

Lesson Study effectiveness for teachers' professional learning: a best evidence synthesis

Lesson Study
effectiveness

Iris Willems

Faculty of Social Sciences, University of Antwerp, Antwerp, Belgium, and

Piet Van den Bossche

Department of Training and Education Sciences, Faculty of Social Sciences,

University of Antwerp, Antwerp, Belgium and

School of Business and Economics,

Maastricht University, Maastricht, The Netherlands

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Abstract

Purpose – The purpose of this paper is to gather evidence for the effectiveness of Lesson Study (LS) for teachers' professional learning.

Design/methodology/approach – A systematic review of relevant papers published between January 2010 and April 2018 was performed. To accomplish the best evidence synthesis, relevant studies were selected based upon well-chosen keywords and inclusion criteria. Afterwards, the quality of the remaining studies was assessed by using a critical appraisal checklist combined with a strength and weakness analysis. Data sources included relevant articles identified through digital searches on Education Research Information Centre and Web of Science, as well through snowball sampling and personal contacts. A total of five studies meeting inclusion criteria were retained for this review.

Findings – These five studies describe LS as a powerful professional development approach because of its positive impact on teachers' professional learning. A significant improvement or change for knowledge, skills, behaviour and beliefs has been reported among teachers.

Originality/value – Only studies with a design that shows high effectiveness were selected. The sample of relevant studies is currently small. As a consequence more large-scale and long-term research which illustrates the short and long-term effects of the LS approach on teachers' and students' learning is desirable.

Keywords Systematic review, Teacher professional development, Effectiveness, Lesson Study, Teachers' professional learning

Paper type Literature review

Introduction

Japan is the cradle of Lesson Study (LS). Since the start of the public education system in 1872, it has been the model for teachers' professional development (PD) (Takahashi, 2014). LS became widely known since the publication of "The Teaching Gap" (Stigler and Hiebert, 1999). In this seminal work the authors indicate that the high results for mathematics and science in Japan could be explained by the LS approach. As a result, LS was introduced as a PD method in various countries and continents (Xu and Pedder, 2014). Elliott and Ling (2011) quote in the editorial of the *International Journal for Lesson and Learning Studies*: LS has been characterised as "a system for building and sharing practitioner knowledge that involves teachers in learning from colleagues as they research, plan, teach, observe, and discuss a classroom lesson" (Lewis, Perry and Friedkin, 2009, p. 142).

Indeed, LS teachers go through four phases of the quality circle "study-plan-conduct-reflect" (Lewis and Hurd, 2011) (Figure 1). The LS circle starts with the study of the teaching material. In this phase teachers take the time to consult, read and study courses, relevant scientific articles, available curricula and other sources (Takahashi and Yoshida, 2004). They formulate lesson goals and research questions (Murata, 2011). Next, the teachers design and plan or revise a research lesson. Together the teachers plan, develop or choose an educational method that



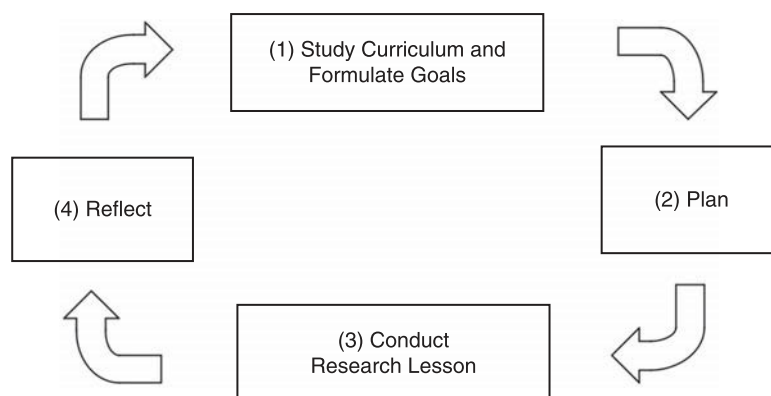


Figure 1.
The Lesson
Study circle

Source: Adapted from Lewis and Hurd (2011, p. 2)

visualises the students' learning (Murata, 2011; Takahashi and McDougal, 2016). One teacher teaches the lesson under the supervision of a professional expert (Takahashi and McDougal, 2016), while the other team members have a live observation of the students (Murata, 2011). During this third step, the observers collect data about how the students think, reason, answer and solve problems. As a final step in the process, the observers discuss and reflect on how students have responded to the teaching and learning process, and how to implement the course (Lewis and Tsuchida, 1997).

However, LS is more than a series of steps to follow. The LS characteristics are the collaborative teacher teams, the centrally placed teaching practice, the lesson design they try out themselves, the learning processes of their own students within their own subject as a study object, and the long-term cyclical course (de Vries *et al.*, 2017). These characteristics correspond to what recent reviews describe as effective and meaningful professionalisation with a view to quality education (Darling-Hammond *et al.*, 2009; van Driel *et al.*, 2012).

LS has been researched and described in various countries over the last decades. Most of these studies are rather small-scale, qualitative, inductive and explorative (Xu and Pedder, 2014; de Vries *et al.*, 2017). Cheung and Wong (2014) gathered for their review "Does Lesson Study work?", studies from 2000 till 2010 that demonstrate the effectiveness of LS. They find nine studies supporting LS benefits on instructional behaviour among teachers and on learning among pupils.

The existing literature shows that there is a need for well-controlled research that demonstrates the effectiveness of LS. Darling-Hammond *et al.* (2009) report: "Efforts to improve student achievement can succeed only by building the capacity of teachers to improve their instructional practice". LS is a PD method with the aim of improving teachers' professional learning such as instructional practice (Lewis, 2002; Lewis *et al.*, 2009). This review aims to gather evidence, for the period 2010 – 2018 (as a follow-up review of Cheung and Wong, 2014, p. 139), with regard to the research question:

RQ1. Is LS effective for teachers' and teacher candidates' professional learning?

Teachers' professional learning

LS has variants outside Japan that are often adapted and implemented as an innovative PD method in schools (Huang and Shimizu, 2016). Such educational innovations and changes often depend on the learning of teachers and on improving their instructions in order to achieve an increase in students' achievement (Matoba *et al.*, 2007; Darling-Hammond *et al.*, 2009).

To visualise this PD, Desimone (2009) has drawn up a conceptual framework (Figure 2). This framework allows researchers to map the effects of PD on both teachers and students, as recommended by Cheung and Wong (2014). It allows to investigate the following theories: a theory about increased teacher knowledge and skills and changes of attitudes and beliefs; a theory about changes in teacher instructions, for example a changed practice that affects students, and a theory that brings together both previous theories to gain insight into how PD functions. Desimone (2009) relies on existing literature to defend a number of relationships in the framework: the link between PD and classroom practice (e.g. Fishman *et al.*, 2003; Supovitz and Turner, 2000); the link between PD and student performance (e.g. Angrist and Lavy, 2001; Cohen and Hill, 2000; Lee *et al.*, 2008); the link between teacher knowledge and practice, and students' performances (e.g. Hill, Ball and Schilling, 2008; Phelps and Schilling, 2004); and the link between teacher instructions and student performance (e.g. Hamilton *et al.*, 2003; Supovitz, 2001; Von Secker, 2002). PD leads to changes and professional learning outcomes in terms of knowledge, skills, beliefs or behaviour. This improves the content of the teacher instructions and/or pedagogical approach (Desimone, 2009). Through processes of collective reflections during the LS cycle teachers develop new knowledge, understandings and beliefs about classroom practices and students' learning (Ricks, 2011).

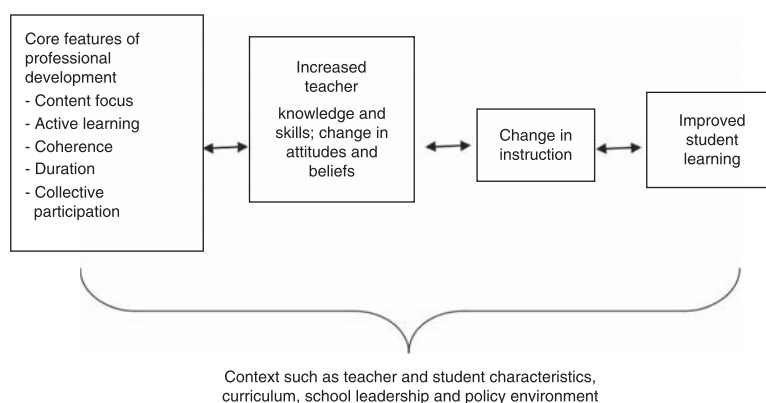
Because of the impact of teachers' knowledge, skills, attitudes and beliefs on student achievements (Desimone, 2009), this present review focusses on teachers, and by extension teacher candidates, as the target group, and teachers' professional learning during the LS intervention as the research subject. Teacher candidates are included, because teaching and education will become their future profession. The beliefs and practice of beginning teachers are often significantly influenced through pre-service teacher education programs (Kyles and Olafson, 2008). Research findings confirm also the effectiveness and impact of LS within initial teacher education (Lamb, 2015).

The current review, "Is Lesson Study effective for teachers' and teacher candidates' professional learning?", from January 2010 to April 2018, starts from the year where Cheung and Wong (2014) ended their review "Does LS work?". Furthermore it responds to their call for identifying evidence through randomized controlled trials (RCT) (p. 147).

Methodology

Best evidence synthesis

To accomplish the best evidence synthesis, relevant studies were selected based upon well-chosen keywords and inclusion criteria (see below). Afterwards, the quality of the remaining



Source: Desimone (2009)

Figure 2.
Proposed core conceptual framework for studying the effects of professional development on teachers and students

studies was assessed by using a critical appraisal checklist (CAC) combined with a strength and weakness analysis. Also information about differences in characteristics, outcome measures and their associated p-values, was used to evaluate the effectiveness of LS interventions on teachers' professional learning in terms of knowledge, skills, behaviour and beliefs.

Keywords and inclusion criteria

A flowchart of the search process leading to the five studies that were analysed in this systematic review is shown in Figure 3. The four main steps undertaken during this search process are identification, screening, eligibility and inclusion. The number of articles involved in the data collection after each step is shown.

The digital databases Education Research Information Centre and Web of Science generated at first 690 studies based on the search term "LS".

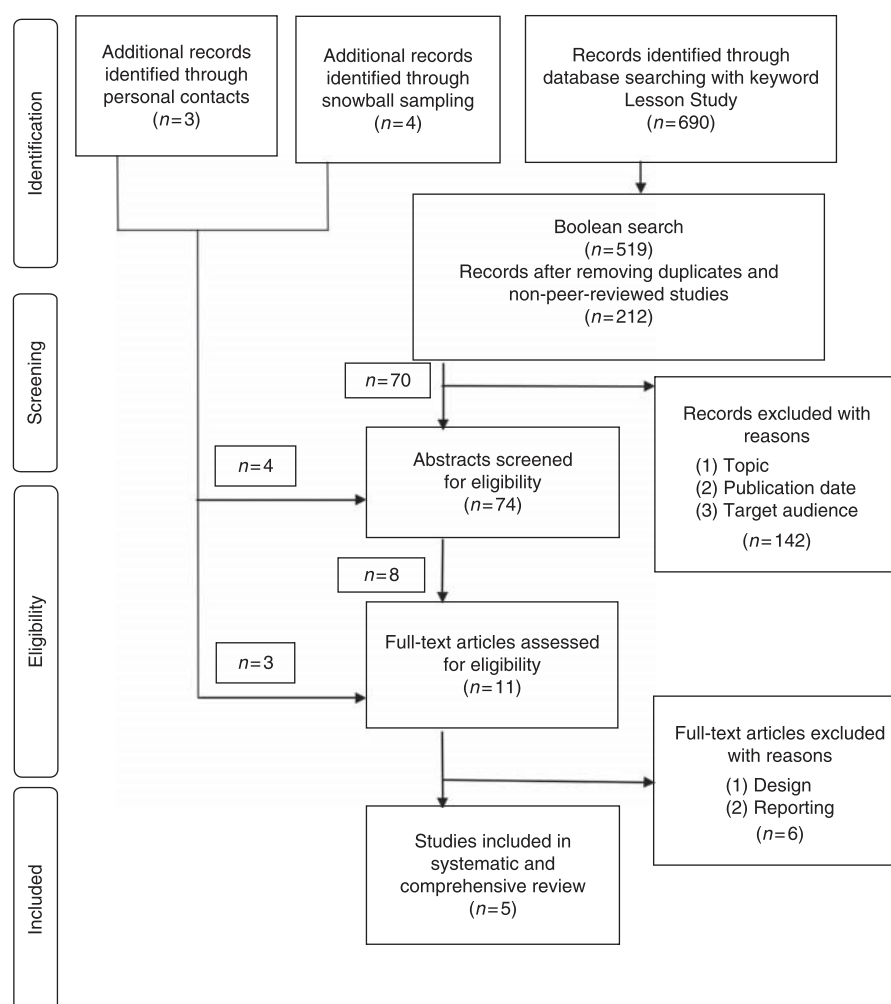


Figure 3.
Flowchart of
screening process
with results

Source: Adapted to Moher *et al.* (2009)

The second step involved Boolean searches in the digital databases resulting in 519 hits. The following keywords were individually combined with the main search term “LS”: effect, quantitative, mixed method, posttest, outcome, impact, correlation, frequency, percentage, significant, statistic, survey, regression, control group, statistical analysis, *t*-test, ANOVA. This second step is aimed to focus on an effect measurement or the result thereof, a research design that allows an effect measurement or a measuring instrument that measures an effect. Removing doubles and not-peer-reviewed publications further reduced the number of articles from 519 to 212. Of these, 70 articles were considered suitable on the basis of three inclusion criteria: the main topic is LS, the publication date is from January 2010 to April 2018 and the target group is teachers or teacher candidates. Through snowball sampling four more studies were accepted at this stage.

The full-texts of these 74 articles were further assessed for eligibility in data reporting and suitability in design. According to What Works Clearinghouse (2008) only well-designed and well-implemented RCT can receive the highest rating of Meets Evidence Standards. The design had thus to be a RCT or a true/quasi-experimental design with control groups. A RCT is a trial with randomly assigned groups in order to determine the effectiveness of an intervention given to one of the two groups. RCTs provide the most reliable evidence for effects because the procedure greatly reduces the risk that the results are affected by disruptive factors. So RCTs are preferred in a systematic review to find out if an intervention is effective or not (What Works Clearinghouse, 2008). Following this assessment eight studies remained. At this point, two additional articles were obtained through snowball sampling and one article through personal contacts.

Critical appraisal

These 11 studies were fully and thoroughly assessed using the CAC (Appendix). The purpose of this detailed assessment is to make a decision about the sound statistical approach in the published research and to retain articles that can provide an answer to the research question of the current review. Therefore the CAC was based on two existing tools: “CAT: A Randomized Controlled Trial” of The Joanna Briggs Institute (Tufanaru *et al.*, 2017) and “How do I critically appraise the literature?” (Aveyard, 2014, pp. 114-121).

The description of the research context and participants, the LS intervention, the research design and instruments, the data collection procedure and data analysis were critically reviewed and recorded into the resulting data set. During the data collection process, the details from the CAC were also identified as a weakness or as a strength of the research.

Ultimately, five articles were retained for this review: three articles obtained through the digital databases and two through snowball sampling.

At this stage it appeared that two publications by Lewis and Perry (2015, 2017) used the same data set, conditions and research method. These two studies will therefore be reported together.

Data coding

The data were coded according to their major characteristics as represented in Table I. The characteristics are defined as: type of education, geographical location, subject matter, participants, number of interventions and research duration, theoretical framework used in combination with the LS approach.

Exclusion for evidence

One study was excluded from evidence synthesis under the following conditions: the study has a score of eight or less on a maximum score of twelve on the CAC in combination with no maximum score on the inclusive criteria checklist.

Table I.
Characteristics
of the studies

Studies	Type of education/ Geographic location	Subject matter	Number of participants/Schools	Number of interventions/ Duration	Theoretical framework
Mutch-Jones <i>et al.</i> (2012)	Middle school/USA	Science	$n = 73/10$ schools	Two/one academic year	–
Lewis and Perry (2015, 2017)	Elementary school/ USA	Mathematics	$n = 213/27$ schools	One/3 months	Desimone's (2009) theoretical framework
Chizhik <i>et al.</i> (2017)	University education/USA	Science	$n = 60/1$ university	Three/one academic year	Rogoff's (2014) super vision model
Schipper <i>et al.</i> (2018)	Secondary school/ the Netherlands	Languages, science, social science	$n = 48/8$ schools	At least two/one academic year	Desimone's (2009) theoretical framework

Findings

Characteristics

The number of participants ranged from 48 to 213 (Table I). In the American studies experienced teachers were recruited in elementary school (Lewis and Perry, 2015, 2017) and in middle school (Mutch-Jones *et al.*, 2012), or teacher candidates at university (Chizhik *et al.*, 2017). The Dutch study (Schipper *et al.*, 2018) selected experienced teachers in secondary schools. Science and mathematics are in most studies represented as subject matter, except for Schipper *et al.* (2018) who include also language and social sciences. The LS interventions cover a period of three or twelve months and count one to three LS circles.

To map teachers' professional learning, four studies combine LS with a conceptual framework (Lewis and Perry, 2015, 2017; Chizhik *et al.*, 2017; Schipper *et al.*, 2018). Lewis and Perry (2015, 2017) and Schipper *et al.* (2018) rely on Desimone's (2009) model. For the research at university Chizhik *et al.* (2017) combine the LS cycle with Rogoff's (2014) apprenticeship model. One study does not utilise an additional theoretical framework and uses only the LS circle (Mutch-Jones *et al.*, 2012).

Strengths/weaknesses analysis

The data analysis reveals strengths and restrictions that may have influenced the search for statistical effects.

Strengths. The five research teams use a research design with intervention groups which go through one or more LS circles and control groups which receive a traditional PD approach. Lewis and Perry (2015, 2017) apply a RCT, Mutch-Jones *et al.* (2012) use a true-experimental design and Chizhik *et al.* (2017) and Schipper *et al.* (2018) utilise a quasi-experimental design.

To increase the credibility and validity of the results triangulation has been applied in all retained studies. The baseline and effect measurements in the studies were performed with a large range of measuring instruments. These include: national tests (Chizhik *et al.*, 2017; Lewis and Perry, 2015), surveys (Mutch-Jones *et al.*, 2012; Lewis and Perry, 2015, 2017), online questionnaires (Schipper *et al.*, 2018), open-ended assessments with standardized rubric coding (Mutch-Jones *et al.*, 2012), video and/or audio recordings (Lewis and Perry, 2017; Mutch-Jones *et al.*, 2012), field and reflection notes (Chizhik *et al.*, 2017; Lewis and Perry, 2015, 2017), interviews (Chizhik *et al.*, 2017; Schipper *et al.*, 2018), lesson plan analyzes (Lewis and Perry, 2017), assessment scales (Lewis and Perry, 2017), observation checklist (Schipper *et al.*, 2018).

The studies did control for baseline differences in intervention and control groups, and checked the validity and reliability of the instruments. All five studies were longitudinal.

They run at least two LS interventions. The studies by Lewis and Perry, (2015, 2017) are large scaled (27 schools) with a big sample ($n = 213$).

The data analyses are tailored to the design: Lewis and Perry (2015, 2017) and Mutch-Jones *et al.* (2012) use a hierarchical linear model to gain insight into nested groups. Schipper *et al.* (2018) use an explanatory sequential mixed method design to gain insight into patterns and effect differences between the groups, while Chizhik *et al.* (2017) use a combination of MANOVA, multiple *t*-tests and ANOVA.

All studies describe their statistic results and analyses extensively.

Most studies undertake actions to avoid bias and therefore increase the reliability of their results. Mutch-Jones *et al.* (2012) check for multicollinearity and engage four researchers to assess observations with validated rubrics. Lewis and Perry (2015, 2017) and Schipper *et al.* (2018) investigate the internal coherence of their questionnaires and remove items after a factor analysis. In two studies, experts assisted in refining the used measuring instrument (Chizhik *et al.*, 2017; Mutch-Jones *et al.*, 2012).

In order to visualise the impact of LS on teachers' professional learning all studies, except Mutch-Jones *et al.* (2012), use a theoretical model (Table I).

Weaknesses. A number of limitations for construct validity were identified. In the study by Mutch-Jones *et al.* (2012) an intervention bias occurs because the LS cycle was not fully completed by the participants. The research team also reports the lack of a professional expert in the LS team, an unstructured coaching and a problematic final test. Both, Chizhik *et al.* (2017) and Lewis and Perry (2017), use a measuring instrument with marginal scale reliability and reported it as problematic. Further, the intervention group, in the study by Mutch-Jones *et al.* (2012), differs significantly from the control group for two of the four dependent variables at baseline.

Examples of potential problems with external validity were found in the study by Schipper *et al.* (2018). The research team was confronted with a result bias. In their study, large differences occur between schools in terms of time allocation, the use of case pupils during the observations and group composition.

There is a potential problem in internal validity in all studies, because no research team is completely blind to the participants. Having observed no statistically significant effects, Chizhik *et al.* (2017) suggested the presence of two confounding variables, namely the unique one-to-one relationship between a student and his mentor and the various school cultures between the internships. The studies of Schipper *et al.* (2018) and Lewis and Perry (2015, 2017) rely on their LS network to recruit teachers, for whom participation is voluntary. There is thus no random allocation of the participants.

Effects on teachers' professional learning

As shown in Table II an improvement, change or growth is determined among teachers in teaching behaviour (Schipper *et al.*, 2018), beliefs (Lewis and Perry, 2015; Schipper *et al.*, 2018), skills (Chizhik *et al.*, 2017; Lewis and Perry, 2017; Mutch-Jones *et al.*, 2012) and knowledge (Lewis and Perry, 2017; Mutch-Jones *et al.*, 2012).

Behaviour and beliefs. Schipper *et al.* (2018) want to investigate whether the LS approach influences teachers' beliefs of self-efficacy and their adaptive teaching behaviour. A pretest and posttest questionnaire and observation instrument were used to capture teachers' behaviour and beliefs.

The adaptive teacher behaviour appears to change significantly positive for Clarity of Instructions ($t_{(25)} = -2.28, p < 0.05$), Teaching Learning Strategies ($t_{(25)} = -2.52, p < 0.05$) and Activating Learning ($t_{(25)} = -2.93, p < 0.01$). At the same time an ANOVA with repeated measurements results in statistical significant differences between the groups in teacher behaviour for Efficient Classroom Management ($F_{(1,46)} = 7.71, p < 0.05$) and Clarity of

Studies	Research questions	Teachers' professional learning capture in	Significant effects on teachers' professional learning
Schipper <i>et al.</i> (2018)	Does LS influences teachers' sense of self-efficacy?	Beliefs	An increase for: efficacy in instructional strategies A difference between groups for: efficacy in pupil engagement
	Does LS influences adaptive teaching behaviour?	Behaviour	An increase for: clarity of instructions, activating learning, teaching learning strategies A difference between groups for: Efficient Classroom Management, Clarity of Instructions
Lewis and Perry (2015, 2017)	What is the impact of LS with mathematical resources on teachers' beliefs and teacher learning community?	Beliefs	A positive impact on: collegial learning effectiveness, expectations for student achievement
	How is the quality of professional learning at the three conditions?	Skills	A higher rate from both LS groups (whether or not using the resources kit) than the non-LS group for: leadership skills, sense of inquiry
	Do LS teachers, supported by mathematical resources, increase their mathematical knowledge for teaching fractions?	Knowledge	A positive impact on: teachers' mathematical knowledge for teaching fractions
Chizhik <i>et al.</i> (2017)	Do teacher candidates, in LS programme, perform better than the control group, on the edTPA test?	Skills	A difference between groups on two of 15 subscales: planning to support varied student learning needs; analysis of student learning /
Mutch-Jones <i>et al.</i> (2012)	Are there content learning gains in teachers' knowledge of science content and learning challenges of students with learning disabilities	Knowledge	
	Are there teachers' process gains about the ability: to identify student learning challenges; to adapt an instructional plan; to develop accommodations for students with learning disabilities?	Skills	An increase between baseline and mid-point assessment for the ability: to adapt an instructional planning; to generate more accommodations for students with learning disabilities

Table II.
Lesson Study
research: significant
effects on teachers'
professional learning

Instructions ($F_{(1,46)} = 6.62, p < 0.05$) in favour of the intervention group. The study also reported a growth in Adaptive Teaching, but no statistical significant difference between groups could be found (Schipper *et al.*, 2018).

Schipper *et al.* (2018) measure also a positive significant impact on teachers' beliefs in terms of sense of self-efficacy on the subscale Efficacy in Instructional Strategies ($t_{(25)} = -2.64, p < 0.05$). In addition, they establish a significant difference for Efficacy in Pupil Engagement ($F_{(1,46)} = 4.51, p < 0.05$) in favour of the LS group.

The studies of Lewis and Perry (2015, 2017) included three conditions: in condition 1, teams conduct LS using the fractions LS resource kit; in condition 2, teams choose their PD method, topic and material, and in condition 3, teams engage in LS on a "locally chosen LS intervention" without the fraction resource kit.

Lewis and Perry (2015) included 33 items in their survey that capture beliefs, interests and dispositions. The six scales to measure teachers' beliefs and learning

community are: “Expectations for Student Achievement”, “Using and Promoting Student Thinking”, “Interest in Mathematics and Inquiry Stance”, “Research Relevance for Practice”, “Collective Learning Effectiveness” and “Professional Learning Community”.

The study reports a statistical significant change, after the LS intervention in condition 1 with the mathematical resource kit, on four of six belief measures between pretest and posttest. Three positive significant changes are found for: Collegial Learning Effectiveness ($t_{(72)} = 2,751$, $p < 0.01$), Research Relevance for Practice ($t_{(72)} = 1,945$, $p < 0.10$), and Using and Promoting Student Thinking ($t_{(72)} = 3,499$, $p < 0.01$) and one is negative significant: Professional Community ($t_{(72)} = 2,414$, $p < 0.05$).

Skills and knowledge. In terms of skills, three studies report a positive significant effect (Chizhik *et al.*, 2017; Lewis and Perry, 2017; Mutch-Jones *et al.*, 2012).

Lewis and Perry (2015, 2017), as described before, included three conditions. When comparing the three conditions in order to find out the impact of the prescribed focus on fraction and the supply of the fractions resource kit on the professional learning quality, Lewis and Perry (2017) found that the LS groups (conditions 1 and 3) rated their experience regarding the quality for their professional learning significantly higher for leadership and research skills than the non-LS group (condition 2) ($t_{(206)} = 2.24$, $p < 0.05$).

Chizhik *et al.* (2017) use the edTPA, a performance-based assessment for teachers, to examine teacher candidates’ achievements and the effect on teaching performance after LS interventions. The edTPA has 15 subscales divided under three sections: “Planning for Instruction and Assessment”, “Instruction and Engaging Students in Learning” and “Assessment”. The LS group has higher means than the control group on 13 of 15 subscales about skills in planning, instructions and assessment. Chizhik *et al.* (2017) found under the section “Planning for Instruction and Assessment” a significant effect for the subscale Planning to Support Varied Student Learning Needs ($F_{(2,60)} = 4.30$, $p < 0.05$) which implies for the LS group better skills and experiences of pupil diversity. Under the section “Assessment”, a significant effect on the subscale Analysis of Student Learning ($F_{(2,60)} = 6.24$, $p < 0.05$) was found.

Mutch-Jones *et al.* (2012) created three versions of a teacher assessment for the base-line, mid-point and final assessment. The assessments aimed to capture teachers’ knowledge and skills. This included skills to adapt an instructional planning to meet science learning goals for all students in an inclusive science classroom, skills to generate accommodations for students with learning disabilities, knowledge of science concepts and processes, and knowledge of the learning challenges of students with learning disabilities.

A significant effect for instructional planning adaptation in favour of the LS group was found on the intercept. At the baseline the control group had a value of 2.06 ($p < 0.00$), for the LS group the level was larger by a value 0.57 ($p < 0.05$). Further, 66 per cent of the variation that lead to improvements in teachers’ instructional planning adaptation, is explained by the LS intervention. For the ability to generate more adjustments for pupils with a learning disability, a significant effect for the LS group was found on the intercept by a value 0.94 ($p < 0.05$); for the control group by value 4.54 ($p < 0.00$). Also 5 per cent is attributed to the LS intervention. Mutch-Jones *et al.* (2012) reported a significant difference between groups in favour of the LS team for teachers’ knowledge of science concepts and processes ($F = 8.421$; $p < 0.01$), and for teachers’ knowledge of students’ learning challenges in inclusive science classroom ($F = 6.049$; $p < 0.05$).

To assess knowledge as part of teachers’ professional learning, Lewis and Perry (2017) combined condition 2 and 3 as a control group. The measure was standardized and the result of the LS intervention with resource kit gave the standardized mean difference (effect size) between the LS intervention with resource kit and the control group. The results showed a positive statistically significant impact of the LS intervention with resource kit on educators’ mathematical knowledge for teaching fractions.

Conclusions based upon review

Xu and Pedder (2014) carried out a comprehensive review to categorise all available LS publications since 1999. Most of the gathered research was small-scaled, qualitative and inductive of nature. In Cheung and Wong's (2014) review, addressing studies published between 2000 and 2010, four studies reported a positive significant impact on teachers' professional learning. But, due to the lack of well-controlled and high-quality studies the evidence was insufficient. Qualitative research continues to provide evidence for the potential of the LS PD approach on teachers' professional learning (Norwich and Ylonen, 2013) or teacher candidates' learning (Meng and Sam, 2013; Zhou *et al.*, 2017) in terms of knowledge and skills (Aimah *et al.*, 2017; Dudley, 2013; Nami *et al.*, 2016; Warwick *et al.*, 2016), behaviour and beliefs (Cajkler *et al.*, 2014; Bruce *et al.*, 2016; Hadfield and Jopling, 2016; Schipper *et al.*, 2017; Yakar and Turgut, 2017).

Addressing the period 2010–2018, the current review is a best evidence synthesis that contributes to the literature by providing a systematic review of studies which all use well-controlled designs to demonstrate the effectiveness of LS for teachers' professional learning. While this review contains only five studies that investigate the effects of LS, it still provides valuable new insights into the effects of LS on the learning process of teachers.

First, it shows that to map teachers' professional learning, LS is usually combined with a conceptual framework. Second, it indicates that LS can be implemented in all levels of education and is effective both for teachers and teacher candidates (Table I).

The five retained studies provide significant evidence for the positive effects of LS in terms of knowledge (Mutch-Jones *et al.*, 2012), skills (Chizhik *et al.*, 2017; Lewis and Perry, 2017), teaching behaviour (Schipper *et al.*, 2018) and beliefs (Lewis and Perry, 2015; Schipper *et al.*, 2018) (Table II). But, as described by Fernandez and Yoshida (2004), LS is an empty shell that must be filled with the knowledge and skills of the collaboratively working team members. According to de Vries *et al.* (2017, p. 28) knowledge and skills and the completion of the four LS steps are promoting or impeding conditional factors. Two studies reported problems on this matter. First, Mutch-Jones *et al.* (2012) found no evidence for their theory that "sharing of expertise has positive effects on the content and processes of knowledge and understanding of learning disabilities challenges". They explain this by referring to a lack of professional expertise in the LS group and the fact that the LS cycle that was not fully completed. Second, Lewis and Perry, (2017) constructed three groups: one LS group with a research-based mathematical kit, one LS group without kit and one non-LS group. Lewis found a significant improvement in teachers' knowledge, but only when research-based resources were available and used by the LS team.

Future directions

LS is the catalyst of professional learning (Lewis and Perry, 2017; Mutch-Jones *et al.*, 2012; Rock and Wilson, 2005) and this learning should be mapped out for both teachers and students by making use of a theoretical framework.

Desimone (2009) describes professional teacher learning within the domains of knowledge, skills, attitudes and beliefs.

Mishra and Koehler (2006) in their TPACK-model break down teacher knowledge into technological, pedagogical and content knowledge, when integrating this knowledge within a certain educational context. Schipper *et al.* (2018) use a Dutch version of the Teachers' Sense of Efficacy Scale (Tschannen-Moran and Hoy, 2001) to measure different levels of teacher self-efficacy, as operationalized constructs for convictions or beliefs.

It is thus possible to further detail the professional teacher learning domain when addressing teacher learning from a different perspective. That is why we advise future researchers to refine and operationalise the constructs for measuring teachers' professional learning.

Beside this operationalization, LS research must identify circumstances and conditions for collective and individual learning among teachers, teacher candidates and students. Indeed, the current review focusses on how LS affects teachers' professional learning, while the ultimate aim of LS is to improve student achievements through the effectiveness of professional teacher development.

Despite the many positive classroom experiences and the sufficient evidence of the effectiveness of LS provided worldwide in small qualitative research, there is still a lack of significant evidence.

While acknowledging the complexity and associated challenges of performing well-controlled and well-implemented long-term studies that map the impact of LS on their educational context, we believe that researchers and governments should invest in this kind of long term research.

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Appendix. Critical appraisal checklist for controlled trialsLesson Study
effectiveness**Article****Author****Year****Record Number**

	Yes	No	Unclear	NA
1. Is the study published in an academic journal and is it peer-reviewed?	☐	☐	☐	☐
2. Is the research question clear and is it clear why the study was conducted?	☐	☐	☐	☐
3. Is the sample big enough?	☐	☐	☐	☐
4. Has the appropriate sample been obtained?	☐	☐	☐	☐
5. Does the study conduct a RCT or a quasi-/true-experimental design with control groups?	☐	☐	☐	☐
6. Are treatment groups similar at the baseline?	☐	☐	☐	☐
7. Are participants analyzed in the groups to which they were randomized?	☐	☐	☐	☐
8. Is the data collection method appropriate for the study design?	☐	☐	☐	☐
9. Is appropriate statistical analysis used?	☐	☐	☐	☐
10. Are outcomes measured in the same way for treatment groups?	☐	☐	☐	☐
11. Are outcomes assessors blind to treatment assignment?	☐	☐	☐	☐
12. Are outcomes measured in a reliable way?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐**Comments** (Including reason for exclusion)**Corresponding author**Iris Willems can be contacted at: iris_willems@telenet.be

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