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How to Make Lesson Study Work in a One-Year University-Level Initial Teacher Education: Conditional Input Factors, Challenges, and Suggestions

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Abstract: Lesson Study (LS) is a methodology that enables student teachers (STs) to gain insights into their pupils' learning processes during their practicum, thereby improving their instructional practices and supporting their professional learning throughout teacher education. However, "time" has emerged as a critical factor for the successful implementation of LS, particularly within the context of a one-year university-based initial teacher education program. To address this challenge, an integrated LS model was designed and implemented within the curriculum, specifically in relation to a thesis component and the practicum experience. This model was evaluated with a focus on professional learning, with the aim of fine-tuning the conditional input factors necessary for its effectiveness. The conceptual framework of Kager guided this evaluation, identifying input factors across three levels: compositional (team level), structural (LS process level), and contextual (organizational level). STs were consulted through questionnaires, individual interviews, and focus group discussions to explore which factors at these three levels either enhanced or hindered their professional learning. In addition, a document analysis of the thesis projects was conducted to triangulate the findings. The results indicate that the three levels interact and mutually influence each other. At the compositional level, interpersonal dynamics—such as trust, dysfunctional collaboration skills, and open communication—as well as limited teaching experience, prior knowledge, and group composition, were found to impede professional learning. At the structural level, STs reported time pressure due to the duration of the entire LS cycle, and some LS groups failed to make sufficient use of the provided tools and support, suggesting a limited understanding of LS. At the contextual level, misalignments in support systems created difficulties for STs in navigating and planning the LS process. This study sheds light on the complex interplay between team composition, contextual support, and structural guidance in the implementation of LS within a one-year university teacher education program. It further provides practical recommendations for improving the integration of LS into the curriculum in order to enhance STs' professional learning and overall engagement with the LS process.

Keywords: Lesson Study, initial teacher education, conditional input factors, learning processes, recommendations

1. Introduction

Learning to teach is complex and often an individual endeavor [1]. Student teachers (STs) are frequently lacking in experience and thus often find the transition to classroom practice to be a very stressful and frightening process [2]. During initial teacher education (ITE), STs are trained to adopt an inquisitive attitude, evaluate their teaching, and reflect critically on their practice [3].

The efficacy of Lesson Study (LS) in fostering collaborative and research learning and reflection among (student) teachers has been substantiated by empirical evidence [4, 5].

Deriving from Japan, LS represents a method of collaborative professional development that places a premium on classroom research, teaching, and curriculum development [6, 7]. While LS is predominantly utilized in primary and secondary education, studies have demonstrated its efficacy across all levels of education [8]. Furthermore, this approach has become increasingly prevalent in higher education [7, 10]. It has been demonstrated in enhancing the perceptions of STs regarding the teaching profession [11]. Moreover, it has been found to satisfy the criteria associated with effective teacher preparation [12]. LS has been demonstrated to facilitate the development and refinement of skills in cooperative learning, enquiry, teaching, observation, and reflection in STs, thereby linking theory to practice [7, 9].

While the integration of LS in ITE is an encouraging development, it has also given rise to a number of challenges, including a lack of prior knowledge and teaching experience among STs, effective planning and scheduling so that no time is lost in this administration, and the provision of more lead time for the benefit of LS implementation [7]. Consequently, in their 2024 study, Tan and colleagues call for a comprehensive investigation into the integration of LS in ITE programs. Mayorga Fernández et al. [13] further suggest that successful integration of LS is best based on STs' experiences aligned with the university curriculum.

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The present study thus seeks to ascertain the optimal conditions for the implementation of an LS model within the context of a one-year ITE program at a university, integrated into the internship and practical thesis. This will entail the utilization of the experiences of STs during their involvement in this integrated LS design.

This study contributes uniquely to the growing body of literature on LS in ITE by investigating its integration within a condensed, one-year university-based ITE program. Unlike prior research that often focuses on LS in extended or stand-alone formats, this study explores a fully integrated LS model embedded within both the internship and the master's thesis trajectory. Drawing on the conceptual framework of Kager, it examines the conditional input factors at the compositional, structural, and contextual levels that either facilitate or hinder professional learning among STs. By triangulating STs' perceptions with an in-depth document analysis of their theses, this study offers a nuanced understanding of how these interacting levels shape the effectiveness of LS. In doing so, it addresses key implementation challenges and provides empirically grounded insights and practical recommendations for the sustainable integration of LS in fast-track teacher education curricula.

2. Theoretical Framework

2.1. Factors and preconditions influencing the success of Lesson Study

Since the publication of The Teaching Gap [14], LS has gained international popularity [10, 15]. It entails teachers working collectively to enhance their pedagogical practice [14]. The LS process commences with the team undertaking a review of the teaching materials, establishing the lesson objectives, and formulating a research lesson (RL) goal. Subsequently, an RL is designed with a specific focus on pupil learning. One team member implements the RL, while others observe and collect data on pupil thinking. Subsequently, the team engages in reflection on pupil responses and deliberation on the potential implications of their findings for future lessons [5, 16].

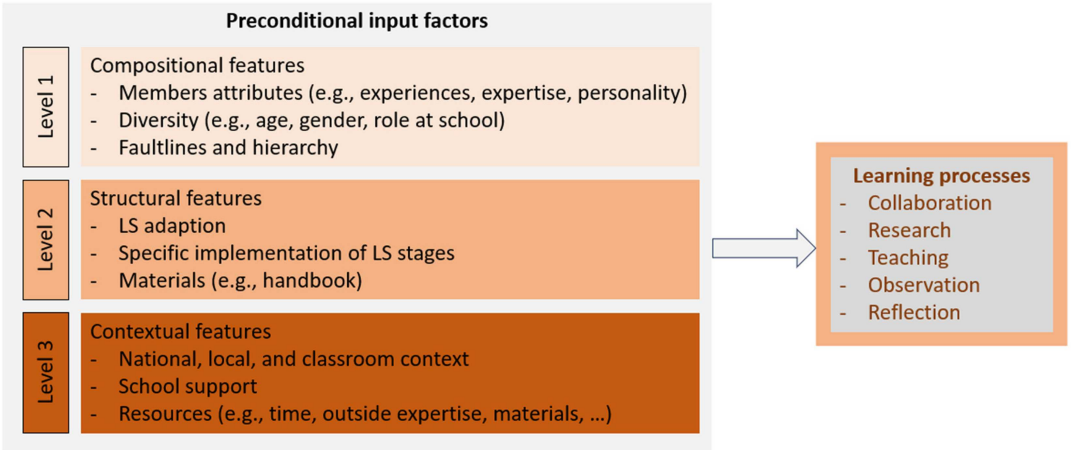
The implementation of LS can be complex due to a number of factors, including time, high workload, anxiety about being observed, lack of administrative support, and challenges in understanding and executing the LS cycle [5, 13, 16].

de Vries et al. [5] identify three categories of conditional factors that influence the success of LS: (1) the teacher's prior knowledge and skills; (2) their intention, including their attitude and expectation concerning the outcome of LS, which is also influenced by their sense of self-efficacy; and (3) other preconditions. These additional factors may include the provision of support and organization for LS, interpersonal and intrapersonal elements such as the level of trust, safety, and friendship, and school-based factors such as the time allocated, endorsement from school leadership, and alignment with broader school objectives.

In a recent contribution to the field, Kager et al. [17] devise a comprehensive conceptual model of teacher professional development through LS. In this model, the conditional factors proposed by de Vries et al. [5] have been rearranged, further complemented, and categorized into different features, based on the literature. Similar to de Vries, these input factors are defined as preconditions for effective LS implementation. These are organized into three distinct groups: compositional (level 1), structural (level 2), and contextual (level 3) (see Figure 1 [17]). The compositional group (level 1) describes the teachers of an LS group and how they function as a team. The model includes the following characteristics of LS team members: (a) teaching experience, expertise (referred here to prior knowledge and skills by de Vries et al.) and personality (referred to as interpersonal and intrapersonal characteristics by de Vries et al.); (b) diversity, for example, age and gender; and (c) faultlines and hierarchies creating subgroups (de Vries et al. refer to the roles or functions of the school participants). Furthermore, both models identify participants' attitudes and beliefs, motivation, and willingness or intention as crucial factors influencing collaboration within LS groups. The preconditions, LS features, support, and school organization described by de Vries as "other preconditions" are also included in Kager's model across the structural and contextual groups. The structural group (level 2) encompasses the adaptation of the LS method, the particular implementation of LS phases, and the provision of supporting materials. The contextual group (level 3) pertains to the educational organization, the school and classroom context, the support received from school mentors or leaders, and the resources available, including time, planning, space, guidance, the quality of the teaching materials, and access to external expertise and LS facilitators.

In their conceptual framework, Kager et al. [17] identify the professional learning of LS participants as processes of

Figure 1
Preconditional input factors and learning processes based on the comprehensive conceptual framework of continuous professional development through Lesson Study



collaboration, research, teaching, observation, and reflection. These learning processes are driven by the preconditional input factors from the framework and are recognized as important competences for STs, as shown in References [2, 3, 18].

2.2. Lesson Study in initial teacher education

A review by Kanellopoulou and Darra [19] on the impact of LS in ITE elucidates the benefits and challenges for efficacious implementation. The benefits for STs include enhanced subject-specific and pedagogical knowledge, augmented collaborative and reflective abilities, and favorable alterations in active learning through the process of planning, teaching, observation, and reflection.

However, the study also identifies a number of challenges and related preconditions, including an insufficient focus on pupil learning, gaps in subject knowledge, stress resulting from limited teaching experience, and poor observation and reflection skills [19]. Additional challenges include fatigue from workload, scheduling, and administrative and logistical issues [7] and inadequate support from ITE programs [4].

The implementation of LS is also significantly affected by time constraints, resulting in a reduction in understanding of key LS features and difficulty in identifying guidance as consequences [4, 13]. Furthermore, organizational issues impede the implementation of LS in ITE, resulting in its prevalence in longer programs over shorter one-year courses [20].

In their seminal work, Tan and colleagues [7] identified a number of LS approaches in ITE, including Practicum-Centered, University-Centered Collaboration, and Heterodox. The Practicum-Centered approaches are comprised of three forms: STs work in collaboration with school-based mentors and teacher educators provide support, STs work with teacher educators, and STs work independently. The University-Centered Collaboration approaches include the planning of the RL at the university and its subsequent conduction in school (or reteaching in university), peer micro-teaching LS, peer-teaching in university, and then conducting in school or in university with pupils. In order to accommodate time constraints, ITE programs use the Heterodox approaches including adapted practicum, partial LS, and joint workshops [7].

Jhang's [21] study identified a positive correlation between the attitudes of LS participants toward self-development and their motivation for both full and partial LS participation. Furthermore, the study indicated that learning outcomes, such as competence, subject knowledge, and instructional skills, are associated with full participation, and voluntary involvement enhances engagement. This presents a challenge for ITE providers, who must decide whether LS participation should be voluntary or compulsory and whether the LS cycle should be completed partially or completely and for what purpose. The evidence suggests that voluntary participation is associated with greater engagement, while full participation is linked to more positive learning outcomes.

The integration of the LS model into the internship and the participation of STs in a full LS cycle are both central components of this research. These reflect the application of insights from existing literature [4, 7, 13, 20, 21]. The decisions made in this study address several challenges commonly encountered in LS implementation in ITE, including fatigue related to workload and time pressure, as well as difficulties with planning and executing RL in real classroom settings.

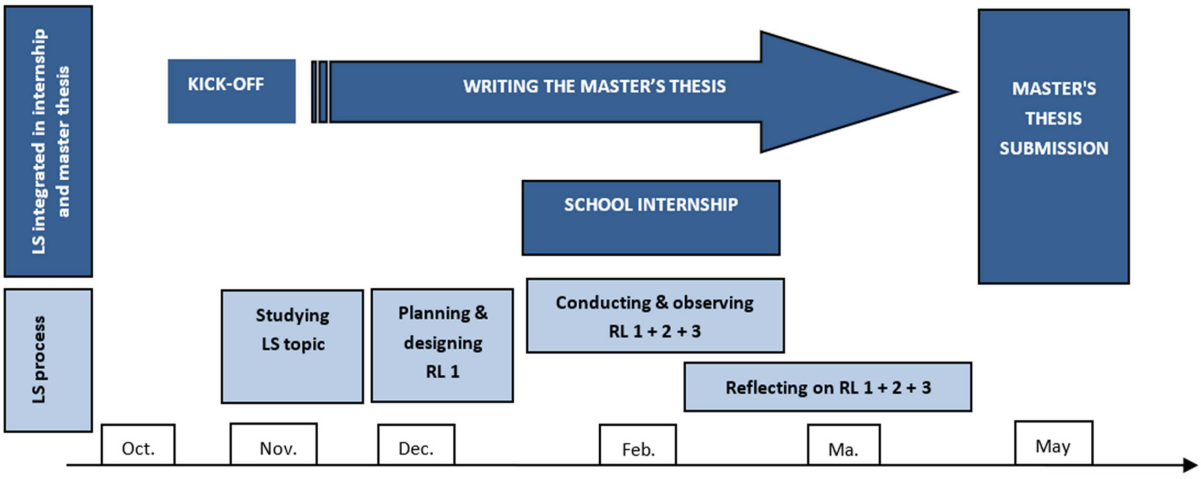
2.3. Integration of Lesson Study in a master's thesis

The Integrated Lesson Study (ILS), which encompasses the entire LS cycle and is conducted on a voluntary basis during the internship phase of the training program, is documented and reported in the master's thesis upon completion (Figure 2). It is asserted that this approach offers a number of advantages that address the key challenges highlighted in the existing literature. Specifically, the approach facilitates time consolidation for the LS teams by integrating research on the LS research topic into the li-terature component of the master's thesis. Furthermore, the three RLs are structured as internship-based lessons, reducing the overall workload. The formation of LS teams has been demonstrated to encourage collaboration while simultaneously reducing the individual time investment required for thesis-writing. The involvement of a university subject teacher to oversee the master's thesis and the LS process, in conjunction with the provision of an LS manual, ensures the integration of theoretical and practical elements while fostering a supportive and stimulating learning environment [7].

3. Research Questions

Bryk [22] proposes that in order to optimize the efficacy of new implementations and methods, it is most fruitful to identify the

Figure 2
Timetable of the Integrated Lesson Study during a one-year university-level ITE program



features and conditions that necessitate adaptation or enhancement. As such, in order to identify the characteristics that improve the efficacy of the ILS model, the following research questions (RQs) are tackled, in alignment with the Krager Framework:

RQ1: What compositional characteristics at the level of the LS team members are perceived as both constraining and supportive?

RQ2: What structural characteristics at the level of the LS process are perceived as both constraining and supportive?

RQ3: What contextual characteristics at the level of the organization are perceived as both constraining and supportive?

With the obtained insights, this study will be able to assess the optimal conditions for implementing an ILS model within the context of a one-year university-level ITE program.

The study was conducted by the first author, who did not participate in the ILS.

4. Research Methodology

4.1. ILS implementation for this study

The study was conducted at a one-year university-level ITE program in Belgium, between October and June.

In Europe, the LS model, as proposed by Dudley [23], is the most prevalent model among researchers and practitioners alike [24]. As illustrated in Figure 3, Dudley's framework [23] underwent three minor modifications to align it with the academic framework of a university ITE program. Initially, at the commencement of the LS process, the STs identify a shared need or interest rather than a specific problem, given their limited teaching experience. The process commences with the joint planning and design of the RL, which is subsequently conducted and observed with a focus on the case pupils. In this phase, one ST assumes the role of teacher, while the other ST assumes the role of observer, collecting observation data. The third stage involves conducting interviews with the case pupils and additionally administering a class questionnaire, a second adaptation, to achieve triangulation of data. The collaborative development of a teaching method enables the STs to vary in terms of content, schools, class levels, and class groups. The final stage of the process is to discuss the data collected to revise the RL. The third adjustment is to share the results in the master's thesis.

During the kick-off meeting held in October, the participants were provided with details regarding the LS framework, the implementation timelines, and the interim deadlines. Furthermore, the participants were apprised of the details pertaining to the internship and the master's thesis. The handbook by Bodvin et al. [24] was recommended as a valuable resource for those implementing LS, offering guidance, tools, and templates, which is in line with the literature [7].

Support was provided at pivotal points throughout the process, including the initial meeting, an online feedback session on the LS framework and RL planning, written interim feedback on RL plans and evaluations, and thesis feedback, which aligned with the 2024 study by Tan and colleagues [7].

In their master's thesis, the STs provide a comprehensive and detailed account of the LS cycle, commencing with a literature review on their selected topic and an examination of the specific research goal. Additionally, they offer a nuanced analysis of how they addressed the research goal through the LS form. Furthermore, they provide a description of the lesson content; the selection and profile of the case pupils; the school context; the LS format and its progression, including interim adjustments; and a detailed analysis of the results, both for the pupils and for themselves. Support materials, such as templates for lesson plans, interview guides, and pupil questionnaires, were made available. The thesis was handed in at the end of May and assessed according to the ITE program assessment criteria.

4.2. Participants

The ITE program can be taken either as an intern or as a teacher-in-training. One of the key features of the program is its flexibility, allowing students to combine their studies with their work and, if necessary, spread the duration of the program over several

Figure 3
Lesson Study model with three modifications for a university ITE program

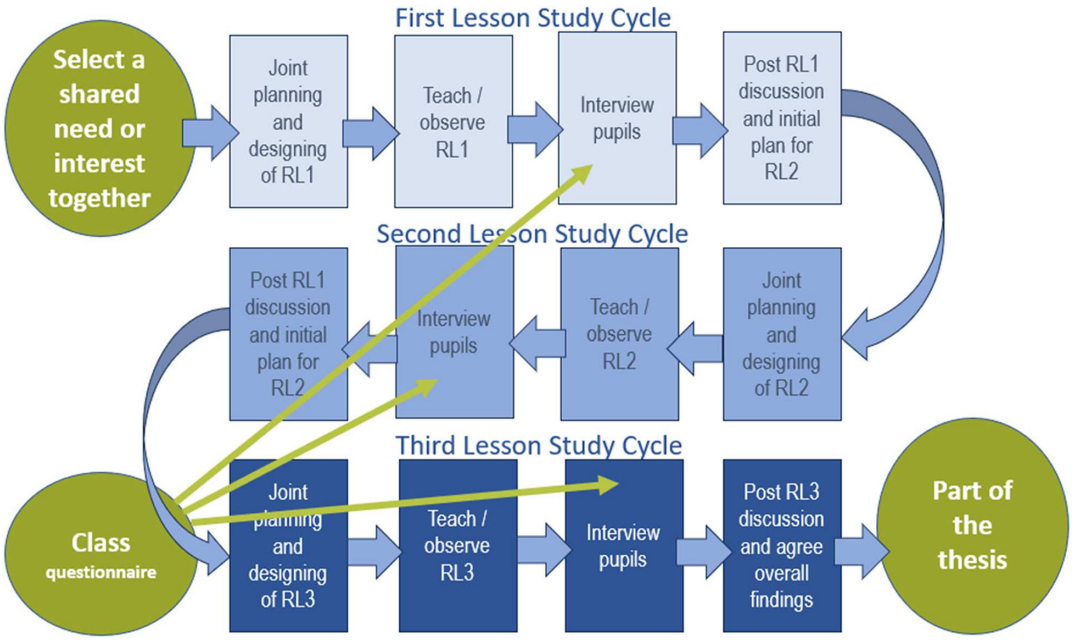


Table 1
Biographic information of participants

LS teams (*)		Student profile	Teaching exprience (years)	Spread training (years)	Subject specific didactics
1	Emilia	Intern	0	1	Economics
	Elisabeth	Teacher-in-training	2	2	Mathematics
2	Jerry	Intern	0	1	Chemistry
	Tommy	Teacher-in-training	2	3	Physics
3	Sting	Intern	0	1	French
	Lisa	Intern	0	1	French
4	Cor	Intern	0	1	Economics
	Chris	Intern	0	1	Economics

(*) names of participants are pseudonyms

years. Two students, both teachers-in-training, spread their teacher training course over two or three years (see Table 1).

The study employed the case study method, which is particularly well-suited to exploratory research [25]. A total of eight participants, comprising three women and five men, took part in the study as volunteers. The participants were randomly paired in small teams to facilitate the development of essential skills, including collaboration, research, teaching, observation, and reflection.

The participants exhibited a range of levels of teaching experience. Six were at the initial stage of their training and lacked prior teaching experience, while the remaining two had two years of teaching experience. The STs represented a range of subject areas, including economics (N=3), French (N=2), mathematics (N=1), physics (N=1), and chemistry (N=1).

4.3. Data collection and analysis

4.3.1. Data sources, instruments, and analytical strategy

As illustrated in Figure 4, data were collected over a period from mid-January to the end of May in order to answer the three RQs, using a variety of methods. The use of multiple sources serves to enhance the reliability of this exploratory case study [25]. The use of focus group discussions and document analysis of the master's theses helped validate the findings from interviews and questionnaires, ensuring that the interpretations and conclusions were confirmed with participants and that the results are both consistent and relevant.

Following the completion of the LS phase planning and designing of the first RL, the first questionnaire was distributed to LS participants. The objective of this questionnaire was to ascertain the participants' expectations, intentions, and feelings of self-efficacy with regard to four key areas: (1) their collaboration within the LS team, (2) their allocation of work and time, (3) the support and guidance, and (4) their professional development with regard to observation and reflection skills, as well as subject, didactic, and pedagogical knowledge, in support of their teaching. The questionnaire comprised multiple-choice questions, open-ended questions, and items on a five-point Likert scale.

In order to identify changes in professional learning processes, including collaboration, teaching, observation, and reflection, an in-depth interview and a second questionnaire, similar to the first, were administered at the conclusion of the entire LS cycle.

The objective was to ascertain which preconditions were constraining and supportive of these processes. The comprehensive background information presented in Table 1 was also obtained through the administration of Questionnaire 2.

To obtain additional information and well-founded arguments on the one hand, and to validate the findings of the in-depth

Figure 4
Timetable data collection

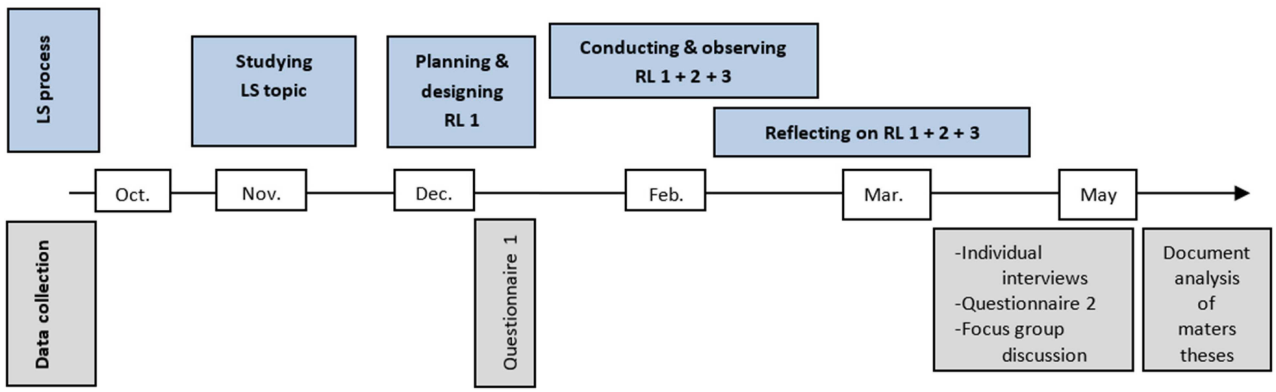


Table 2
Excerpts drawn from the coding framework, organized according to level

(Sub)codes	Questionnaire 1	Interviews	Questionnaire 2	Focus group discussion
LEVEL 1: COMPOSITIONAL CHARACTERISTICS				
Diversity of the team members (age, gender, intern or teacher-in-training, subject-specific didactics)	Question 0 Background I am conducting this LS as ○ A teacher-in-training ○ An intern	Question 0 Please indicate to what extent age or gender were factors that influenced the decision to collaborate.	Question 1 – 2–3 Background ○ Name ○ Age ○ Subject-specific didactics	Question 1A LS is for experienced teachers and not for interns. Is that right?
LEVEL 2: STRUCTURAL CHARACTERISTICS				
LS model and the number of RLs	Question 3 Please indicate the extent to which you expect LS to have an impact on the following aspects. (Likert scale: 1 = strongly agree; 5 = strongly disagree): ○ A higher workload in the context of my internship or classes	Question 10 In question 3, you indicated [...] at 5 for a higher workload in the context of your internship / own teaching practice as an ST. . . . Looking back on this, is this still true? Can you explain this or give an example?	Question 15 Which LS figure did you use for your master's thesis and for learning about the LS circle?	Question 6 The kick-off, that is, introduction to LS, in the form of an online presentation, came too late.
LEVEL 3: CONTEXTUAL CHARACTERISTICS				
The available time and planning of the internship	Question 6 In total, how much time do you estimate you will need to spend on debriefing and reworking your RL? For example, ○ I estimate that the first/second/third debriefing with my LS partner will take [...] hours. ○ I estimate that the first/second/third reworking of my RL will take [...] hours.	Question 6 How much time did you spend effectively reworking your lessons? To what extent was this within your expectations? To what extent did your expectations agree with reality?		Question 7 To what extent did the planning and timing of the three RL fit within the internship? What would you like to adjust?.

interview and the second questionnaire on the other, a focus group discussion was organized and further cross-referenced in documents, as in the theses.

The data were subjected to deductive analysis, employing a comparative approach to identify constraining and supportive factors. In order to achieve this, the data were (sub)coded with the RQs in mind and in accordance with the preconditional input factors of the comprehensive conceptual frameworks of Kager et al. [17]. The data were organized at three levels: the level of the compositional characteristics, the level of the structural characteristics, and the level of the contextual characteristics.

In the present study, each question and statement was linked and (sub)coded within the framework of Kager to identify the conditional factors mentioned by the LS participants. This process resulted in the establishment of a comprehensive coding framework, characterized by a clear delineation of the (sub)codes and data sources employed, as illustrated in Table 2. The coding framework facilitated the identification of links between data and codes.

Table 3
Alignment of research questions and data sources

Research Question	Focus	Data Sources
RQ1 – Compositional characteristics	Team composition, relationships, prior knowledge/experience	Questionnaires 1 and 2, interviews, focus group discussion, reflection notes from the thesis
RQ2 – Structural characteristics	LS process design, time use, tool support, role division	Questionnaire 2, interviews, focus group discussion, thesis analysis
RQ3 – Contextual characteristics	Organizational support, curriculum integration, scheduling	Interviews, focus group discussion

4.3.2. Alignment of research questions, data sources, and coding framework

To ensure conceptual coherence and methodological transparency, each of the three RQs was explicitly aligned with one or more data collection tools, as presented in Table 3.

1) RQ 1 focuses on compositional characteristics at the level of the LS team (e.g., team composition, interpersonal relationships, prior experience). This question was primarily addressed through questionnaires 1 and 2, in-depth interviews, focus group discussion, and document analysis of the master's theses reflection notes.
2) RQ 2 examines structural characteristics of the LS process (e.g., use of tools, LS understanding, number of RLs) and was informed by data from questionnaires 1 and 2, interviews, focus group discussion, and document analysis of the master's theses.
3) RQ 3 explores the contextual characteristics at the level of the broader organizational setting (e.g., time management, curriculum alignment, support systems, scheduling issues). This question was addressed through questionnaires 1 and 2, interviews, and a focus group discussion, allowing for a cross-case perspective on the interactions between levels.

These insights enabled the study to assess the optimal conditions for the implementation of an ILS model within the context of a one-year university-level ITE program. Notably, the study was conducted by the first author, who remained external to the ILS process, thereby reducing bias in data collection and interpretation.

In the subsequent analysis phase, each question and statement from the data collection tools was linked and (sub)coded using the conceptual framework of Kager et al. [17], with the aim of identifying the conditional input factors perceived as either supportive or constraining by the participants. This process resulted in a comprehensive coding scheme, in which the subcodes were clearly organized according to the three conceptual levels: compositional, structural, and contextual. Table 2 presents an overview of this coding framework and the corresponding data sources, facilitating transparency in how empirical data were analyzed in relation to the conceptual model.

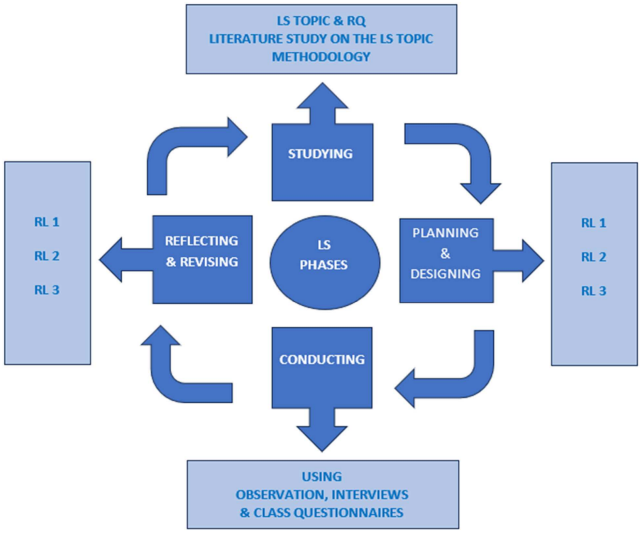
As part of the data triangulation strategy, a structured document analysis of the students' master's theses was conducted. This process is described in more detail in the following subsection.

4.3.3. Integration of the LS cycle into the master's thesis trajectory

Figure 5 illustrates how the document analysis of the master's theses was conducted, showing how each thesis reflects the full LS cycle as integrated into the ITE program. These practice-oriented theses are structured to cover each phase of the LS cycle. The LS phase of "studying" corresponds to the selection of the LS topic, the formulation of the LS research question, the literature review, and the methodology. The phase of "planning and designing" relates to the development of the three RLs, including their revision or adjustment based on reflections, as elaborated in phase 4, "reflecting and revising." Phase 3 refers to the actual implementation of the RLs in practice, utilizing observations and interviews—in line with Dudley's LS framework [23]—as well as class questionnaires, following Bodvin's recommendations [24].

The subsequent sections present the results of this study, obtained through the application of a coding framework and multiple data sources.

Figure 5
Integration of the Lesson Study cycle into the master's thesis trajectory



5. Results

This section presents the findings of the study in relation to the three RQs, which address the conditional input factors influencing the implementation of the ILS model: compositional (RQ1), structural (RQ2), and contextual (RQ3) characteristics. To support readability and navigability, a brief summary of the key findings across the three levels is provided below.

1) Compositional factors include team composition, prior teaching experience, interpersonal dynamics, and motivation. Effective collaboration was found in teams with balanced subject expertise and experience levels, while interpersonal trust and clear expectations supported meaningful peer learning.

2) Structural factors relate to the understanding and implementation of the LS process. Teams that adhered closely to the LS manual demonstrated higher process fidelity and more effective data use. Tools, digital templates, and training supported engagement, while flexible adaptations (e.g., two RLs instead of three) helped address time constraints.

3) Contextual factors encompass institutional support, scheduling, and alignment between university and school expectations. Supportive mentoring and access to resources enhanced implementation, but misalignments in scheduling and workload created stress, particularly for less experienced STs.

Tables 4–6 present these results in detail, organized per level. The data were analyzed using the established coding framework and mapped to the compositional, structural, and contextual levels of Kager's model.

5.1. Compositional level: STs' experiences with team-related factors

Table 4 presents STs' experiences concerning diversity, intentions, prior knowledge, and personal characteristics within their LS teams.

Table 4
The ILS model: an overview of conditional factors and ST's experiences at the level of the compositional characteristics

The level of the compositional characteristics		
STs' experiences as supportive to the ILS model	Conditional factors	STs' experiences as constraining to the ILS model
The **diversity** of STs in terms of shared subject-specific didactics and interest in teaching topics facilitates more constructive conversations and interactions between teachers during the reflection phase, as a result of a greater mutual understanding. The formation of groups comprising an intern and a teacher-in-training enables interns to derive benefit from the teacher-in-training's **prior knowledge and teaching experience.** The **intentions** behind participation in LS are grounded in a commitment to pedagogical practice and collaborative endeavor. Positive **interpersonal** relations, such as mutual trust and open communication, contribute to effective collaboration. The seamless collaboration of students fosters moments of enhanced self-confidence and self-belief. The acquisition of greater **self-confidence** through teaching experience gives rise to expectations of considerable freedom and autonomy during the ILS process.	STs' 1. **diversity** (e.g. age, gender, intern or teacher-in-training, subject-specific didactics) 2. **intention** (attitude towards LS, social environment towards LS, (self)efficacy, sense of competence to control a situation) 3. **prior knowledge** (e.g. pedagogy, subject, didactic) **and skills** (observation, (self)reflection, teaching experience, teaching practice, lesson plan preparing and designing, (re)search) 4. **interpersonal** (cooperation, trust, leadership, safety, collegiality, interaction, open communication) **and intrapersonal** (self-knowledge, feelings of guilt) **characteristics**	The **diversity** of STs in terms of groups consisting of different subjects, or consisting only of interns, has resulted in a reduction in learning experiences in terms of subject knowledge and an increase in workload. STs' **intentions** based on a lack of self-efficacy, combined with a lack of competence to control a situation, have led to feelings of pressure or worry. Furthermore, a lack of self-confidence can result in heightened expectations regarding the level of support required. A lack of **prior knowledge and teaching experience** can also lead to feelings of uncertainty. **Interpersonal** challenges, such as the presence of dysfunctional collaborative skills, can impede deep learning experiences, increase the workload, and raise doubts about the benefits of LS. The **intrapersonal** challenges, such as a lack of self-knowledge, faced by STs have the potential to increase the partners' workload and compromise collaboration, which may ultimately lead to feelings of frustration.

Table 5
The ILS model: an overview of conditional factors and ST's experiences at the level of the structural characteristics

The level of the structural characteristics		
STs' experiences as supportive to the ILS model	Conditional factors	STs' experiences as constraining to the ILS model
The STs perceive the LS as a **successful endeavor** due to the presence of several favorable factors, including effective collaboration, meticulous preparation, transparent communication, and the acquisition of valuable insights through observation, feedback from pupils, or reflection. All STs are capable of **completing** the entirety of the LS cycle. The quality remains consistently high when two of the three RLs are performed or the observations are recorded on video instead of live. The utilization of **supporting material** is perceived as highly beneficial. The STs consider the **kick-off meeting** and the proposed timeline with interim deadlines to be beneficial in preparing for the ILS. The STs consider the **LS handbook** to be an indispensable reference tool, offering guidance on navigating the LS. Those students who had used **templates** from the LS handbook demonstrated a high level of proficiency in the use of the LS, as evidenced by the quality of their master's thesis presentations.	Conditional factors 1. Sts' **understanding** the LS features and the LS cycle 2. Specific **implementation** of the LS stages: study – plan – conduct with revision – reflect - share 3. **Supporting materials** (e.g. LS handbook, templates, debriefing letter, roadmap with timetable, time commitment and interim deadlines, kick-off presentation)	It is a common experience for interns to feel considerable stress when tasked with **planning** three RLs during the course of their internship. STs who did **not utilize the LS handbook** on a regular basis and did not search for additional feedback exhibited a tendency to deviate from the ILS model. Furthermore, they demonstrated a limited comprehension of the LS features and displayed inferior ILS outcomes. STs who **deviated from the LS characteristics** perceived the LS as challenging and demonstrated a lack of understanding (of the benefits) of the LS.

Table 6
The ILS model: an overview of conditional factors and STs' experiences at the level of the contextual characteristics

The level of the contextual characteristics		
STs' experiences as supportive to the ILS model	Conditional factors	STs' experiences as constraining to the ILS model
ITE support is typically perceived as beneficial, particularly in terms of providing guidance and assistance to students. The implementation of effective **planning and time management** strategies derived from the principles of the ITE organization serves to enhance the ILS organization. The provision of support and feedback from a **school mentor** has been demonstrated to have a beneficial impact on the selection of the LS research topic and the quality of RLs, fostering the development of constructive relationships and self-confidence.	1. **Support from ITE** (guidance from supervisor, ILS information) 2. (Internship) **school support** (schedule, guidance, open communication with school mentor or leader, colleagues). 3. **Resources** (ILS master's thesis guidelines, time table with interim deadlines, planning of the internship, outside expertise)	STs perceived that time pressure and an increased workload resulting from **interim deadlines** were significant factors. STs who felt the need for a comprehensive **roadmap** with schedules, time commitments, and intermediate deadlines reported enhanced organizational efficacy and a heightened sense of clarity. It is challenging for those undergoing training to combine their schedules in **secondary school** with those of the ITE.

The interviews indicated that neither age nor gender was a significant factor in the implementation of the ILS. However, the composition of the group in terms of subject matter and whether the participants were interns or teachers-in-training were identified as crucial conditional input factors for a productive collaboration with the LS partner.

Duo 1 and 2, comprising an intern and a teacher-in-training, perceived the collaboration as advantageous for the intern, given the teacher-in-training's existing knowledge and teaching experience. Furthermore, the group discussions revealed that the possession of teaching experience is not a prerequisite for the completion and acquisition of knowledge in an LS.

Duos specializing in different subject-specific didactics reported a diminished learning experience in terms of subject knowledge and an increase in workload due to the necessity of developing disparate lesson plans.

When you teach the same subject, this is the most useful anyway, then you talk about the same problems, etc. In our case, we teach chemistry and physics. This increased my workload because we couldn't use the same lesson plans. (Tommy)

The second questionnaire also showed that a common subject and shared interest led to better conversations and interactions during the reflection phase (N=5).

The first questionnaire showed that the STs' intentions to participate in the LS met the core objectives: they appreciated the link between theory and classroom practice (N=5) and collaboration (N=3). When the collaboration during the LS process proceeded in an optimal manner, characterized by comprehensive preparation and planning, five STs exhibited enhanced levels of self-confidence and belief in their abilities, as evidenced by the second questionnaire results. Emilia, an intern, confirmed this in the group discussion:

Honestly, I had less stress for my LS classes than for my other internship classes because of this [good preparation]. Did working together really help? Yes, definitely. [. . .].

A comparison of the first questionnaire with subsequent interviews enabled the identification of the impact of input factors on the learning processes. The following example illustrates how the expectations and behavior of one team member impeded the learning of another.

Cor asserts that the attitude of STs toward LS affects cooperation. This is because his partner did not perceive the utility of LS, which resulted in a lack of effective collaboration and a lack of constructive dialogue. This resulted in considerable frustration and an increased workload for Cor. Cor perceived that this dysfunctional collaboration impeded his deep learning, which in turn led to a reduction in belief in the benefits of LS, trust, and sense of collegiality:

The only drawback within our collaboration was when things were agreed or created online. My partner did not work in the shared document but worked on his own, which caused duplication and frustration for me.

In addition to Cor, another duo also encountered these challenges, as evidenced by the findings of the second questionnaire.

The absence of self-efficacy, including the perception of lacking control over a situation, also affects interactions between team members. This is illustrated by the accounts of Lisa and Tommy in their interview. Consequently, they encountered greater challenges in collaboration during periods of peak demand, as the partners, who were interns, exhibited elevated levels of anxiety, felt the pressure acutely, and experienced panic. Moreover, a dearth of self-efficacy and self-assurance, stemming from a paucity of teaching experience, necessitated more assistance, as exemplified by the cases of Emilia, Jerry, and Lisa.

Interpersonal characteristics such as open communication, cooperation, trust, a sense of security, and collegiality were mentioned as facilitating learning and interaction in terms of giving and receiving feedback. Emilia stated in her interview:

Both [LS partners] were open to feedback from the pupils and from each other. Agreements between them were carefully followed, which increased trust in each other. We showed understanding for each other when things did not go as planned and gave each other space to grow as we went through the LS. Because we were open with each other, we felt comfortable giving each other honest feedback. In this way, both positive points and working points could be immediately integrated into the next RL, so the collaboration contributed to our learning.

If something is not right, they [pupils] don't participate, what an insight I got there!. (Cor)

Right, more differentiation did have an impact on my pupils! What an eye opener. (Lisa)

Indeed, through LS you can observe well and see what works and what doesn't, so you can better organise your lessons. From now on,

I want to do that regularly with LS, for example, when I want to try something new, like book widgets, so that I can observe briefly and objectively. (Sting)
What we learned from it, both for mathematics and economics, is flipped learning and how that has an impact on the pupils motivation. (Elisabeth)

With this, participants identified four key areas of learning: teaching, observation, (self)reflection, and didactic knowledge. Moreover, it was suggested that effective collaboration could further facilitate these processes.

The composition of the group has a discernible impact on the STs' ability to learn together about the subject matter. However, there was a lack of consensus regarding the impact of LS on inquiry-based learning.

5.2. Structural level: STs' experiences with LS process design

The conditional input factors at the level of contextual characteristics relate to the support and resources provided and the learning environment. The findings presented in this chapter are derived from both questionnaires, interviews, and the focus group discussion, as detailed in Table 5.

Regarding ITE provider support, STs were generally satisfied, scoring it 3.5 out of 5, and perceived it as useful. They reported that their supervisors were easily accessible. However, two STs felt a reduced sense of self-efficacy and self-confidence due to a lack of well-planned follow-ups by their supervisors. Four interns involved their school mentor and found the experience to be highly positive. Their responses can be summarized as follows: the collaboration led to a well-thought-out starting point for the RQ, an improvement in RLs, the establishment of a positive relationship, and an enhancement of self-confidence.

Teachers-in-training indicated that it is particularly challenging to combine the schedules of secondary education lessons with those of ITE providers:
The start of a school year in secondary education does not correspond to an academic year, which means that as a teacher (-in-training) you can only start working on your thesis properly in November, while December is also very busy due to the exams in secondary education. (Elisabeth)

But also interns experienced planning and scheduling problems, according to Tommy:
Interns only have 15 hours of internship, and within that, three RLs have to be scheduled. At the same time, this should be combined with the "teaching free" times of the duo partner who comes to observe during the RLs. So we should be able to schedule six RLs. This puts pressure on the team and cooperation.

Sting corroborated the assertion that planning and scheduling represented a substantial challenge for interns, characterizing the process as *"a daunting and intricate puzzle that demanded considerable time and effort"* and noting that it was a significant source of stress.

The interview findings revealed that four of the six interns with less confidence due to a lack of teaching experience requested more follow-up support in the form of feedback, coaching, interim deadlines, and guidance materials, collated in a roadmap. According to them, this would facilitate the integration of the LS cycle into the master's thesis and the school internship more smoothly. Conversely, both teachers-in-training, Elisabeth and Tommy, indicated that interim deadlines increased their workload and that too many guidelines affected their sense of autonomy, as discussed in the group discussion.

5.3. Contextual level: STs' experiences within the organizational setting

This section presents the findings regarding the conditional factors of STs' understanding of the LS characteristics and LS cycle, the LS model and number of RLs, and supporting materials. The findings are derived from the master's thesis analysis, both questionnaires, interviews, and focus group discussions (see Table 6).

The theses demonstrate that all pairs successfully completed all four steps of the LS process, albeit with varying degrees of success. These steps are study, plan, conduct with revision, and reflect.

The first step of the ILS process, the study of the LS topic, which formed part of the literature review in the master's thesis, was of an acceptable to excellent standard in all duos. However, there was a discrepancy between the findings of the literature review and the RQ in the study of Duo 4. It is also important to note that not all of the sources used were drawn from qualitative scientific research. Furthermore, the challenge that interns encounter during this step of their ILS, as highlighted by Jerry in his interview, is the selection of a suitable ILS research topic or goal:
If an intern is seeking a starting point for their LS, it can be challenging to identify a suitable topic if they lack familiarity with the pupils, the school, and the school mentor's vision.

Despite the provision of a methodology for the formulation of research goals in the LS manual, not all teams elected to utilize it. Duo 4 diverged from this approach by formulating an additional research goal, as opposed to incorporating a mediating factor within the LS research question itself. The research goal from Duo 2, in accordance with the method, is as follows:
What effect does differentiation through peer tutoring have on case pupils' motivation and how does the group assignment play a role in this? The research goal from Duo 4, deviating from the method, is as follows: *How does introducing a physically active game in economics class improve students' learning performance? And how and what are the factors that influence effectiveness?*

The second step of the ILS process, namely, the planning and designing of the RLs, was identified as a significant source of stress for all STs. The data presented in Questionnaire 2 indicates a considerable range in the time required for lesson preparation among individual STs, with a span of 2–30 hours and an average of 12 hours. The data revealed that four of six interns indicated that this LS phase necessitated a greater time investment than initially anticipated. Conversely, the remaining participants, comprising a combination of interns and teachers-in-training, asserted that the preparation time for the RL was consistent with their expectations.

Furthermore, Duo 1 was unable to schedule the requisite number of live observations and instead videotaped the initial two observations. According to this duo, viewing the lessons collectively facilitated enhanced reflection on the lesson structure. Duo 3 conducted only two RLs, instead of the required three, without giving a reason.

The selection of three case pupils for observation and interview purposes proved challenging for all participants. The interns placed considerable reliance on their school mentor, and the teachers-in-training advanced the argument during the group discussion that the selection process might have an adverse effect on their relationship with the class. Not all participants were in agreement with this

assertion during the group discussion. Sting advanced the position that the LS method fosters the development of more robust relationships with pupils. He observed that such feedback enables the implementation of adjustments, which in turn allows for greater attention to be devoted to motivating pupils, thereby strengthening the relationship with them.

As a third step in the LS circle, the teams proceeded to conduct the RLs. The data collected during the RLs by all LS teams are obtained through the use of custom-made measurement instruments, which facilitate the response to the RQ. The veracity of three types of measurement instruments—the observation and interview manual and the class questionnaire—was determined through document analysis. Duo 1 and 3 employed the prescribed formats from the LS manual and adapted them in a manner consistent with their RQ. As a consequence of the shifting focus, Duo 2 devised novel measurement instruments for each RL. Duo 4 was unable to complete the RL revision in an appropriate manner, and the initial RL was unsuccessful in achieving the desired results. A detailed examination of the observation and interview manual revealed a discrepancy between the content of the questions and the LS RQ. Furthermore, the data collected through the class questionnaire were found to be unreliable due to the fact that the questionnaire was completed by the observing ST and a few pupils, whereas the intention was to question the entire class.

This resulted in the data collected on the RL being unreliable, which may have led to misguided choices when modifying the RL.

In the course of the interview, Cor states that the original RL was revised based on observational data:

The initial game was unsuccessful, with pupils exhibiting a lack of interest. We then developed an alternative game based on our observations, which proved to be more effective.

The remaining teams based their reflections on the data collected in accordance recommended LS methodology. This fourth step of the LS circle is, also to Emilia, an important learning process:

I have learned to reflect better on my lessons. That part of the internship (with LS) makes you think about the RL, because you base it on the feedback the pupils give you during the interviews and the questionnaire. I found that really surprising. Before that, during my internship lessons, without LS, I had sometimes thought about: "Did I do well?," but I didn't really get an answer to that, not even from my school mentor. She looked at my teaching style, not at what worked for the pupils.

And

In addition, I acquired a great deal of insight into the nature of relationships with students. It would be erroneous to underestimate their significance. Students may indicate that a lesson is not meeting their needs, but they often fail to provide specific details unless the teacher initiates a dialogue and encourages them to articulate their concerns. Subsequently, a considerable amount of information is revealed. If the material is not satisfactory, they tend to disengage from the activity. This insight proved invaluable. (Jerry)

The data obtained from the second questionnaire and interview indicated that the STs of Duo 4 who did not extensively utilize the LS manual and its templates demonstrated a reduced understanding of the characteristics associated with LS.

Duo 1 and 3, who reported positive learning outcomes, closely adhered to the LS manual and utilized the available materials in an effective manner. Emilia testified in the group discussion:

I used the manual during the whole LS process. I followed all the steps very well, even during the RLs.

STs who did not participate in the online kick-off meeting indicated that they had missed a considerable amount of information regarding (the organization of) the ILS model, despite the availability of the LS handbook and a concise roadmap. The reasons for absence were deemed to be relatively innocuous. These included late registration for teacher training or a delayed decision regarding the thesis, as well as other work-related or domestic priorities. Overall, seven of the eight STs indicated that they felt adequately prepared for the LS. One student indicated that they lacked sufficient information, while the others highlighted a number of positive factors that contributed to their preparation. These included effective collaboration and planning, guidance and feedback from the teacher trainer, and a comprehensive didactic preparation at the ITE.

The interviews sought to ascertain the extent to which the LS experience was perceived as successful. Two STs indicated that they felt their ILS process was not entirely successful and rather challenging. This was due to a lack of cooperation and communication with the partner, as well as because the LS was not well implemented and diverged from the model, resulting in an incomplete alignment with the LS features. In contrast, the remaining participants evaluated the LS experience as successful, citing effective collaboration (N=5), meticulous preparation (N=4), transparent communication with their partner (N=3), and the acquisition of knowledge through teaching practice in a real classroom environment (N=3), observation (N=3), and reflection (N=3).

6. Discussion

The present study investigated the conditional input factors of an ILS model implemented in a one-year ITE program at the university level. The findings suggest that the ILS model offers significant potential to embed an adapted LS cycle within the school internship context and integrate it into the master's thesis trajectory. This positions the ILS as a promising approach for one-year ITE programs. However, its effectiveness relies on careful consideration of the conditional input factors—compositional, contextual, and structural—and the interplay between them [17]. In this discussion, findings related to each level are explored in depth, followed by integrative insights and conclusions.

6.1. Compositional level

The study found that team composition substantially influenced collaborative learning. LS teams comprising a mix of interns and more experienced STs exhibited more effective collaboration. Prior teaching experience facilitated deeper engagement, with experienced STs often taking the lead in lesson planning and reflection. In contrast, teams composed of members from different subject areas faced alignment issues and increased workload, as reported by the participants of this study, echoing earlier concerns about the need for disciplinary cohesion. This is in line with the research of Schipper et al. [26].

Additionally, prior knowledge and teaching experience were crucial to the development of professional identity and confidence. In line with de Vries et al. [5], interns lacking prior experience encountered greater uncertainty but benefited from structured mentoring and collaborative support. Teams with a balance of novices and experienced peers performed better, suggesting that such a mix can promote autonomy and learning. Where experienced STs were unavailable, school mentors provided valuable scaffolding.

Interpersonal dynamics also emerged as a decisive factor. Trust, collegiality, and effective communication enabled constructive dialogue and feedback, aligning with the findings of Hervas and Medina [27], Khokhotva [28], and Mathieu et al. [29]. Conversely, unresolved tensions and unclear expectations hindered learning.

Voluntary collaboration protocols and clarity about roles and objectives prior to starting the LS process may strengthen interpersonal cohesion.

Moreover, the study underscored that while participation was voluntary, intrinsic motivation varied, influenced by participants' attitudes, self-efficacy, and contextual pressures. Even willing participants sometimes struggled with the intensive demands of LS. These findings suggest a need for pre-implementation orientation [26], including structured tools such as an LS board game that introduces the key steps and principles of LS, fosters team reflection, and supports the development of a shared understanding and collaborative mindset [30].

In summary, optimal team composition—balancing subject alignment, experience, and motivation—was key to successful collaboration. Teacher educators should be mindful of both individual attributes and team dynamics when organizing LS groups.

6.2. Structural level

Institutional support played a critical role in the success of the ILS model. Adequate guidance, also resources, and communication from ITE providers enabled interns to manage the process effectively. While the study did not center on mentorship during internships, most interns reported that mentors helped compensate for the absence of experienced LS members, particularly in setting LS goals and refining LS research questions.

However, misalignments between ITE timetables and school expectations were identified as significant barriers. Echoing Schipper et al. [26], these misalignments created stress and confusion. Time constraints during the internship intensified these issues, especially since LS typically requires an extended timeline [31]. While structured feedback mechanisms helped interns stay on track, more experienced STs expressed concern that rigid structures could limit autonomy—highlighting the delicate balance between guidance and professional freedom [32].

To address this, the study recommends a dual-track support system: clear, structured guidance for less experienced interns and more flexible scaffolding for advanced STs. This approach recognizes diverse developmental needs and can help mitigate the tension between autonomy and structure. Additionally, providing a curated bibliography for literature reviews may reduce workload, particularly for STs with prior master's degrees, while improving thesis quality.

6.3. Contextual level

The success of ILS depended on STs' understanding of the LS cycle. Without clear comprehension, engagement with individual LS phases proved difficult. To address this, tools such as the LS board game and digital manuals can help STs grasp the characteristics and expectations of the LS model. As highlighted by Hummes and Seckel [33], structured tools and transparent communication are necessary to set realistic expectations and encourage full participation.

The study revealed that teams that either neglected key LS stages or deviated from the prescribed process faced challenges in effectively collecting and analyzing data for their LS-based research. In contrast, teams that closely followed the LS manual achieved stronger outcomes. Thus, providing structured timelines, tools, and training on the LS methodology is essential to ensure consistent and meaningful engagement across all phases.

Interestingly, implementing a shortened LS process with two RLs rather than three did not negatively affect learning outcomes. This finding responds to calls in the literature for solutions to time-related constraints in LS [7]. Video recordings of lessons also proved an effective substitute for live observations, offering logistical and time-saving benefits without diminishing the quality of reflection or learning.

Furthermore, support tools played a critical role. Aligning with Fauskanger and Bjuland [34], the use of structured LS materials increased process fidelity and supported consistency. While print manuals were provided, STs expressed a strong preference for digital formats. Digitization improves accessibility, reduces the time spent customizing templates, and allows for more efficient planning.

In sum, the ILS model's success is tightly linked to clear structural guidance, access to practical tools, and flexibility in adapting to time limitations. Digitalization and streamlined support tools can enhance process quality while mitigating logistical challenges.

6.4. Interconnections between levels

The study demonstrates that the effectiveness of the ILS model hinges on the alignment and balance between compositional, contextual, and structural levels. Misalignment—such as mismatched team composition combined with insufficient support or an overly rigid LS structure—can lead to confusion and stress, ultimately undermining learning outcomes.

In particular, "time" emerged as a cross-cutting theme. Time constraints at both the contextual (scheduling) and structural (process duration) levels significantly impacted the ability to implement LS effectively. Concrete adaptations—such as the two-lesson format and the use of video—offer viable solutions to these persistent issues, addressing the need for practical strategies highlighted in References [7, 13, 35, 36].

Achieving balance requires ITE providers to coordinate team formation, mentoring support, scheduling, and LS design in a coherent, mutually reinforcing way. When effectively aligned, these factors allow LS to bridge theory and practice, fostering deeper professional learning and more authentic teaching experiences [37].

7. Conclusion

This study explored the conditional input factors that influence the successful implementation of an ILS model within a one-year university-level ITE program. Findings indicate that thoughtful team composition, tailored institutional support, and a well-structured LS process are all essential. Importantly, these factors must work in concert to maximize engagement and professional learning. Concrete strategies—such as reducing the number of RLs and incorporating digital tools—can help mitigate time-related challenges. The alignment of compositional, contextual, and structural input factors is therefore critical for enabling LS to function as a meaningful, practice-oriented component of teacher education.

Recommendations and limitations

This qualitative study offers several insights that have the potential to influence future research directions or to form the basis for future research.

First, further research is warranted into how the composition of LS teams affects collaboration, workload, and time commitment. It is important to note that this is a small-scale and experimental study conducted by one researcher (the first author). This may have

resulted in certain insights not being recognized. Furthermore, the exclusive involvement of the first author in the research process may have constrained the range of perspectives, potentially impacting the interpretation and analysis of the data. Consequently, the results of the study should be interpreted with a degree of caution.

Another potentially fruitful research topic at the compositional level is that of the differences in supervision and support between interns and teachers-in-training. Researchers could focus on these differences through methods such as surveys and in-depth interviews. Additionally, a replication of Gorospe's [2] research on teaching anxiety, particularly in relation to evaluation and classroom management, among STs within the context of LS, would be a valuable contribution. This would assist in determining the extent to which (an integrated) LS in ITE alleviates teaching anxiety.

It is acknowledged that professional learning occurs in other domains not encompassed by this study, including knowledge, skills, attitudes, and beliefs, teaching behavior, professional dialogue, norms, and routines. A substantial body of research has already been conducted on these topics, and further research could be conducted at the team or individual level, with a particular focus on comparisons between interns and teachers-in-training.

Next, it would be beneficial to explore ways in which the mentor of the internship school can be involved in the ILS process. This would enhance the learning experience of interns, as well as facilitate collaborative working and collaborative learning by connecting the training institution and teaching practice during the internship, as reported by Duijzer and Peltenburg [38].

It would also be beneficial to build upon the work of Patzak and Zhang [39], with the aim of further exploring their insights into the combination of autonomy support and structured guidance and its effect on the motivation of interns, on the one hand, and teachers-in-training, on the other, within the LS context.

Finally, a larger-scale study of the impact of the general conditional input factors and their interrelationships on STs' learning outcomes, in areas such as collaboration, research, teaching, observation, and reflection, is therefore recommended. This study, using Kager et al.'s conceptual framework [17], would contribute to the understanding of teacher educators regarding the promotion of professional learning among STs in a one-year university ITE program by the ILS model.

Ethical Statement

This study does not contain any studies with human or animal subjects performed by any of the authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest to this work.

Data Availability Statement

The data that support the findings of this study, as well as the measurement instruments used, are openly available in Figshare at https://doi.org/10.6084/m9.figshare.30149167

Author Contribution Statement

Iris Willems: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Visualization, Project administration. **Wouter Schelfhout:** Writing – review & editing. **Elke Struyf:** Writing – review & editing, Supervision.

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