Scaling up Lesson Study in Urban and Rural Schools to Realize Sustainable, Inclusive Teacher Professional Development in Zambia

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Abstract

A case study was conducted by employing exploratory sequential design of the mixed methods design to understand the progress and effectiveness of the government's scaling up process of the lesson study approach in Zambia, which started in a few pilot provinces and then moved to the non-pilot provinces. The major objectives of the study were to understand how the benefits of the scaling up of lesson study have reached school management and teachers; how the concept and method of lesson study and student-centred learning are understood, interpreted and practised by teachers in the non-pilot provinces; how the cognitive and non-cognitive developments of the students are observed in the classrooms; and to identify inhibiting factors in realizing an inclusive, quality education in the process of scaling up the use of lesson study. The findings of the study indicated that lesson study activities were conducted in schools because they had to follow the government policy in one of the non-pilot provinces, Lusaka Province of Zambia. However, the concept and/or methods of the lesson study were not properly understood or practised by the teachers. This paper suggests that to realize the substantial scaling up of the lesson study, not only policy dissemination or cascade-type training, but also school-based training and follow-up for teachers need to be conducted and strengthened, and headteachers and local education officers should provide teachers with the necessary skills and resources.

1. Introduction

Lesson study was developed in Japan in the middle of the 20th century as a method of teacher-led professional development; has been stimulated and improved by practical outcomes produced in the classroom and lesson analysis methods developed both within and outside Japan; and is now internationally recognized as a highly specified form of classroom action research.

Lesson study is a direct translation of the Japanese term *jugyo-kenkyu*, which is composed of two words: *jugyo*, which means lesson, and *kenkyu*, which means study or research and consists of the study or examination of teaching practices. Teachers engage in a well-defined process that involves discussion lessons that they have first planned and observed together (Fernandez and Yoshida, 2004). There are two types of lesson study: a top-down method, which disseminates the latest pedagogical information, and a grass-roots method, which reforms pedagogical practices by reviewing teaching and learning methods through teachers' observations and discussions (Inagaki and Sato 1996, Saito, 2012).

In response to serious problems that emerged in Japanese schools in the latter part of the

1990s, Sato and colleagues further developed lesson study for the learning community, an approach to lesson study that has been attracting practitioners and scholars in Japan (Sato 2006, 2007, Saito 2012). It means that lesson study has been developed and scaled up based on and following the practical needs of the schools. In this way, Japan has succeeded in developing a system that not only develops teachers but also develops knowledge about teaching that is relevant to the classroom and sharable among the members of the teaching profession (Stigler and Hiebert, 1999).

Lesson study is a relatively young enterprise outside Japan, and one of the most significant differences between lesson study and other types of professional development is the joint observation of real practices in classroom settings (Saito, 2012). According to Lewis, Perry and Murata (2006), lesson study improves teaching through the refinement of lesson plans, and it also strengthens pathways to instruction such as teachers' knowledge, teachers' commitment and community, and learning resources. Lesson study may stimulate the development of teachers' awareness of pupils' needs as well as different possible teaching strategies (Bjuland and Mosvold, 2015). Learners also tend to enjoy the lesson when lesson study activities are undertaken by teachers, and learners' enjoyment of the lesson enhances their motivation and learning performance.

For example, lesson study is practised widely in the United States (Lewis, 2013). In the United States, lesson study was introduced by scholars as a Japanese professional method to improve teachers' mathematical understanding in combination with a call for professional development that is more school-based and grounded in daily realities (Saito, 2012). It is too early to determine whether lesson study is successful in the United States, but the likelihood of success would be increased by the participation of Japanese educators who could help determine the essential qualities of lesson study, the key experiences that make it useful to teachers, and the supporting conditions that enable its effectiveness (Fernandez and Yoshida, 2004; Matoba and Sarkar Arani, 2005).

Lesson study experiences at the school level in Japan and the United States indicate that there are some key issues in realizing a sustainable, inclusive teacher professional development mechanism with lesson-study practices. Lesson study is not intended to be a stand-alone effort, and such efforts should be expanded, after starting lesson study with a single team of teachers, to include other teachers to embed lesson study for school improvement and professional development (Stepanek et al., 2007). There are several difficulties in the scaling-up activities performed by a single teacher or by a small number of teachers. There is a strong possibility that other members within the school have some negative feelings about lesson-study activities as well as the teachers engaging in them. In addition, managing the time factor is another problem since lesson study is regarded as a time-consuming activity in most cases. Some researchers have noted that school leaders or administrators need to extend their support to teachers carrying out lesson study activities (Saito, 2012).

Through Japan's official development assistance (ODA), international cooperation projects, to introduce lesson study methodology and to strengthen teacher professional development

practices, have been conducted in Asian and African countries including Indonesia, Laos, Senegal, and Zambia.

To realize an inclusive, quality education, it is necessary to consider not only education policy decided at the national level but also the improvement of classroom practices, which cannot be automatically brought about by such policy (Baba, 2011). In the classroom, teachers are the agents who implement the curriculum and play a key role in improving classroom practices and achievements. Teachers interpret and digest the concepts and contents of the curriculum first; then, they make plans for actual lessons based on their understanding. The capacity of teachers is one of the critical elements of improving teaching and learning processes and outcomes. The remarkable feature of the evidence (from the more than 50,000 students and 800+ meta-analyses) that the biggest effects on student learning occur when teachers become learners of the own teaching, and when students become their own teachers (Hattie 2009). UNESCO encourages the image of teachers as lifelong learners.

However, teachers have unique problems, especially in developing countries, namely, i) too much quantitative expansion before quality improvement, ii) many unqualified teachers, iii) negative assets from a colonial period, iv) inadequate working conditions or treatment of teachers, and v) non-existent or weak subject-based research. To tackle these issues, various teacher training programmes, including lesson study, are being implemented in developing countries (Baba, 2011).

1.1 Lesson Study in Zambia

In Zambia, while significant progress may have been made with regard to universal access to education, low performance is prevalent in most schools. The 2013 Grade Nine National Assessment Survey conducted by the Examinations Council of Zambia in all ten provinces of Zambia indicated that a large proportion of learners in grade nine were below the minimum level of performance (Examinations Council of Zambia, 2013). The Ministry of Finance and National Planning (2014) in Zambia also noted that there had been little progress reported in the quality of most schools, and as a result, learning outcomes have remained low.

Japan International Cooperation Agency (JICA) has supported some countries across the world in integrating lesson study activities into their teacher professional development programmes, and Zambia is not an exception. Since 2004, the government of Zambia has worked with JICA to institutionalize lesson study across Zambia as a way of improving primary and secondary mathematics and science instruction (Robinson, 2015:1).

The Ministry of General Education has given teacher professional development a high priority, as outlined in the 1996 policy document “Educating Our Future.” The policy statements are translated in the development and institutionalization of the School-Based Continuing Professional Development (SBCPD) through the development of the School Programme of In-service for the Term (SPRINT) Framework.

After spending one year between 2004 and 2005 reviewing existing systems, developing a program/project framework, and deploying key personnel, a technical cooperation project, the

Strengthen Mathematics, Science and Technology Education (SMASTE) project, was initiated by the Ministry of Education in collaboration with JICA. In Zambia, lesson study is conducted in a cycle that contains the following eight (8) activities: i) setting an issue and theme, ii) preparing an experimental lesson collaboratively, iii) implementing and observing a lesson, iv) reflecting on the lesson, v) improving the lesson plan based on the reflection, vi) implementing and observing the improved lesson, vii) reflecting on the lesson again, and viii) summarizing the activities (Ministry of Education, 2007).

Under SMASTE Phase 1 (2005-2007), 1,989 teachers from 213 schools from one (1) pilot province (Central Province) were trained, and the Ministry developed an 18-year master plan for SBCPD through lesson study. SMASTE Phase 2 (2008-2010) trained 14,035 teachers from 1,057 schools from three (3) pilot provinces (Central, Eastern and North-Western Provinces), followed by the Strengthen Teachers' Performance and Skills (STEPS) project (2011-2015), which covered 42,000 teachers from 3,000 schools from all 10 Zambian provinces. "The Project for Improvement of Pedagogical Content Knowledge: Linking Pre-Service and In-service Education (IPeCK)" is a 5-year project, between 2014 and 2019, intended to strengthen the teacher professional development system with an improved understanding of lesson study. According to the scaling-up plan of the Ministry of General Education, by 2023, the remaining approximately 100,000 teachers from approximately 9,500 schools from the 10 provinces will be included (Nakai, 2016) in the lesson study learning community.

According to "the Report on the Impact Assessment of Lesson Study in Zambia," a comparison of the pass rates of all the science and mathematics subjects between 2009 and 2013 shows a significant improvement in the 3 (three) pilot provinces out of all 10 provinces in Zambia: namely, Central, North-Western and Eastern Provinces. In science, the performance of learners improved from 35.47% in 2009 to 73.24% in 2013 for North-Western Province, from 60.78% to 63.3% for Central Province, and from 48.38% to 50.72% for Eastern Province, respectively. The pass rates at the national level also improved from 53% in 2009 to 63% in 2013 in science and from 40% in 2009 to 49% in mathematics. The results of the impact assessment show that lesson study has positively impacted teachers' attitudes, the teaching process, and pupils' attitudes towards learning mathematics.

"Millions Learning – Scaling up Quality Education in Developing Countries," prepared by the Centre for Universal Education at the Brookings Institution, chose "Lesson Study, Zambia" as one of the 14 cases that demonstrated a measurable improvement of learning to differing degrees in a low- or middle- income country across a diversity of contexts and levels to examine their scaling experience (Robinson 2016). The report concludes that the success of lesson study in Zambia was dependent on the view that teachers are agents of change, rather than targets of training. Key features of scaling up lesson study also include its flexibility in design and implementation, the introduction of lesson study as a complement to an existing in-service training programme rather than as a parallel project by the Zambian government and JICA, and strong government ownership of the programme (Jung, 2016).

1.2 Problem Statement

Lesson study, adopted from Japan, has been successfully scaled up in Zambia through the government policy according to the report of the Brookings Institution; however, low performance is still prevalent in most schools in Zambia. Positive changes of learners' performance in the three pilot provinces and the national pass rate improvement has been observed between 2009 and 2013; which were not sustainable. After STEPS (2011-2015) and IPeCK (2014-2019) started with covering nation-wide schools in the non-pilot provinces, the quality improvement in basic education has slowed down or stopped. The Ministry of Finance and National Planning in Zambia noted in 2014 that there has been little progress in increasing the quality in most schools; as a result, learning outcomes have remained low.

In Japan, lesson study has been improved and nation-widely practiced through bottoms-up approach based on educational practitioners' needs. Substantial (not superficial) understanding and delivery of lesson-study practices and the learner-centred lesson image are shared by teachers and administrators to make lesson-study practices and outcomes more effective and sustainable at the school level.

A notable difference between lesson study in Zambia and in Japan is whether concerned educators and education administrators share a common understanding of a targeted lesson image realized through lesson study. Zambian educators or administrators might say the target image is "learner-centred," as written in the policy, but few of them can clearly express what the target image is beyond the abstract expression (Baba, 2011). Teachers' understanding and delivery of learner-centred pedagogy was still relatively superficial, while evaluations found that the lesson study practice improved teachers' lesson planning and students' performance on exams (Lingambe et al., 2014). Some teachers and head teachers hold negative attitudes towards continuing professional development through lesson study practice, seeing it as a burden of additional work forced by the government (Jung, 2016).

Successful scaling up of lesson study was reported after a 6-year pilot project in the 3 target provinces followed by a 7-year nation-wide distribution covering all 10 provinces of Zambia. However, the government of Zambia noted that there had been limited improvement observed in realizing quality education after the scale-up. Detailed research or impact survey has not yet been conducted to clarify the reasons.

There might be some gap between school management and teachers' understanding and practices of lesson study in the pilot provinces and the ones in the non-pilot provinces. The top-down scale up attempt with the government policy could cover all schools; however, the concept and methods of lesson study might not have reached school management or teachers properly and encouraged school-based teacher professional development.

2. Purpose of the Study

The research aims to understand how the benefits of the scaling up of lesson study have reached school management and teachers and contributed to the quality education at the school level in the non-pilot districts; and to draw implications for the improved school-based teacher

professional development.

The following are the research question of the study:

i) How are the concept and methods of lesson study are understood, interpreted and practised by school management and teachers in the non-pilot provinces?
ii) How have cognitive and non-cognitive developments been observed among the students in the non-pilot provinces?
iii) Are there any differences between the output of the scaling up of lesson study in the urban school and the one of the rural schools?
iv) What are the contributing factors to encourage teachers to practice lesson study for their teacher professional development?

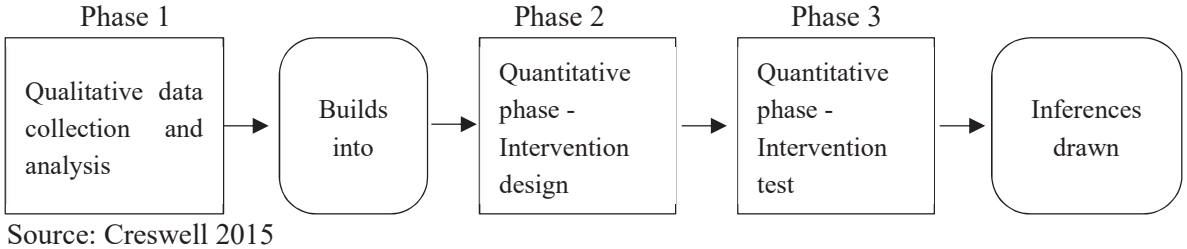
3. Methodology

This study conducted a case study employing a exploratory sequential design of the three basic design of the mixed methods approach. A core assumption of the mixed methods approach is that when an investigator combines statistical trends (quantitative data) with stories and personal experiences (qualitative data), this collective strength provides a better understanding of the research problem than either form of data alone.

Through the exploratory sequential design of the mixed methods approach, qualitative data is first collected and analysed. The results from the qualitative data are examined and used to design a quantitative component, such as new measures or new intervention activities. The idea is that the new quantitative component improves on what is already available because it is grounded in the actual experiences of participants. Then, the new quantitative component is practiced and tested; finally, how the new component improves the existing one is reported (Creswell 2015).

The three phases of the explanatory sequential design are shown in Figure 1.

Figure 1: Exploratory Sequential Design of the Research



Source: Creswell 2015

Following the three phases of the exploratory sequential design, the following steps were conducted in the study:

<Phase 1: Qualitative data collection and analysis>

1-1 A workshop of "strengths, weaknesses, opportunities, threats (SWOT) analysis" with stakeholders in basic education development in Lusaka Province;
1-2 Observation and video recording of lesson study practices; and

1-3 Semi-structured interviews

<Phase 2: Quantitative phase – Intervention design>

2-1 Designing an intervention and questionnaire

2-2 Baseline quantitative data collection (questionnaire survey) and analysis

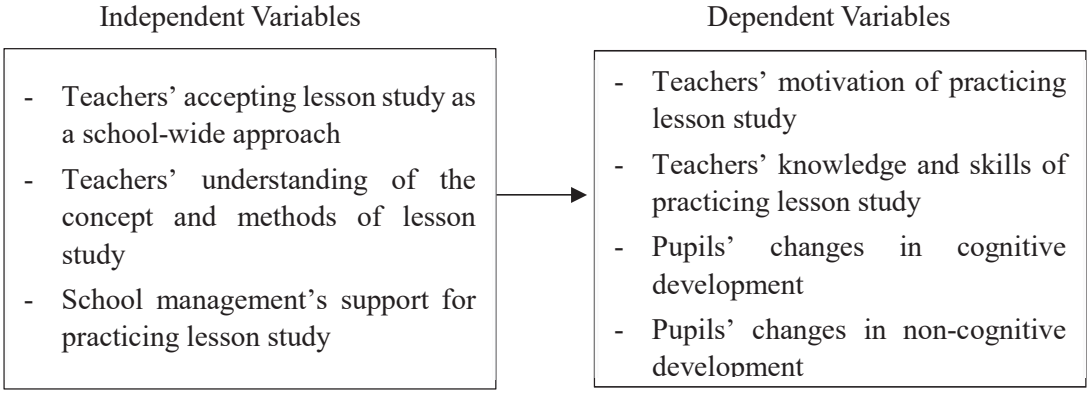
<Phase 3: Quantitative phase- Intervention test>

3-1 Intervention implementation

3-2 End-line quantitative data collection (questionnaire survey) and analysis

A conceptual framework to answer the research questions mentioned above was tentatively prepared as in Figure 2, which would be updated based on the results of the qualitative data analysis in Phase 1.

Figure 2. Conceptual Framework of the Study



To understand the changes in teachers' attitude and understanding and students' cognitive and non-cognitive development before and after the intervention test, a questionnaire survey including the Likert scale (from 5 = strongly agree to 1 = strongly disagree) questions was designed in Phase 2 based on the results from the qualitative data analysis in Phase 1. The questionnaire of teachers had 30 questions answered using a Likert scale (ranging from 5=totally agree to 1=totally disagree) in four sections, namely, i) about your school situation; ii) about your own knowledge and skills; iii) about the pupils' achievement; and iv) your assessment of lesson study outcome. The questionnaire of students had 27 questions also answered using a Likert scale in five sections: including i) your score (percentage) on the last exam; ii) how much fun you have in each subject; iii) relationship with your mathematics teacher; iv) how many hours you study at home; v) your parents' relationship with your school. The questionnaire forms are as shown in the appendix of this article.

The baseline questionnaire survey was conducted in June 2016; the intervention was implemented between September 2016 and June 2017; and the end-line survey in October 2017. The data were analysed as follows: qualitative data using thematic analysis and quantitative data using descriptive statistics, t-test, and correlation analysing methods.

3.1 Target Schools

Two target schools were selected purposively from Lusaka Province, which is one of the 7 non-pilot provinces: one high school (High School A) from an urban area and the another (High School B) from a rural area. The two target schools are outlined in Table 1.

Table 1: Outline of the Two Target Schools

School name	High School A in an urban area	High School B in a rural area
School outline	852 students (Female: 240 students, Male: 612 students)	1,836 students (Female 540 students, Male: 1,296 students)
	63 teachers (Female: 27 teachers, Male: 36 teachers)	71 teachers (Female: 30 teachers, Male: 41 teachers)
	- One of the top achievement high schools in Zambia - High transition rate to higher education - Shortage of textbooks and teaching materials	- Limited high schools in the rural area - Overcrowded classroom - Shortage of textbooks and teaching materials - Students have low English proficiency

Source: High Schools A and B, October 2017

3.2 Research Process

Phase 1: Qualitative data collection and analysis (June 2016)

The teachers and schools of Lusaka Province, which is one of the non-pilot provinces of SMASTE Phase 1 (2005-2007) and SMASTE Phase 2 (2008-2010), have been involved in the lesson study training since STEPS started in 2011.

From the observation of the lessons in the target schools, teachers conducted a lesson under the lesson study programme, which proved that the concept and/or methods were not properly understood by those teachers. The teachers did not follow the lesson study process. They just conducted a class with colleague teachers participated; none of the steps for teachers' mutual learning of i) preliminary setting of an issue and theme; ii) preparing experimental lesson collaboratively prior to the lesson; and iii) discussing and reflecting after the lesson were conducted. Lesson study activities were conducted only by mathematics and science teachers, which follows the scope of lesson study given by the JICA-supported project. As a result, those activities were not recognized by the entire school, and only limited support was given by the administrative staff of the schools.

The interviews of head teachers and deputy head teachers showed that at both schools, few teachers understood the objective of lesson study. They are the ones who attended the lesson study cascade-type training. In comparing teachers at the urban school with those at the rural school, the subject teachers at the urban school appeared be collaborating more in conducting lesson study and planning/reflecting meetings, which might indicate that they better understood the lesson-study objectives.

The SWOT analysis workshop was conducted on June 16, 2016, with 11 people

participated: namely, 2 people from provincial education offices, 6 from the target schools including head teachers and teachers, 3 from University of Zambia and Hiroshima University. At first, the progress, achievement and constraints of lesson study practices were presented by each high school and the provincial education officers explained the national policy and the progress and challenges of the other schools in Lusaka Province. Based on the information, the SWOT analysis was conducted by all the participants. Table 2 below outlines the results of the SWOT analysis of the lesson study practices at the target schools.

Table 2: Summary of the SWOT Analysis Results

Strengths	**Weaknesses**
1) More student-oriented lessons. 2) More lesson plans developed. 3) More devised lessons. 4) More confidence in the lessons. 5) Improved teacher collaboration. 6) Challenges through improved teamwork among same subject teachers. 7) Improved lesson quality.	1) Lesson study is not recognized as a school-wide activity, just for mathematics/science subjects. 2) Limited support from school administration. 3) Time-consuming 4) Additional burden for teachers. 5) Few teachers understand the concept and/or methods of lesson study. 6) Teachers are reluctant to conduct a lesson study class and to be assessed by colleagues. 7) Lack of text and materials available for students. 8) Poor English capacity of students.
Opportunities	**Threats**
1) Lesson study can strengthen school teaching capacity when implemented in all subjects. 2) Capacity development of school coordinator. 3) Monitoring by zone/district coordinator needs to be improved. 4) Exchange of experiences among schools. 5) Support from teacher training institute.	1) High time and cost requirements. 2) Too busy with extracurricular activities. 3) Classroom is too crowded. 4) Teachers have trouble advising each other (afraid of criticizing). 5) Teachers might try to look good only for a lesson study class.

Source: Baseline and End-line Surveys of the Research, 2016, 2017

Phase 2: Quantitative phase – Intervention design (June and July 2016)

Through the analysis of qualitative data collected by the classroom observation, interviews and SWOT analysis results, the following approaches were identified as key to improving sustainable, quality lesson study practices at the target schools:

i) to promote lesson study activities for all subjects; and

ii) to strengthen school management support.

During the discussion with the SWOT analysis participants, it was unexpectedly reported that the government of Zambia would introduce a new lesson study strategy to request all schools to practice lesson study not only in science and mathematics classes but in all subject classes.

After the government's updating the lesson study policy, all primary and secondary schools are to practice lesson study in all subjects for school-based teacher professional development.

Following the update of the lesson study policy, for expanding lesson study coverage in each school, the school management would provide some guidance of lesson study for teachers and encouraged them to conduct lesson study in all subjects. The study decided to consider this series of events as effective interventions and to see the changes caused by them in the target schools. The baseline questionnaire survey was conducted in June 2016 before the updated lesson study approach was introduced by the target schools.

Phase 3: Quantitative phase – Intervention test (September 2016 – October 2017)

Soon after the baseline survey, following the government policy, the head teachers of the target schools officially announced that lesson study should be promoted not only for mathematics and science subjects but also for the other subjects and that lesson study activities need to be supported by the school administrative staff members. During the period between September 2016 and October 2017, lesson study was to be practiced in all subjects in the target schools. The end-line questionnaire survey was conducted in October 2017.

The questionnaire surveys covered 19 teachers and 74 students in the baseline and 40 teachers and 45 students in the end-line, as summarized in Tables 3 and 4.

Table 3: Summary of the Questionnaire Respondents (Teachers)

Baseline or End-line	School	No. of respondents by sex (persons)				By total years of teaching (persons)			
		Female	Male	Not specified	Total	0 = < <10 years	10 = < <20 years	20 = < years	Total
Baseline	A	1	7	0	8	3	4	1	8
	B	2	9	0	11	7	2	2	11
	Total	3	16	0	19	10	6	3	19
End-line	A	8	12	1	21	11	5	5	21
	B	7	12	0	19	12	6	1	19
	Total	15	24	1	40	23	11	6	40

Source: Baseline and End-line Surveys of the Research

Table 4: Summary of the Questionnaire Respondents (Students)

Baseline or End-line	School	No. of respondents by sex (persons)				By grade (persons)			
		Female	Male	Not specified	Total	Grade 11	Grade 12	Not specified	Total
Baseline	A	12	32	3	47	20	25	2	47
	B	10	15	2	27	0	27	0	27
	Total	22	47	5	74	20	52	2	74
End-line	A	2	18	0	20	11	9	0	20
	B	4	21	0	25	12	13	0	25
	Total	6	39	0	45	23	22	0	45

Source: Baseline and End-line Surveys of the Research

4. Research Findings and Discussions

The results of the questionnaires of teachers at the baseline and end-line surveys at High School A and High School B are outlined in Table 5 below.

Table 5: Descriptive Statistics of Teachers' Questionnaire (Questions 1-1 – 3-5)

	High School A						High School B					
	Baseline			Endline			Baseline			Endline		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
1-1	8	3.88	0.641	21	4.19	0.814	11	4.00	0.775	19	3.47	1.172
1-2	8	3.63	0.744	21	4.48	0.873	11	4.18	0.405	19	4.37	1.065
1-3	8	4.13	0.991	20	4.65	0.745	11	4.00	0.632	19	3.63	1.571
1-4	8	3.25	0.707	20	3.75	0.967	11	3.55	0.522	19	3.32	1.293
1-5	8	4.25	0.886	20	4.70	0.657	11	4.18	0.603	19	4.21	1.316
1-6	8	3.25	1.282	20	3.80	1.196	11	3.64	0.809	18	3.28	1.674
1-7	8	3.00	1.069	20	3.10	1.373	11	3.18	1.168	19	2.37	1.535
1-8	8	3.63	1.506	20	4.40	0.754	10	3.30	0.949	19	2.79	1.584
1-9	8	3.75	1.165	20	4.10	0.852	10	2.80	0.919	19	2.68	1.204
1-10	8	4.00	1.069	19	4.68	0.671	11	4.00	0.632	19	3.16	1.463
2-1	8	3.88	1.356	21	4.57	0.676	11	3.91	0.539	19	4.11	1.100
2-2	8	3.75	1.035	20	3.95	0.945	11	3.73	0.467	19	3.47	1.504
2-3	8	3.13	0.641	21	4.57	0.811	11	4.09	0.701	18	4.56	0.856
2-4	8	3.88	0.991	21	4.52	0.873	11	4.00	0.632	19	4.26	0.933
2-5	8	3.63	0.744	21	4.76	0.539	11	4.09	0.701	19	4.53	0.841
3-1	8	3.75	0.707	21	4.52	0.512	11	3.82	0.603	19	3.32	1.108
3-2	8	3.50	0.756	21	4.10	0.700	11	3.55	0.522	18	3.44	0.784
3-3	8	3.50	0.535	21	4.14	1.108	11	3.73	0.467	18	3.22	1.060
3-4	8	3.63	0.744	21	3.90	0.831	11	3.18	0.405	17	2.82	0.883
3-5	8	3.63	0.744	21	4.10	0.625	11	3.45	0.688	17	2.65	1.169

Source: Field data, 2016, 2017

In both schools, teachers of not only mathematics and science but also other subjects were provided the questionnaire during the end-line survey, which proves that the intervention was functional. The mean values of the teachers' answers from High School A in the end-line are higher than those from the baseline, while some of the teachers' answers from High School B show decreased values on the questions related to the local coordinators' monitoring and guardians' and pupils' understanding. High School B might have disadvantage in being monitored by local coordinators. Additionally, there was a transfer of head teachers in High School B, which might have caused negative effects.

The results of questions 4-1 to 4-10 at High School A and High School B, which were added to the end-line questionnaire to further understand teachers' attitude and understanding of lesson study, are shown in Table 6. At both schools, teachers of mathematics and science as well as the other subjects answered the questions. Most of the mean values from High School A are higher than those from High School B, and the standard deviation of the teachers' rating of High School B is higher than that of High School A for most questions. This difference might be caused because there was not continuous support to lesson study due to the head teacher transfer in High School B.

Table 6: Descriptive Statistics of Teachers' Questionnaire (Questions 4-1 to 4-10)

	High School A / Endline			High School B / Endline		
	N	Mean	SD	N	Mean	SD
4-1	21	4.48	0.750	19	4.21	0.918
4-2	21	4.43	0.811	19	4.47	0.905
4-3	19	4.58	0.607	16	4.75	0.447
4-4	21	4.43	0.811	19	4.37	0.761
4-5	19	4.37	0.761	19	4.11	0.937
4-6	20	4.40	0.754	19	4.53	0.841
4-7	21	4.43	0.676	19	4.53	0.612
4-8	21	4.43	0.811	19	4.21	0.918
4-9	21	4.52	0.680	18	3.72	1.018
4-10	21	4.48	0.680	19	3.95	1.129

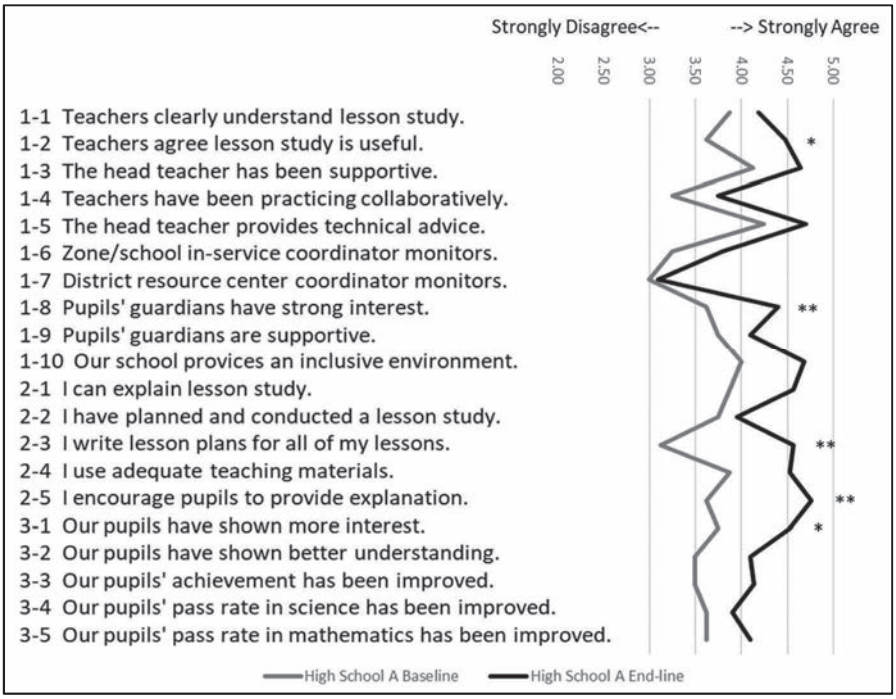
Source: Field data, 2017

As shown in "3-1. High School A" of Figure 3, at High School A (urban school), improvements are observed from the baseline to end-line survey, by comparing the differences between the means of the teachers' answers of the two surveys. In Figure 3, '**' and '*' show the differences are significant at the 1% and 5% levels, respectively, based on the statistical test of the difference between the means of two different groups. Teacher ratings show significant positive changes in questions "1-8 Pupils' guardians improved interest," "2-3 I write lesson plans for all of my lessons," and "2-5 I encourage pupils to provide explanations." Teachers are practising lesson plan preparation and student-centred lessons following the lesson study concept.

At High School B (rural school), as in "3-2. High School B" of Figure 3, improvements are found in the answers to 7 (seven) questions, while there was some decrease in the answers to 13 questions. The questions of "1-3 Head teachers has been supporting," "Teachers have been collaboratively practising," and "Zone/school in-service coordinator monitor" show significant negative changes. On the other hand, there is some improvement in the means of the questions "2-3 I write lesson plans for all of my lessons," "2-4 I use adequate teaching materials," and "2-5 I encourage pupils to provide explanations." The intervention could not improve the collaboration among teachers in High School B. The school management has changed at High School B, which might cause some confusion about the intervention of the updated lesson study policy or school approach. The graph also shows that teachers are more confident in lesson preparation and in student-centred lessons at High School B.

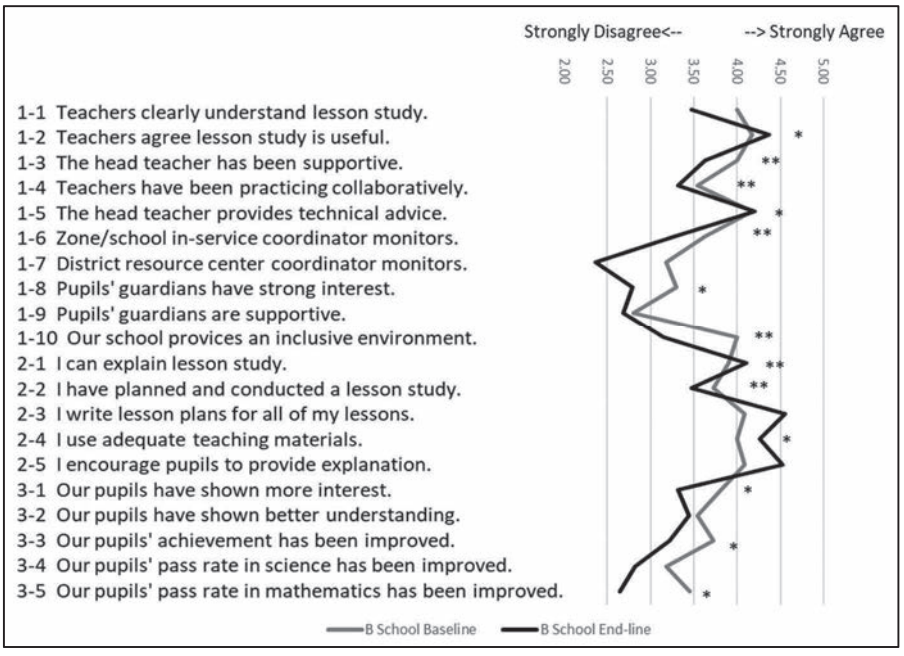
Figure 3: Difference between the Baseline and End-line Answers

3-1: High School A (** = p<0.01 * = p<0.05)



Source: Authors, 2017

3-2: High School B (** = p<0.01 * = p<0.05)

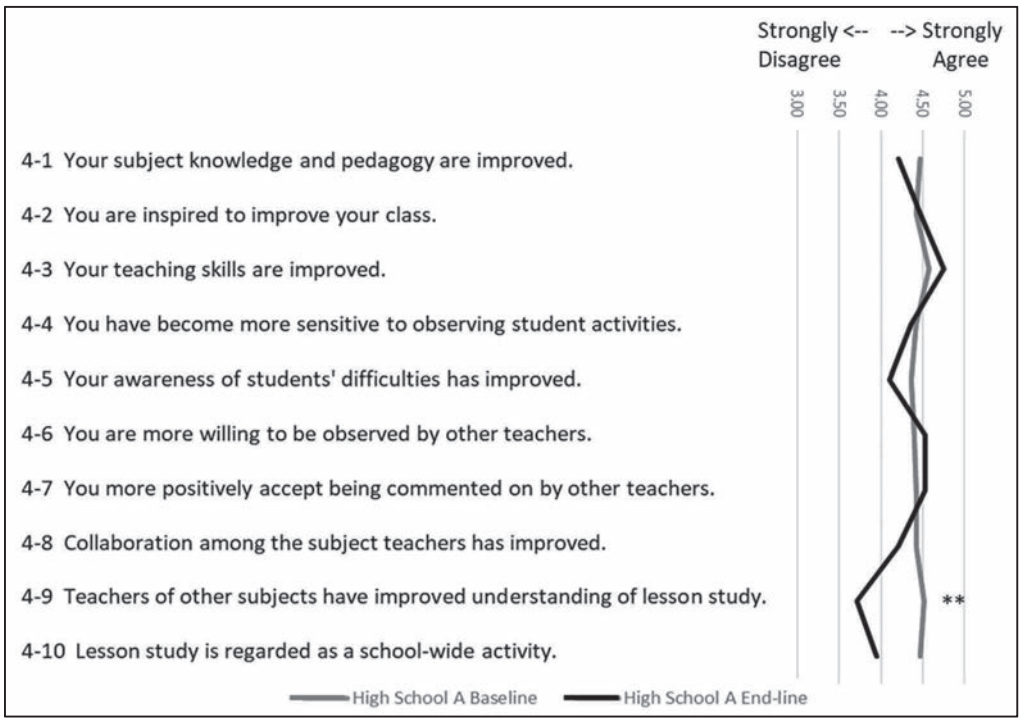


Source: Authors, 2017

Questions 4-1 to 4-10 were added to determine how teachers felt about the changes in their own knowledge, skills and practices and other teachers' attitudes after experiencing lesson study for 16 months.

As shown in Figure 4, most of the means of the 10 questions 4-1 to 4-10 are relatively high scores between 4 and 5. The difference between High School A and High School B is significant at the 1% level for the question "4-9 Other subject teachers' understanding of lesson study is improved." Teachers are relatively confident in their knowledge, skills, and pedagogy and are more sensitive to students' activities and difficulties at High School A and High School B; however, mathematics and science teachers at High School B still experience some difficulties in collaborating with the other subject teachers. The difference between the two schools again proved that the weakened school management support due to the head teacher transfer influenced the teachers' lesson study practices negatively in High School B.

Figure 4: Difference between High School A and High School B Answers



Source: Authors
Note: ** = $p<0.01$

Tables 7 and 8 show the correlation coefficients of teachers' ratings of questions 4-1 to 4-10 for High Schools A and B, respectively. At High School A, the better relationship with the other subject teachers shows a significant correlation with teachers' confidence in their knowledge and skills. At High School B, collaboration with the other subject teachers continues to be limited; therefore, collaboration may not yet contribute to the improvement of teachers' knowledge and pedagogy. All teachers must have known that lesson study is a school-wide approach for their teacher professional development; however, limited teachers' collaboration negatively influence their knowledge and skills in High School B.

Table 7: Correlation Coefficients of Questions 4-1 to 4-10 (High School A)

	4-1 Your subject knowledge and pedagogy are improved.	4-2 You are inspired to improve your class.	4-3 Your teaching skills are improved.	4-4 You have become more sensitive to observing student activities.	4-5 Your awareness of students' difficulties has improved.	4-6 You are more willing to be observed by other teachers.	4-7 You more positively accept being commented on by other teachers.	4-8 Collaboration among the subject teachers has improved.	4-9 Teachers of other subjects have improved understanding of lesson study.	4-10 Lesson study is regarded as a school-wide activity.
4-1 Your subject knowledge and pedagogy are improved.	1.000									
4-2 You are inspired to improve your class.	.575**	1.000								
4-3 Your teaching skills are improved.	.574*	.500*	1.000							
4-4 You have become more sensitive to observing student activities.	.745**	.524*	0.275	1.000						
4-5 Your awareness of students' difficulties has improved.	.516*	.663**	0.458	.485*	1.000					
4-6 You are more willing to be observed by other teachers.	.525*	0.176	0.291	0.333	0.092	1.000				
4-7 You more positively accept being commented on by other teachers.	.437*	-0.010	0.354	0.204	0.043	.657**	1.000			
4-8 Collaboration among the subject teachers has improved.	0.279	0.148	0.009	0.077	0.121	0.224	0.240	1.000		
4-9 Other subject teachers' understanding of LS is improved.	.507*	.437*	0.326	0.404	0.306	0.128	0.078	.463*	1.000	
4-10 Lesson study is regarded as a school-wide activity.	0.393	.517*	0.213	.440*	.546*	0.101	-0.105	0.416	0.418	1.000

Source: Authors
Note: ** = p<0.01 * = p<0.05

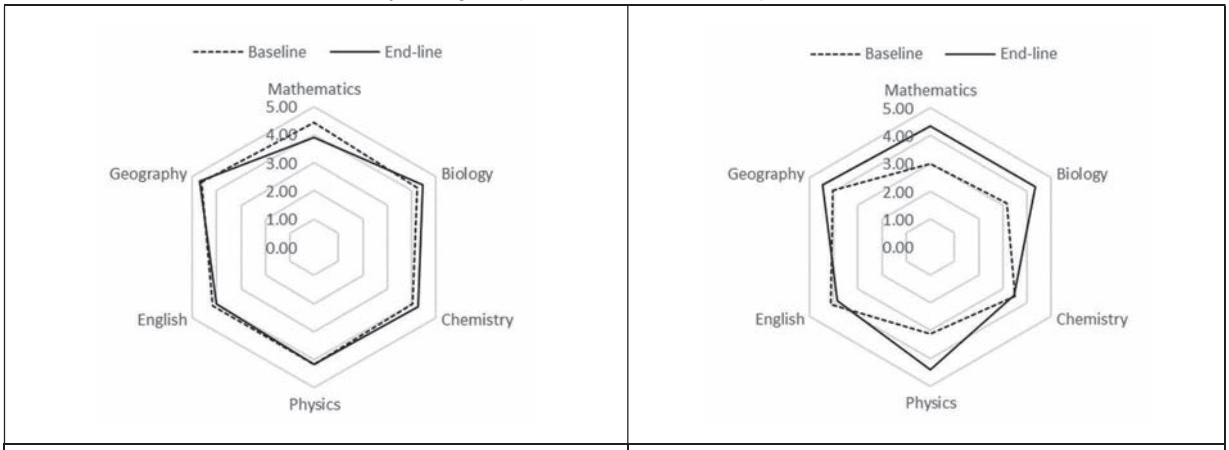
Table 8: Correlation Coefficients of Questions 4-1 – 4-10 (High School B)

	4-1 Your subject knowledge and pedagogy are improved.	4-2 You are inspired to improve your class.	4-3 Your teaching skills are improved.	4-4 You have become more sensitive to observing student activities.	4-5 Your awareness of students' difficulties has improved.	4-6 You are more willing to be observed by other teachers.	4-7 You more positively accept being commented on by other teachers.	4-8 Collaboration among the subject teachers has improved.	4-9 Teachers of other subjects have improved understanding of lesson study.	4-10 Lesson study is regarded as a school-wide activity.
4-1 Your subject knowledge and pedagogy are improved.	1.000									
4-2 You are inspired to improve your class.	.561*	1.000								
4-3 Your teaching skills are improved.	0.296	.682**	1.000							
4-4 You have become more sensitive to observing student activities.	0.193	.557*	0.385	1.000						
4-5 Your awareness of students' difficulties has improved.	-0.046	0.297	0.422	.787**	1.000					
4-6 You are more willing to be observed by other teachers.	0.247	.640**	0.333	0.394	0.289	1.000				
4-7 You more positively accept being commented on by other teachers.	0.041	.463*	0.149	.582**	.489*	.631**	1.000			
4-8 Collaboration among the subject teachers has improved.	0.154	.478*	0.303	.800**	.615**	.476*	.479*	1.000		
4-9 Other subject teachers' understanding of LS is improved.	-0.084	.473*	0.241	.562*	.551*	0.306	.728**	.536*	1.000	
4-10 Lesson study is regarded as a school-wide activity.	0.054	.644**	0.354	0.270	0.336	.539*	.566*	0.140	.588*	1.000

Source: Authors
Note: ** = p<0.01 * = p<0.05

The results of the questionnaire survey to see the students' cognitive and non-cognitive skills changes are summarized in Figures 5 and 6 below.

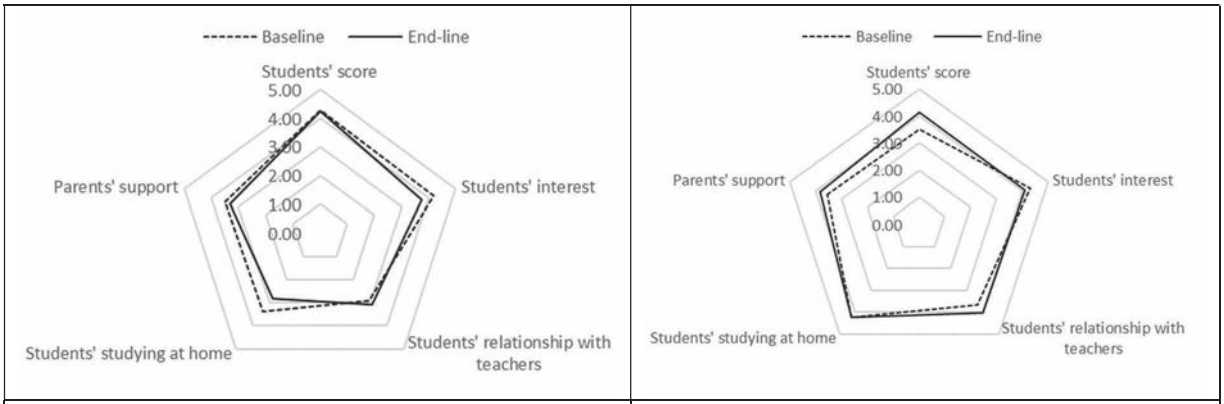
Figure 5: Radar Charts of Students' Examination Scores by Subject (Questions 1-1 – 1-6)



Mean Values of Major Subjects of High School A	Mean Values of Major Subjects of High School B

Source: Authors, 2017
Note: 5-level Likert scale (5 = 80-100%, 4 = 60-79%, 3 = 40-59%, 2 = 20-39%, 1 = 0-19%)

Figure 6: Radar Charts of Students' Rating by Section 1 – 5 Average Scores



Mean Values of Each Section at High School A	Mean Values of Each Section at High School B

Source: Authors,2017
Note: 5-level Likert scale (5 = strongly agree/always, 4 = agree/often, 3 = neither disagree nor agree/sometimes, 2 = disagree/seldom, 1 = strongly disagree/never)

In Figure 5, there is only limited development between the baseline survey and the end-line survey for High School A, while clear improvements are observed for High School B. The target groups of the questionnaire surveys are not the same between the baseline and the end-line surveys. Although the respondents were randomly chosen by each school, the differences may affect the results in some ways. Considering that High School A has been a highly reputed school with good promotion rates, it is understandable that there was a little improvement. At High School B, the significant improvements are observed in mathematics, biology and physics. It might be possible

to say that lesson study has contributed to the improvement; however, the influence of the intervention is not clearly observed since limited improvement in geography and decreased score in English in High School B.

Figure 6 shows the differences between the mean values of students' ratings by section of the baseline survey and the end-line survey. At High School A, there is a 0.43-point decrease in the mean value of Section 2 "Students' Interest" and a 0.54-point decrease in the mean value of Section 4 "Study at Home" from the baseline to the end-line survey, while there is a 0.18-point increase in Section 3 "Relationship with Teachers." At High School B, there is a 0.37-point increase in the mean value of Section 3 "Relationship with Teachers" and a 0.28-point increase in Section 5 "Parents' Support," which relates to students' non-cognitive development.

When comparing the results of the two schools, High School A already has good achievement in test scores and students' interest in major subjects; however, students' relationship with teachers and/or guardians' relationship with the school are relatively limited and the intervention did not improve the situation. On the other hand, at High School B, teachers with student-centred approach in their mind have produced positive changes of the students both in cognitive and the non-cognitive skills in mathematics and science, although the benefits of lesson study have not been shared with the other subjects yet due to the limited school management support.

5. Conclusions and Recommendations

The study results indicate that some benefits of the scaling up of lesson study have reached schools and teachers in the non-pilot provinces. Teachers have conducted lesson study in mathematics and science by respecting student-centred approach and gradually started lesson study practices in the other subjects, although they are not yet confident of lesson study concept and methodology. There have been limited training and/or workshop related to lesson study conducted for teachers, although only few teachers could join a cascade-type training provided by the JICA-supported programme.

In the study, positive changes in teachers' attitudes and understanding and in students' cognitive and non-cognitive development are more clearly observed in High School B than in High School A. High School A is already highly reputed school, while High School B still has room for growth, which might prove the effectiveness of lesson study practices.

After the updated lesson study policy introduced and all subjects covered by lesson study, more teachers have regarded lesson study as serious challenge of the school. A top-down strategy has successfully encouraged Zambian teachers to practice lesson study. The negative impact caused by the head teacher transfer in High School B shows that the school management support is one of the key factors to promote. The study could target only two schools; therefore, the difference between urban and rural was not clarified.

In conclusion, based on some changes among the teachers and students of the two target schools, followings are the possible implications to improve the effectiveness of lesson study in the non-pilot provinces.

1) Teachers' understanding of the lesson study objective and method and their motivation to practice lesson study are positively correlated with supportive school management and with good relationships with teachers of other subjects.
2) Teachers' improved understanding of lesson study contributes to their increased motivation to practice student-centred lessons with prepared lesson plans and teaching materials and to practice sensitivity to student understanding and difficulty.
3) More teachers, through lesson study practices, are willing to be observed and commented on by other teachers and to have positive attitudes towards improving their lessons by learning from each other.
4) Through this research, it was not clear how lesson study contributes to students' cognitive development; however, the study implies that by enhancing teachers' understanding of student-centred lessons, lesson study contributes to the improvement in students' non-cognitive development, especially students' improved relationships with teachers in the rural school.
5) Not only policy dissemination or cascade-type training, but also school-based training and follow-up for teachers need to be conducted and strengthened, and headteachers and local education officers should provide teachers with the necessary skills and resources.

The Brookings Institute's case study report on the lesson study programme in Zambia notes that one of the major reasons for scaling up the programme is to employ teachers as change agents. Traditionally, teachers are the beneficiaries of education development projects; however, the lesson study programme has set out to change teachers' mindsets and to lead teacher professional development. The report also mentions that one of the greatest challenges in launching lesson study was in impressing upon teachers the importance of continuing their own education and training. As teachers began to witness the difference in the performance of their students through their lessons, many began to appreciate the impact of their lesson study practices (Jung et al., 2016).

As evidenced by the case study findings, in the non-pilot provinces of the lesson study approach in Zambia, which are new to the lesson study programme, teachers do not yet properly understand the concept or the methodology of lesson study or do not have any opportunities to witness changes in their students' attitudes or performance. Therefore, this paper recommends that school-based training, to improve teachers' understanding of "why and how lesson study needs be conducted in the context of Zambia" and to reactivate and encourage their lesson-study practices, should be conducted for teachers of all subjects as a school-wide strategy. Simultaneously, head teachers and school management should play a key role in supporting teachers and providing them with the skills and resources they require to incorporate the practice of lesson study as part of their daily teaching practices.

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APPENDICES

Appendix 1

Questionnaire for Teachers:

1. About Your School Situation:
   - 1-1 The teachers in my school generally clearly understand the objective and method of "lesson study".
   - 1-2 The teachers agree that lesson-study activities are useful for improving teaching in general.
   - 1-3 The head teacher has been actively supporting the lesson-study activities.
   - 1-4 The teachers have been collaboratively practising the lesson-study activities.
   - 1-5 The head teacher gives us technical advice to improve our teaching.
   - 1-6 The zone/school in-service coordinators monitor our teaching/learning and give us technical advice.
   - 1-7 The district resource centre coordinator monitors our teaching/learning and gives us technical advice.
   - 1-8 The pupils' guardians are interested in the teaching/learning environment at the school.
   - 1-9 The pupils' guardians are supportive of improving the teaching/learning environment.
   - 1-10 Our school provides an inclusive teaching/learning environment for all the pupils.
2. About Your Own Knowledge and Skills:
   - 2-1 I can explain the objective and method of lesson study to my colleagues.
   - 2-2 I have planned and conducted a lesson study following the lesson-study cycle.
   - 2-3 I write lesson plans for all of my lessons.
   - 2-4 I use adequate teaching materials and text books during my lesson planning.
   - 2-5 I encourage pupils to provide explanations of how they arrive at solutions/answers during a lesson.
3. About the Pupils' Achievement:
   - 3-1 Our pupils have shown more interest in the lessons after introducing lesson study.
   - 3-2 Our pupils have shown better understanding of the lessons after introducing lesson study.
   - 3-3 Our pupils' achievement has improved after introducing lesson study.
   - 3-4 Our pupils' national examination pass rate (Grade 12) in science has improved after introducing lesson study.
   - 3-5 Our pupils' national examination pass rate (Grade 12) in mathematics has improved after introducing lesson study.
4. Your Assessment of Lesson-Study Outcome:
   - 4-1 Your knowledge of subject matter and pedagogy have improved.
   - 4-2 You are more inspired to improve your class.
   - 4-3 Your teaching skills have improved.
   - 4-4 You have become more sensitive to observing student activities.
   - 4-5 Your awareness of students' difficulties has improved.
   - 4-6 You more positively accept being observed by other teachers.
   - 4-7 You more positively accept being commented on by other teachers.
   - 4-8 Collaboration among the subject teachers has improved.
   - 4-9 Other subject teachers' understanding of lesson study has improved.
   - 4-10 Lesson study is regarded as a school-wide activity.

Note: * = 10 questions under "4. Your Assessment of Lesson-Study Outcome" were included in the questionnaire only at the time of the end-line survey.

To see the changes in students' cognitive and non-cognitive development, a questionnaire survey, consisting of the following 27 questions of 4 sections, was conducted by the baseline survey in June 2016 and by the end-line survey in October 2017. The Section 1 questions are designed to understand students' cognitive development, while the questions in Sections 2-5 are designed to uncover students' non-cognitive development.

Appendix 2

Questionnaire for Students:

Section 1: What was your score (percentage) on the last exam? (5. 80-100%, 4. 60-79%, 3. 40-59%, 2. 20-39%, 1. 0-19%)

1-1 Mathematics
1-2 Biology
1-3 Chemistry
1-4 Physics
1-5 English
1-6 Geography

Section 2: How much fun do you have in each subject? (Likert scale questions from 5 = most fun to 1 = no fun at all)

2-1 Mathematics
2-2 Biology
2-3 Chemistry
2-4 Physics
2-5 English
2-6 Geography
2-7 Civic/Ethical Education

Section 3: How is your relationship with your mathematics teacher? (Likert scale questions from 5 = strongly agree to 1 = strongly disagree)

3-1 I have a good relationship with my mathematics teacher.
3-2 My mathematics teacher understands my comprehension.
3-3 My mathematics teacher asks questions and talks to me frequently in the classroom.
3-4 My mathematics teacher asks questions and talks to me frequently outside the classroom.

Section 4: How many hours do you study each subject at home every day? (5. >2 hours, 4. 1.5-2 hours, 3. 1-1.5 hours, 2. 30 min.-1 hours, 1. 0 hours)

4-1 Mathematics
4-2 Biology
4-3 Chemistry
4-4 Physics
4-5 English
4-6 Geography

Section 5: How is your parents' relationship with your school? (Likert scale questions from 5 = strongly agree to 1 = strongly disagree)

5-1 Your parents help or give you advice about your homework.
5-2 Your parents speak with your teachers or the principal.
5-3 Your parents check your examination scores.
5-4 You feel your parents are generally satisfied with your school.
