational data
The MTL teams and the HTL team prepared to collect observational data that topically aligned with their research topic (e.g., team E_{HTL}'s research topic was "keeping attention during the instruction", and members collected observational data related to "whether students are attentively involved during the instruction and the research lesson as a whole"). The LTL (A_{LTL}), one MTL (C_{MTL}), and one HTL (E_{HTL}) team instead prepared to collect observational data that deviated from their research topics. Team A_{LTL} did not further discuss these prepared observational data during the reflect phase, but teams C_{MLT} and E_{HTL} did. In so doing, they created an additional topical thread, starting from the prepared observational data. For example, team E_{HTL} added (1) "how the students worked together within the groups" (broad focus), (2) "whether students understood the assignment" (broad focus), and (3) "whether students shook hands with the teacher when entering the classroom" (narrow focus). These foci deviated from their research topic "keeping attention during the instruction". The team discussed the first focus extensively during its post-lesson discussion (reflect phase), which members interpreted as the role and task division between groups of students, as well as student motivation and engagement.

No teams operationalised their chosen foci, or they did so only minimally, apart from team C_{MTL}, in that the BBB method could be viewed as an operationalisation in itself. This method describes several concrete steps and behaviours that can indicate that students have delayed their demands for teachers' attention.

4.3 Exploring the relationship between topical alignment and perceived teacher learning
The team with the lowest reported teacher learning (team A_{LTL}) also clearly showed the least topical alignment in comparison with the teams that reported midlevel to higher teacher learning (teams B_{MTL}, C_{MTL}, D_{MTL}, and E_{HTL}). Team A_{LTL}'s research activities deviated from its research topic from the plan phase

onwards, which could indicate that this team experienced less teacher learning due to lack of topical alignment. Moreover, team A_{LTL} did not (fully) participate in all LS research activities, due to one member's expressed negative attitude toward LS. During the LS conversations, participants of team A_{LTL} mentioned several aspects they inherently associated with LS, such as being time-consuming and inefficient. They also mentioned more team-specific aspects, such as that they took too little time to prepare the research lesson and lacked a subject-specific research topic that would have provided a more relevant focus to individual team members. This team's minimal teacher learning thus could be attributed to these factors as well.

The MTL and HTL teams did not differ in terms of how they topically (mis) aligned their research activities: They both showed a mix of aligned and misaligned research activities with the research topic. Team D_{MTL} was the only team for which we did not observe an additional thread of topical alignment, but it displayed a similar amount of misaligned research activities in comparison with the other teams. These findings do not provide enough evidence for us to deduce whether a relationship exists between topical alignment and teacher learning.

5 Discussion and conclusion

This study had two goals. First, we aimed to gain insights into how the LS teams topically (mis)align their research activities. Second, we explored the relationship between the existence of topical (mis)alignment among LS research activities and perceived teacher learning. The following subsections discuss the findings stemming from these research goals in greater detail.

5.1 Teams' topical (mis)alignment
Our findings show that all investigated teams faced challenges regarding topical alignment, in line with prior research (e.g., Choy et al., 2017; Murata, 2021). In turn, we propose some ways to address these challenges.

5.1.1 Broad and abstract research topics
All teams chose broad, abstract research topics (e.g., motivation, keeping attention), which made concretising what the team wanted to learn about more important, as well as more difficult. Another challenge was determining what they wanted to establish and investigate regarding student learning (Cerbin, 2011). The findings suggest that broader concepts can lead teams to discuss a variety of abstract concepts, without clear links to the research topic (e.g., the research topic of team E_{HTL} was keeping attention, but they discussed how students worked together). For practice, we recommend that teams be

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encouraged to conceptualise their research topic thoroughly and focus on a specific aspect to enable comprehensibility and deep focus. Reading literature on the research topic can support this process (Choy & Lee, 2021), by making the topic more tangible. Inexperienced teams such as those in this study could particularly benefit from this type of support.

5.1.2 Focus on behavioural engagement

All teams chose a research topic related to students' behavioural engagement (Hospel et al., 2016). This choice seems logical, considering that the teams were cross-curricular, and a subject-specific research topic could impair the experienced relevance for some team members. Although investigating behavioural engagement is suitable for LS (Lewis et al., 2019), it also could have made planning a research lesson more challenging. First, most behavioural engagement problems cannot be resolved in one or even a few research lessons. Second, a subject-specific teaching and learning problem directly informs what to teach during the research lesson, whereas a behavioural engagement problem, such as motivation, does not. Team C_{MTL} was the only team that made a direct connection between the research topic and what to teach: Their research topic was "executive functioning skills", and they explicitly taught the students the BBB method to delay attention-seeking and support students' executive functioning skills (Section 4). Doing so seemed to have helped the team stay on its chosen topic. However, this team, similar to the others, still developed an assignment with additional contents to teach, unrelated to executive functioning skills. This finding is consistent with our previous work, in which we establish that the subject matter taught during the research lesson is not always related to the LS team's research topic (Uffen et al., 2022). We also note explicitly that teaching subject matter unrelated to the research topic could be necessary, especially with regard to a topic concerning behavioural engagement, but it could be helpful for teams to be aware of this concern, to help prioritize their focus. In this regard, an example can be taken from team D_{MTL}: It taught subject matter regarding mathematics unrelated to its research topic, but members did not discuss how students learned the mathematical issue. Instead, they prioritized the group dynamics, which was their research topic.

In practice, teams could benefit from incorporating behavioural engagement more directly into the matter to be taught, as illustrated by team C_{MTL}. A facilitator could support teams in formulating the concrete student behaviour they would like to observe and develop (Cerbin, 2011), which could help the teams make explicit connections between the matter to be taught and the behavioural aspects they want to develop. Furthermore, LS can be time-consuming and requires substantial cognitive effort (Fernandez & Choski, 2002), so we recommend that LS teams prioritise discussing what is related to their

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research topic, as team D_{MTL} did. By prioritising, teams can use their time in a more goal-oriented and conscious manner, which could increase participants' perceptions that LS is worthwhile. If time remains, the team can discuss additional observations unrelated to their research topic.

5.1.3 Pivotal research activities
From the plan phase onwards, all teams progressively deviated from their research topics. Notably, the students' learning goals and the foci the teams chose regarding the observational data they planned to collect steered the focus of several research activities, in such a manner that additional topical foci emerged that were parallel to the research topic focus. This progression seems logical, in that the research activities require teachers to concretise their students' learning (e.g., Dudley, 2014; Lewis et al., 2019), and LS teams can easily shift their focus to concrete and practical input during the LS cycle (e.g., Amador & Weiland, 2015; Bjuland & Mosvold, 2015; Lewis, 2016). Another possible reason the teams deviated at these points in the cycle relates to the challenges of working with a broad and abstract research topic related to behavioural engagement, as discussed previously. For practice, we recommend that teams and their facilitators pay specific attention to how the teams concretise student learning that relates to their research topic during two research activities: formulating learning goals for students and preparing the observational data.

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5.2 Topical (mis)alignment and perceived teacher learning
The LTL team showed the least topical alignment, and the other teams did not reveal a clear relationship between topical (mis)alignment and perceived teacher learning. Although we identified team E as an HTL team, it is plausible that the reported difference in perceived teacher learning between this team and the MTL teams would have been negligible if all team members had filled out the questionnaire. For example, one team E_{HTL} teacher who was vocal about not viewing LS as worthwhile during the meetings did not fill out the questionnaire. A surprising finding is that none of the teams indicated that they had learned a lot. This result could be related to the moderate topical alignment, though this explanation requires further research.

5.3 Limitations and research avenues
This study has some limitations that open possible avenues for further research. First, we measured perceived teacher learning using a seven-item questionnaire, which we analysed at the team instead of individual level. In some teams, perceived teacher learning varied, which is in line with previous research showing that individual teacher learning from LS can vary among team members (De Vries & Roorda, 2019; Skott & Møller, 2017). This variation underpins the influence of multiple variables on how teachers experience LS

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and its value in their learning. Researchers might approach such differences with more caution, such as by conducting interviews that explore the factors that influence perceived teacher learning at an individual level. Furthermore, we acknowledge that teacher learning from LS can occur in several areas, such as teachers' knowledge or norms and routines regarding professional development (e.g., Dudley et al., 2019), whereas continued research might focus on perceived teacher learning regarding the research topic.

Second, we did not analyse how participants and facilitators influenced topical alignment, because it is a new concept. Follow-up research could make participants aware of the concept beforehand. It would also be interesting to conduct stimulated recall interviews to shed light on participants' and facilitators' reasoning and perspectives on how they topically aligned their LS cycles.

Third, theoretically, topical alignment may seem straightforward to map; in practice, it is not. Several difficulties arose that compromised the repeatability and objectivity of this study (Devers, 1999). For example, participants occasionally defined a goal or question in one way but then referred to it in a different way later. In general, team members did not overtly notice or correct these changes as they occurred. Moreover, we chose to indicate topical alignment when the teams provided reasoning about how the discussed concepts interrelate (e.g., assumed relationship between involvement and adulthood), but we did not evaluate the adequacy of the reasoning. Additional research could investigate this issue. Another difficulty in interpreting topical alignment is that some crucial research activities took place outside the audiotaped meetings, such as preparing for data collection and detailed elaborations on the structure of the lesson. Thus, we are unsure whether the data provide a complete picture of all topical (mis)alignments. Nevertheless, by focusing on the available data, we provide a reasonable first exploration of topical alignment.

5.4 Conclusion

Although the relationship of LS to teacher learning requires further investigation, this exploratory study clarifies that, despite trained LS guidance, novice LS teams tend to work messily with their research activities as they progress through the LS cycle. In this study, we investigate the concept of topical alignment, which is useful for both practice and subsequent research in this area. In the future, we recommend placing topical alignment explicitly on the agenda of LS meetings. Strengthening this alignment could result in major improvements in perceptions of LS as worthwhile, because it would enable all research activities to contribute to deepening teams' understanding of their chosen research topic, resulting in more meaningful teacher learning. Building on our results, we developed Appendix E, as a potential tool for LS participants

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and facilitators to use in their efforts to uncover topical (mis)alignment at specific times during the LS cycle and thereby identify where topical alignment can be strengthened.

Notes

1. An item-level analysis did not reveal a distinctive pattern related to perceived teacher learning; the means of the items across teams are comparable, such that all teams score lower (e.g., increased subject matter) or higher (e.g., increased ability to observe students) on the same item.
2. The BBB method that team C_{MTL} mentioned refers to a heuristic that reminds students to delay asking for teachers' attention by first consulting their books (first B), then asking a neighbour (buddy, second B) for help, and only then asking teachers at their desk (bureau in Dutch, third B).
3. Important to note is that teams differ in how many research activities they conducted and how many themes and foci they discussed during, as shown in Table 3.
4. Kahoot! is a game-based online learning platform.

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Samenvatting

Blijf bij het onderwerp: inhoudelijke (mis)alignment tussen onderzoeksactiviteiten voor Lesson Study en de relatie met leerervaringen in Lesson Study teams

Lesson study (LS) is een professionaliseringsaanpak waarbij leraren in kleine teams het leren van hun eigen leerlingen onderzoeken. Leraren kiezen op basis van een vraagstuk uit hun praktijk een onderzoeksonderwerp waarover ze willen leren. Het is belangrijk dat leraren tijdens de verschillende onderzoeksactiviteiten van LS dit onderzoeksonderwerp op de agenda houden en erop voortbouwen. Dit proces noemen we inhoudelijke afstemming, in het Engels 'topical alignment'. Uit onderzoek blijkt echter dat leraren gemakkelijk afdwalen van hun onderzoeksonderwerp, terwijl wij ervan uitgaan dat als teams bij hun onderzoeksonderwerp blijven, zij betekenisvoller en diepgaander leren ervaren. In deze exploratieve studie onderzoeken we hoe LS-teams hun onderzoeksactiviteiten inhoudelijk op elkaar afstemmen, en hoe dit verband kan houden met hun ervaren leren van LS. Dit onderzoeken we door middel van audio-opnames van alle LS-bijeenkomsten van vijf beginnende teams en een vragenlijst over het ervaren leren van LS door 17 LS-deelnemers. Deze studie laat zien dat inhoudelijk afstemming creëren uitdagend is voor LS-teams en dat het van belang kan zijn om dit expliciet op de agenda van de LS-bijeenkomsten te zetten. Naast concrete aanwijzingen voor de praktijk, biedt deze studie een checklist voor LS-teams om de inhoudelijke afstemming tussen de LS-onderzoeksactiviteiten te bewaken.

Kernwoorden inhoudelijke afstemming, lesson study, leren van docenten, docentonderzoek, onderzoekend leren

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Appendix A

Research activities during LS and a fictive example of how an LS team could topically align its research activities with the research topic "substantiating viewpoints"

LS phase	Research activities	Example of topically aligned research activities for the topic "substantiating viewpoints"
Study	Choosing…	
	- long-term goal	Students become critical thinkers
	- a research topic	How students substantiate their viewpoints
	- a class	Choosing a fourth-year class that had started debate clubs
	- a subject matter goal	Students are able to substantiate their own viewpoints
	- a research goal	Learning how to support students in learning to substantiate their viewpoints
	- a research question	How does it help students support their point of view if allowed to process information about different forms of argumentation?
	- inclusion criteria case students	One student who finds it more difficult to substantiate their viewpoints, one who finds it less difficult, and one student of whom team members are not sure
	Studying curriculum and content	Studying (1) literature on fallacies and forms of argumentation and (2) available teaching materials related to argumentation, such as debate
Plan	Formulating learning goals research lesson	Students can… …explain and recognise circular reasoning and three given forms of argumentation …substantiate their viewpoints to a fellow student …explain what kind of argumentation they used
	Defining an experienced difficulty	Students predominantly use circular reasoning (e.g., "freedom of speech is important to me, because everybody should be free to say what they think")

	Activity	Details
	Overview structure research lesson	**Start** – showing a short video clip of circular reasoning, explaining why it is a fallacy, and introducing and discussing three forms of effective argumentation **Assignment** – providing statements and asking the students to first individually prepare several arguments that reflect their viewpoints about two statements. Then, in groups of three, they discuss the quality of the arguments using the information they read about fallacies and argumentation **End** – giving all students an exit ticket (short formative assessment) with the following questions: "I came to understand…," "I still have a question about…"
	Preparing data collection on student learning of case students: - observation - interview questions - additional data	**Observations** – operationalising how to recognise fallacies and effective forms of argumentation during students' speeches **Interviews** – preparing questions related to learning about students' own habits in argumentation, learned forms of fallacies and argumentation, and how the research lesson contributed to these insights **Additional data** – the exit tickets (see "end" of the lesson)
Teach	Teaching the research lesson Collecting data on student learning (optional) Re-teaching the research lesson and re-collecting data on student learning	Teach as planned Collect data as planned (optional) Re-teach as planned and re-collect data on student learning as planned
Reflect	Engaging in a post-lesson discussion: - Discussing research lesson and collected data on student learning	Discuss themes of collected data on student learning - Observational data: (1) fallacies and forms of argumentation students used and (2) how students explain to other students what they did - Data from interviews and exit tickets, focussing on how students learned about argumentation - Answer to the research question – using the discussed data
	(optional) Adjusting the research lesson	Discuss themes of adjusting the research lesson: - Explaining two most observed fallacies students used: "appeal to authority" and the "bandwagon" - How to deal with the observed difficulty of distinguishing the fallacy "appeal to authority" and the use of proper argumentation "appeal to expert opinion"
	(optional) Engaging in a second post-lesson discussion Discussing collected data on student learning	Same themes as during the first post-lesson discussion
	Reflecting on what is learned	Discuss the answer to the research question

Notes. Based on De Vries et al. (2016), Lewis et al. (2019), and Choy et al. (2017).

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Appendix B

Overview of topical decisions in each research activity per LS team on which the topical alignment is based during the study phase

Research activity	Team A	Team B	Team C	Team D	Team E
Long-term goal	No explicit decision, named concepts: Critical thinking, preparing for society, educating students, graduating, transitioning into adulthood, independence	No explicit decision, named concepts: Motivation, activation, self-regulated thinking and working, graduating	Independent, autonomous, and critical people who can maintain themselves and find their own way in society	The student feels valued, has self-respect, makes independent choices, and is aware of the usefulness of education	Offering the student what he or she needs to develop within the subject (matter) and is towards adulthood
Research topic (starting point first stream of topical alignment – alignment between research activities with the research topic – for all of the teams)	Initial: writing skills Revised: involvement of students	Activation and motivation	Executive functioning skills by using the "BBB method" (a method to learn to receive delayed attention, which is an aspect of executive functioning skills)	No explicit decision, named concepts: Group dynamics and students' insights of group dynamics	Keeping attention of students during instruction
	Revised: misaligned with long-term goal	Aligned with long-term goal	Aligned with long-term goal	Aligned with long-term goal, based on how the team explains how they think that (insight into) group dynamics lead to self-reflection: this would make student more independent, which would make them function better and feel more valued and appreciated, which would foster self-respect	Aligned with long-term goal, based on how the team explains that keeping attention of students during instruction help them develop within the subject (matter) and towards adulthood

Choosing class, choice based on…	Differentiated learning levels and teachers' knowledge of the students	Teachers know the students	Initial: diverse student population in terms self-reliance / Revised: availability (other team picked the chosen class)	Teachers know the students	Experienced difficulty by the participants with the specific class in keeping the students' attention
alignment	Misaligned	Misaligned	Initial: aligned with research topic / Revised: misaligned	Misaligned	Aligned with research topic
Subject matter goal[a] [a] Teams B, C, D, and E use the subject matter goal interchangeably with the learning goal of the research lesson.	Initial: students are able to write a short text/note to express appreciation, greetings, or good wishes / Note: no longer applicable during plan phase, and no alternative discussed	The active and motivated student	Initial: the students can **use** the BBB method / Revised: the student can **tell** what the BBB method is	1. Students are aware of the influence of their own and others' behaviour in a group 2. Students take responsibility for their own actions and behaviour	1. Offering the student what they need to make a good start [of the lesson] 2. The advancing insight into the meaning of waves (light, sound, water) in physics
alignment	-	Aligned with research topic	Revised: aligned with research topic	1. Aligned with research topic 2. Misaligned	1. Aligned with research topic 2. Aligned with learning goal
Teachers' research goal	Initial: gain insight in the pupils' involvement, as well as experiencing the feeling that we as teachers have reached all of the pupils / Note: seems still applicable during the revised LS cycle, but this is not addressed by the participants	Not specified	To gain insights into whether the students succeed in making use of the BBB method	Gaining insights into what extent students are aware of their own and others' influence on the group	See how we [teachers] can grab the attention of students and get them to work. To see how the instruction lands
alignment	Aligned with research topic	-	Aligned with research topic	Aligned with research topic	Aligned with research topic

Stay on topic: Topical (mis)alignment between lesson study research activities and its relationship with teachers' perceived learning

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Research question	Initial: 1. To what extent are we able to see whether all pupils cooperate – the involvement of pupils? 2. Is aim K7 achieved? Revised: To what extent does working with a game contribute to students' involvement? Aligned with research topic	With which teaching method can the teachers visibly activate all students during class? Aligned with research topic	In what way can a teacher teach the BBB method to students with different work engagements and learning levels? Aligned with research topic	1. To what extent does students' perceived self-image correspond to the actual state of affairs or to someone's position in a group? 2. Does an environment with other students who do want to work together stimulate or inhibit co-operation? Aligned with research topic	1. Which teaching method is suitable to get attention and to make students interested? 2. Is the chosen teaching method suitable to captivate students' attention from the start of the lesson? Aligned with research topic
Inclusion criteria for designated students	Level of involvement during class and learning level. Aligned with research topic. Learning level is misaligned	Being very active or very inactive. Aligned with research topic	Work engagement and learning level. Misaligned	Engagement towards working together and awareness of one's own and other influence on the group dynamic. Aligned with research topic	Learning level. Misaligned
Study of content and curriculum	Initial: national exam requirements are consulted. Revised: discussing existing games, however the gathered information is not used. Misaligned	Reference to a glossary with concepts related to communication. Aligned with learning goal	The BBB method is repeatedly discussed by referring to how the method is documented by the school combined with own experiences in how students use the BBB method. Aligned with research topic	Reference to a book from a psychologist about taking responsibility and self-respect. Aligned with research topic, based on the teams' reasoning how the long-term goal relates to their research topic (see research topic)	Not used. -

Appendix C

Overview of topical decisions in each research activity per LS team on which the topical alignment is based during the plan phase

Research activities	Team A	Team B	Team C	Team D	Team E
Learning goals research lesson	Initial: have pupils write a short English text, in which they reflect on whether they chose the right assignment, chose the right buddy to work with, came up with criteria; as well as on what they will focus on and what they think is important. Revised: not specified	Students need to… 1. … clearly explain what the concept of communication entails 2. … explain what verbal and non-verbal communication is 3. … name and apply four forms of non-verbal communication 4. … explain what open and closed questions are 5. … determine in which situations what questions are used	1. Students learn to receive "delayed attention" (defined as not reaching out to the teacher before trying out other resources first) 2. Students can warn people against the consequences of smoking by making a poster	Not specified during plan phase During the study phase mentioned as being the same as subject matter goal 1. Students are aware of the influence of their own and others' behaviour in a group 2. Students take responsibility for their own actions and behaviour	1. At the end of the lesson, the students better understand the similarities between waves of sound and water 2. Students take responsibility of their own learning process
	-	All: aligned with learning goal (starting point)	1. Aligned with research topic 2. Aligned with learning goal (starting point)	1. Aligned with research topic 2. Misaligned	1. Aligned with learning goal (starting point) 2. Aligned with research topic based on the teams' reasoning that making students responsible makes them more attentive during the lesson
Experienced difficulty	Not specified	Not specified	Students reach out to the teacher too soon without trying for themselves first	Not specified	Related to focus and attention: Getting the attention of students at the beginning of the lesson is difficult, before you can even start with the subject matter
	-	-	Aligned with research topic	-	Aligned with research topic

Structure of the research lesson	Initial: Start – Not specified Assignment – Students choose a specific text they want to write (e.g., a thank-you note, a card to a sick family member). The teacher provides two criteria (not specified) for the text, and students formulate additional criteria for the text themselves (lower learning level students formulate two and higher learning level students formulate three criteria). They choose a fellow student to do the assignment with End – Not specified Revised: Start – Not specified Assignment – General knowledge quiz with questions about different subjects (e.g., science, language, religion). For example: "the diameter of earth is...", "Iceland it the world's' biggest country, true or false?" End – Not specified	Start – showing a video fragment to introduce verbal- and non-verbal communication Assignment – students can choose to work individually or in groups with a maximum size of three. They have to make a vlog or PowerPoint about communication End – taking a test to check if the students reached the goals of the research lesson	Start – Teacher starts by explaining the BBB method and motivates students to use the method during class Assignment – Students have to search for at least four reasons why smoking is bad and process the information in poster. The steps of the BBB method and a guide on how to use the program Microsoft Word are provided as tools for support End - Students write down in a self-report which 'B's' of the BBB method they have used and how	Start – Giving instruction for the assignment, allocating students to pre-selected groups (criteria: students who want to work together) Assignment 1 – Students must draw up a budget for a hundred-person gala Assignment 2 – Students must figure out what information should be included on the gala invitation and provide an estimate on printing costs End – Groups share their findings with the others and the teacher provides a summary	Start – Teachers asks two students to assist in getting the class to the front to watch a video about water waves Assignment – Students form groups to make an assignment about water waves End – The assignment needs to be handed in, and the group with the most correct answers is rewarded a candy bar

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Prepared observations, foci					
Assignment: misaligned Initial: "being busy" and critical thinking Examples how operationalised: "looking up think, for example using a dictionary", "comparing text to criteria" (being busy), and "did the student made the right choices in relation to what text to write and who to work with?" (critical thinking) Operationalised: student looking up information Revised: multiple foci, for example: - skilled in English/Dutch - skilled in use of computer - being withdrawn - not being active - not being interested - positive engagement	**All: aligned with learning goal** Active behaviour Operationalised: eye contact between student and teacher Note: during the earlier study phase, the participants did mention multiple operationalisations of active behaviour. However, it is unclear how they used these insights in the actual preparing of the observations	**Start and end: aligned with research topic** **Assignment: aligned with both research topic and learning goal** 1. How students use the BBB method 2. Whether the student has the capability to search for information 3. Whether the student reads the assignment 4. Whether assignment is carried out in English or Dutch Operationalised foci: Focus 1: the chosen BBB method can be viewed as an operationalisation of delayed attention in itself Focus 2: no operationalisation Foci 3 and 4 are so narrow that they can be viewed as an operationalisation of their own accord	**Start: aligned with research topic** **Assignments 1 and 2, and end: misaligned** 1. Which student takes on a dominant or passive role 2. If and how groups worked together 3. If and how tasks were divided among group members 4. Comparing observations between the first and second assignment	**Start: aligned with both research topic and learning goal, based on the teams' reasoning that making students responsible (by making students assist during class) makes them more attentive during the lesson** **Assignment and end: aligned with learning goal** 1. Whether students are attentively involved during the instruction and the research lesson 2. Whether and for how long the students remain attentive during the research lesson 3. How they work together within the group 4. Whether students understand the assignment and know what to do 5. Whether students shake hands with the teacher when entering the classroom Operationalised foci: Foci 1 and 2: whether students talk during instruction, have questions, and come to the front themselves during the introduction video or should be brought forward Focus 3: which groups they form Foci 4 and 5: no operationalisation

	Case 1	Case 2	Case 3	Case 4	Case 5
Prepared interview questions	Misaligned No explicit choices are made Some examples are mentioned: "How did you like this? Did you learn from this? What did you like about it?"	Aligned with research topic Not specified	Foci 1, 2, and 3: aligned with research topic Focus 4: aligned with prepared observational data (starting point) General interview questions practical guide	All: aligned with research topic 1. General interview questions practical guide 2. Additionally constructed questions to gain insight into group co-operation and awareness of their own and others' influence in a group	Foci 1 and 2: aligned with research topic Focus 3: aligned with prepared observational data (starting point) Foci 4 and 5: misaligned Unclear. Interview questions seemed to have been formulated outside of the meeting Some examples are mentioned during the plan phase: "How was the role-division? Who knew the most answers? Did you provide input yourself?"
Prepared additional data	Misaligned -	Not specified The test at the end of the research lesson is used to check whether the students achieved the learning goals	Misaligned Gathering lesson material: students' self-reports on whether and how they used the three 'B's' of the BBB method Note: not referred to during the reflect phase	General questions: misaligned Additional questions: aligned with research topic Collecting additional data before the first research lesson to inform the groups: Sociogram to fill out by all the students relating interpersonal relations among students Questionnaire to fill out by all the students within the class and engagement towards working together	Examples are all aligned with both the research topic and the learning goals Not specified
	- Aligned with learning goals	Aligned with research topic	Both: aligned with research topic	-	

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Appendix D

Overview of topical decisions in each research activity per LS team on which the topical alignment is based during the reflect phase

Research activities	Team A	Team B	Team C	Team D	Team E
First post-lesson discussion Themes discussed relating the research lesson and data on student learning	1. Students' participation 2. Use of resources by students	1. Students' position on the axis at the start and end of the lesson in terms of "high-low activity", not further specified 2. Students' (active) participation 3. How the students executed the assignments 4. With whom the student worked 5. General feedback on the research lesson by the students (e.g., difficulty of the lesson, whether they liked it)	1. How the BBB method is used 2. In which language the assignment is carried out 3. Students' participation	1. Group dynamics (e.g, how well students worked together, to what extent they were aware of group dynamics, whether they took on an active or passive role within their group) 2. Students' perceived self-image and group functioning in relation to the actual state of affairs 3. Time management (e.g, assignment took longer to finish)	1. Attention of students during the introduction video 2. Whether the working method worked to reach the learning goal related to the subject matter 3. How students formed groups and divided roles and tasks 4. Motivation/engagement of students 5. Whether students needed support during the lesson 6. How the two students experienced leading the introduction of the research lesson 7. Roles and tasks of LS participants (e.g., whether teacher must intervene in case of disruptive behaviour, difficulty with observing due to lack of operationalisation)

	Theme 1 and 2: misaligned	Themes 1 and 2: aligned with research topic Theme 3: aligned with learning goal Themes 4 and 5: misaligned	Theme 1: aligned with research topic Theme 2: aligned with prepared observational data Theme 3: misaligned	Themes 1 and 2: aligned with research topic Theme 3: misaligned	Theme 1: aligned with research topic Theme 2: aligned with learning goal Themes 3 and 4: aligned with prepared observational data Themes 5, 6, and 7: misaligned
First post-lesson discussion Themes adjusted in the research lesson	The team decided to quit the LS cycle, so no second research lesson was prepared or given	1. Adjusting the introduction of the research lesson, for example, assuring the students that their final product will not be shown in class and explaining why the research lesson is different than a normal lesson 2. Provide instruction manual for Kahoot! 3. Small practical adjustments to the PowerPoint, for example, also writing down the instruction instead of only saying it	1. Dividing the goal of the lesson in two separate goals: (a) students can explain the BBB method and (b) students can use the BBB method 2. Emphasis on reading the instruction for students 3. Creating an in-between moment for students to check whether they meet the criteria of the assignment 4. Time management by the teacher	1. Time management 2. Second assignment is going to be a non-digital assignment (collage) 3. Assignments are to be done in smaller groups 4. Providing some students with feedback on their role, self-awareness and group-awareness, so that they are able to reflect and learn from this	1. Integration of something that attracts attention (teacher wearing a bear costume) 2. Students get distinctive roles and tasks during the group assignment in relation to responsibility by the students 3. Teachers' role (the teacher intervenes in case of disruptive behaviour)

–	Misaligned	Themes 1 and 2: aligned with research topic / Theme 3: aligned with learning goal / Theme 4: misaligned	Themes 1, 2, and 3: misaligned / Themes 3 and 4: aligned with research topic, regarding theme 3: based on the teams' reasoning that they can influence group dynamics by placing students in smaller groups	Theme 1: aligned with research topic / Theme 2: aligned with both research topic and learning goal / Theme 3: misaligned
Second post-lesson discussion / Themes discussed relating the research lesson and data on student learning	–	Same as the first post-lesson discussion	1. How the students used the BBB method 2. How the students understood the BBB method 3. What language is used during the assignment 4. Whether the criteria are met for the assignment (subject matter related) 5. Students' focus during the lesson 6. Role of the teacher	1. Group dynamics (e.g. how well they worked together, role division, and how the designated students fit in the group) 2. Students' perceived self-image and group functioning in relation to the actual state of affairs	1. Effectiveness of wearing a bear costume in relation to captivate attention 2. Role division within groups – no focus specified 3. Students' experience of the teacher's instruction– no focus specified 4. Students' experience of the working method – no focus specified 5. Clarity of the assignment
–	Same as the first post-lesson discussion	Themes 1 and 2: aligned with research topic / Theme 3: aligned with prepared observational data / Theme 4: aligned with learning goal / Themes 5 and 6: misaligned	Themes 1 and 2: aligned with research topic	Theme 1: aligned with research topic / Themes 2, 3, 4, and 5: misaligned	

Second post-lesson discussion	-	Not specified	Not specified	Not specified	Not specified
Themes adjusted in the research lesson				
Reflecting on what is learned	1. Prepare better and try out [the research lesson] first	1. Providing content during the research lesson that is unknown to students 2. LS is about the process, the collaboration with teachers, and observing education 3. A reminder to observe students more during daily practice, due to the realisation that you cannot oversee everything when you are teaching 4. Letting students chose between working individual or in groups sometimes motivates and activates them more and sometimes less	Not specified, teachers are asked to reflect in their own time as they ran out of time	Not specified	Unknown, discussed in an unrecorded meeting without presence of the facilitator
Discussed themes	Misaligned	Themes 1, 2, and 3: misaligned Theme 4: aligned with research topic	-	-	-

Appendix E
Checklist for analysing and tracking topical alignment during LS

LS phase	Research activities	Short description of made topical decisions	Questions in support of topical alignment
Study	Choosing...: a long-term goal a research topic a class a subject matter goal a research goal a research question inclusion criteria case students		How did we concretise our research topic? Is our research topic related to behavioural engagement or subject matter? When related to behavioural engagement: what exactly do we want the students to *learn/develop* concerning the behavioural engagement? Did we choose a feasible and comprehensible research topic? Did we clearly state what we want to learn relating to the research topic? Is LS suitable for our question? Did we choose a class and inclusion criteria case students related to the research topic?
	Studying curriculum and content		What do we need to study to learn more about our research topic? (Optional) Can we ask an expert (*knowledgeable other*) on our research topic for help?
Plan	Formulating learning goals research lesson		Does the learning goal pinpoint concrete student behaviour related to our research topic?
	Defining an experienced difficulty		What do the students find difficult in relation to our research topic?
	Overview structure of the research lesson		Is the research lesson designed in such a way that it reasonably should evoke the desired student behaviour and learning as formulated in our learning goal? How does the research lesson evoke this behaviour? If not, how can we change the research lesson?

	Activities	Questions
	Preparing data collection on student learning of designated students: observation interview questions additional data	What do students say, do, write or draw when reaching the learning goal? When teaching the research lesson, is it likely that they will show these behaviours? Why? At what points will (the case) students respond differently to the research lesson? Why? Will the interview questions provide for data that will actually contribute to answering the research question? How? Do the additional data actually contribute to answering the research question? How?
Teach	Teaching the research lesson Collecting data on student learning (optional) Re-teaching the research lesson (optional) Re-collecting data on student learning	Did we make a detailed lesson plan? Did we make a detailed instruction on how to collect the data?
Reflect	Engaging in a post-lesson discussion: Discussing collected data on student learning (optional) Adjusting the research lesson	Is our focus on discussing data on student learning that will help answering our research question? Are the collected data on student learning helpful in answering the research question? Do we have to make improvements in how we collect the data as well?
	(optional) Engaging in a second post-lesson discussion Discussing collected data on student learning	Do we focus predominantly on adjustments made to the research lesson that align with our research topic?
	Reflecting on what is learned	What is the answer to our research question?

Notes. Based on De Vries et al. (2016), Lewis et al. (2019), and Choy et al. (2017).

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