

South African Primary Mathematics Teachers' Experiences and Perspectives about Lesson Study

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Abstract

This study aims to investigate the perspectives of primary school teachers in South Africa, who participated in a *Lesson Study* (LS) project, on this professional development process and about their professional learning. The study followed a mixed approach, with data collected through a questionnaire, followed up by interviews. A novel approach in this study was to source teachers' experiences of the individual stages of LS as well of the integrated process. Teachers' perspectives on LS were categorised into five themes, *collaboration – commitment and the free rider effect, confidence issues, teachers' knowledge and skills, misconceptions about the LS approach, and external issues including concerns over time of teachers and learners, systemic challenges and school management*. Using teachers' individual and focus group inputs in the questionnaire and the interviews, we report about their experiences.

Keywords: Lesson Study, professional development, teachers' perspectives, teachers' challenges, mathematics education

Introduction and Background

Lesson Study (LS) (*Jugyou kenkyu* 授業研究 in Japanese) is a Japanese model of teacher-driven research in which a group of teachers work collaboratively to target an

identified subject area for development in their students' learning. Using existing evidence, participants collaboratively research, plan, teach and observe a series of lessons, using ongoing discussion and reflection to refine their interventions (Takahashi & McDougal, 2016; Fujii, 2016).

The global interest in LS was mainly occasioned by the findings of the TIMSS Video Study (Stigler et al., 1999) which, *inter alia*, revealed captivating Japanese problem-based learning practices in mathematics classes in primary schools. LS was introduced into the Anglophone educational literature with the well-known book of Stigler and Hiebert (1999), 'The Teaching Gap'. Since the publication of this book, LS has gained significant momentum worldwide in mathematics education (Fujii, 2016; Ono & Ferreira, 2010).

As with many countries globally, South Africa has only recently started using LS to improve the teaching and learning of mathematics in primary schools. Ono and Ferreira (2010) chronicled the events leading to the inception of LS in South Africa. Accordingly, the emergent interest of LS in South Africa can be traced back to 1999 until 2006 under the auspices of the Japan International Co-operation Agency (JICA). However, due to challenges such as a curriculum reform processes in South Africa (Ono & Ferreira, 2010), there was a period of dormancy, possibly unintended, in the implementation of LS in schools. The revival of the LS and its implementation in a significant number of ordinary public schools across four provinces in South Africa, two of which are among the provinces with the largest proportion of learner and teacher population in the country (DBE, 2020), was evident from 2011 due to the collaboration between the DBE and JICA. This resulted in a more structured approach to use LS as one of the models to develop mathematics teachers in primary schools. Currently the five-stage LS cyclic model (Authors, 2019), as discussed in the section on the theoretical framework, is used in schools in South Africa.

In this paper we aim to investigate teachers' perceptions and experiences after having being exposed to a LS project.

Problem Statement and Purpose of the Study

Two important issues are relevant in South Africa - that of the language of instruction not necessarily being the first language of teachers or students, and the large class sizes. In relation to the former, the difficulty is the widespread code switching or trans-langaging that the teacher, presenting the lesson, often resorts to as s/he seeks to assist learners understand the concepts taught, notwithstanding the fact that the lesson was collaboratively planned in English, and the other teachers' lack of proficiency in the language switched to. Unlike in the Japanese context, which is mainly characterised by monolingualism, South African (classroom) context is characterised by multilingualism where each language is further characterised by numerous dialects.

With regard to class size, although the recent national learner-teacher ratio in schools with state-paid teachers is 34.3:1 (DBE, 2020), there are several instances where the actual class sizes are excessively large (Köhler, 2020).

Although the development of teachers is often viewed as a "key building block" (Darling-Hammond, 2017) to bolster and sustain their proficiency in the subjects they teach, listening to teachers' voices is not always entertained to understand their perspectives on professional development programmes. Insufficient feedback from teachers deprives policy makers and teacher educators of the opportunity to teachers' experiences with the professional development programme they are exposed to. Given that LS emphasises a shift from an individualistic approach, that has characterised teacher development for decades in South Africa, to a collaborative effort, understanding how teachers experienced the LS programme is paramount to bolstering its effectiveness. The purpose of this study is, therefore, to understand teachers' experiences of LS, guided by the assumption that teachers'

voices, as implementing agents, can guide the improvement of LS to make it more effective for improving mathematics teaching and learning. Our primary research contribution through this paper was to share teachers' experiences with individual components/stages of LS. Given that LS is a fairly new approach for teacher development in SA, understanding teachers' experiences with each stage was desirable to provide focused support.

Teacher Perspectives on and Challenges with Lesson Study

LS has become a globalised phenomenon in the sense that institutions charged with the responsibility to develop teachers often tend to borrow and globalise teacher development models from other countries (Grimsaeth & Hallas, 2016). Grimsaeth and Hallas (2016) used the term *glocalisation* to explore the intricacies of the interaction between the LS as a global pedagogical model and the local culture where the LS is implemented. The term is used to describe how an approach, that is developed and used globally, is adjusted to accommodate local needs and culture. Glocalising LS means that it is essential to understand the Japanese pedagogical culture as well as the local pedagogical culture to mitigate the potential challenges that are likely to compromise the purpose for which LS was conceptualised. In this section, therefore, we review literature on teacher perspectives on as well as the challenges they experience when implementing LS.

Confidence

Although LS is meant to develop teachers in terms of improving their practice (Authors, 2020), some challenges seem to suggest that there are instances where it is counterproductive. For instance, lack of teacher *confidence* should be a compelling reason to participate in the LS practice, however it has resulted in a withdrawal attitude (Mon et al., 2016).

Personal growth and academic empowerment

A number of researchers have reported on how LS contributes towards developing teachers' *personal skills and academic empowerment*. In a study in Mexico, Preciado-Babb and Liljedahl (2008) found that the recognition of the obtained results turned out to be a key factor in allowing teachers to change towards an inquiry-collaborative-research teaching style. In another pilot study, implementing LS in Thailand, Kadroon and Inprasitha (2013) analysed the changing values about teaching mathematics that teachers have. They found that teachers, who participated in LS, developed a new view on how to teach mathematics and how to view and assess the learners. The intervention contributed to the process of changing values (mathematical, general educational and mathematics educational values) in teachers about teaching mathematics.

Ogegbo et al. (2019) report teachers experiencing growth in professional skills as well as their understanding of the mathematical content. They claim that participating in LS develops teachers' understanding of how learners learn through discussions around the planned research lesson. The way teachers consider their students' thinking was impacted positively (Posthuma, 2012).

Collaboration

In a large multinational survey, Jaworski et al. (2017) investigated teacher inputs on the nature and value of teacher collaboration in mathematics. Their findings fell into two main areas, reflections on *collaboration* and on impacts on *teachers' knowledge, thinking and practice* – in other words their *academic empowerment*. Regarding collaboration, respondents commented positively on diversity, contact with other teachers and the ongoing shifting roles, but also questioned issues such as ownership, time effectiveness and the actual value of collaboration. Jaworski et al. (2017) found that the impact of LS on practice and on teachers'

knowledge and thinking was mainly on improved teaching, including teachers developing confidence in the classroom and creating a willingness to try new approaches.

The social constructivist approach of LS contributes heavily towards the success of LS (Taylor et al., 2005) and teachers experience the *collaboration* involved in LS as a major advantage (Friedman, 2005; Posthuma, 2012). However, teachers, experienced some aspects of the collaboration as challenging, the most prominent of these problems being the situation where certain participants do most of the contributions and others ride along as passengers (Ogegbo et al., 2019).

Skott and Møller (2020) experienced a very definite need for how teachers should behave in the joint reflection sessions - to tell teachers that they actually made an error at the blackboard can be experienced as hurtful for some teachers. They also experienced a resistance from teachers to open up their classrooms to colleagues for observation. Their findings are in line with those of Dave and Takuya (2019) who reported that teachers are reluctant to be critically evaluated by their peers.

Systemic challenges

Some of the challenges emerging from the implementation of LS are *systemic* in nature. For instance, LS in Japan is a highly structured and an institutionalised practice in the education sector (Takahashi & McDougal, 2016; Seleznyov, 2020). Outside Japan, however, this is not always the case. Ogegbo et al. (2019) mention the fact that since LS is not always accommodated into teachers' normal work plan, teachers consider their participation in LS as an additional responsibility to their professional duties. Ogegbo et al. (2019) also found that other external issues, such as lack of support from the school management or the district and the provincial education departments, seem to discourage teachers (Groves et al., 2016; Seleznyov, 2020).

Time

Lastly, a study conducted in Malaysia by Mon et al. (2016) identified *time constraints*, teachers' workload which affects their participation in LS, teachers' lack of confidence due to insufficient content knowledge and teachers' discomfort being observed while teaching, as some the challenges associated with the implementation of LS.

Theoretical Lens Framing the Study

Developing a theoretical framework for our study, we started with the five-stage LS cycle used by most schools in South Africa (Figure 1) (Authors, 2019), and then developed a conceptual framework that took into account evidence from the literature about teachers' experiences with LS as shown in Figure 2.

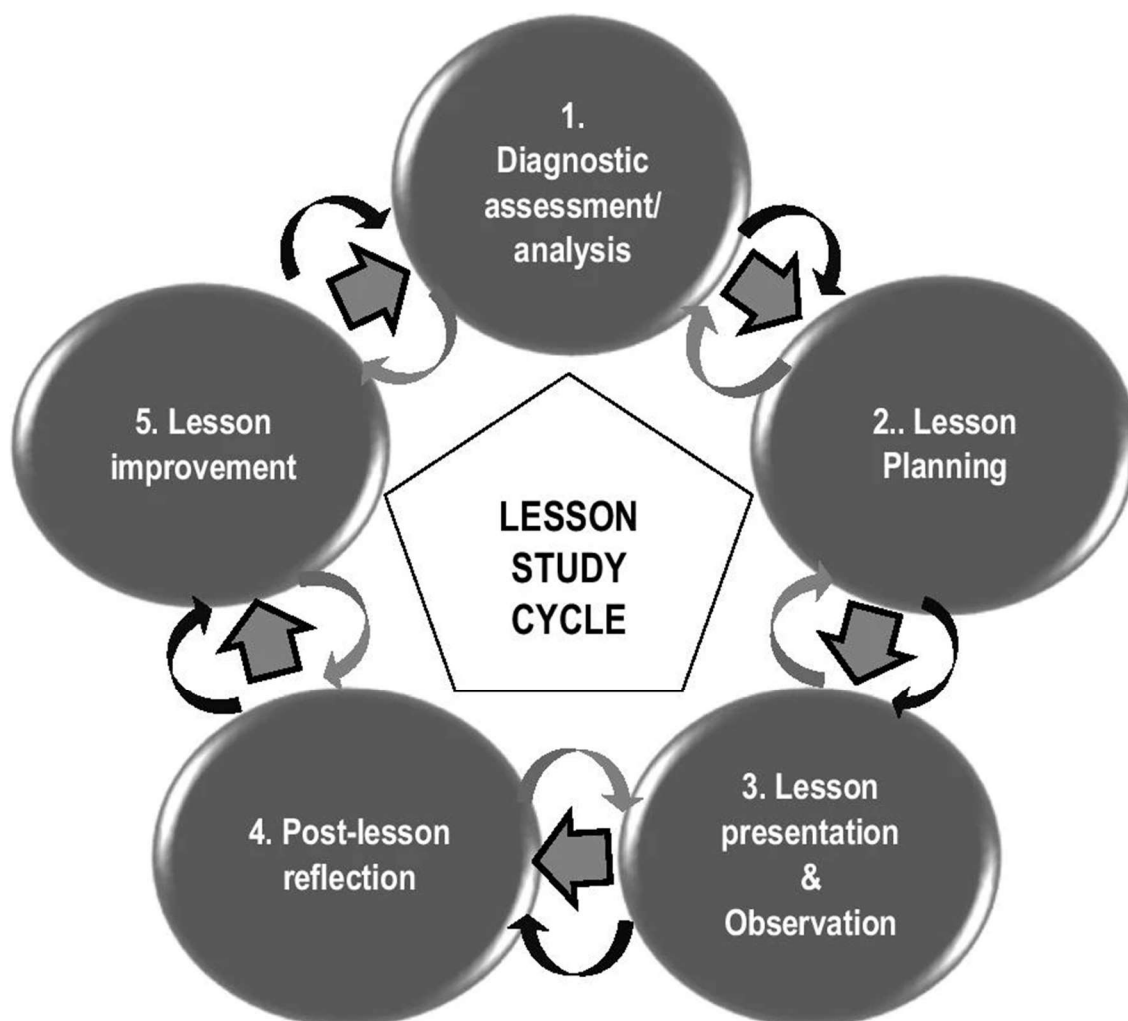


Figure 1. Lesson Study cycle (Sekao, 2019)

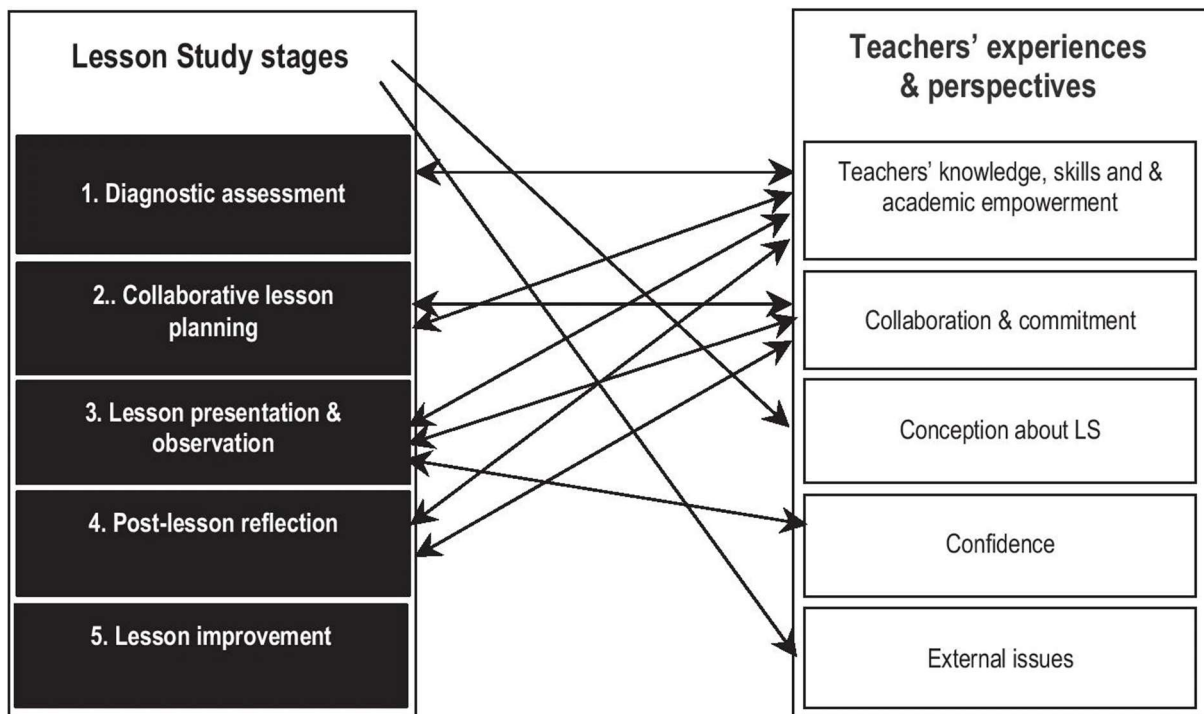


Figure 2. Teachers' experiences and perspectives on Lesson Study stages

Although LS stages are implemented as “repeated cyclical activities” (Lewis & Perry, 2017, p. 263) or an integrated cyclic process, often with iterative process between consecutive stages (shown with curved arrows in Figure 1), each stage has unique features that provide teachers with unique experiences.

Stage 1 (diagnostic assessment/analysis) is about teachers' response analysis to identify common misconceptions emanating from learners' responses from previous assessment to inform the problematic topic that should be tackled during the LS session. Alternatively, teachers constituting an LS cluster identify a topic that poses a challenge for (some of) them to teach effectively and use it as the basis for the LS session (Authors, 2019). As part of the glocalisation process, diagnostic analysis is a distinguishing feature in the LS model used in public schools in South Africa (Fujii, 2016).

In Stage 2 (collaborative lesson planning) teachers meet in groups to brainstorm different methods and strategies that can be employed to teach the identified topic (Authors,

2020). The brainstorming session could be preceded by teachers individually gathering information on how to teach the topic in order to prepare to participate meaningfully in the study of mathematics content and curriculum materials (*kyozaikenkyu*) (Lewis & Perry, 2014).

In Stage 3 (Lesson presentation and observation) one teacher from the group teaches the lesson at his/her school on an agreed date and the other teachers observe the lesson (Chong et al., 2017). An observation sheet which teachers, observing the lesson, use to document their observations, is made available before the lesson presentation. Other external knowledgeable persons (such as a subject advisor), who may not have been part of the lesson planning process, may be invited to observe the lesson (Authors, 2019).

In Stage 4 (Post-lesson reflection) one of the observers facilitates the post-lesson reflection session, and the presenter of the lesson is the first one to share their reflections on the lesson. Central to the post-lesson reflection are the lesson objectives - what contributed to their achievement or lack thereof (Kadroon & Inprasitha, 2013).

During Stage 5 (Lesson improvement) all the ideas emanating from the post-lesson reflection are consolidated and used to improve/refine the lesson (Chong et al., 2017). Some variations of the format could be considered, such as a different teacher could teach the lesson to different learners or the same teacher could teach it again (Authors, 2019).

There is a general agreement among researchers that the use of LS promotes teacher learning and improves instruction. For instance, Lewis's (2016) proposed framework on the intervening changes or pathways of impact encapsulates the key tenets of teacher learning afforded by LS, which can also be traced back to Desimone (2009). The critical features of professional [teacher] development espoused by Desimone such as content-driven, collective participation or collaboration and coherence with policy prescripts are entrenched in the LS cycle (Lewis & Perry, 2017). Although Desimone (2009), supported by Lewis and Perry

(2017), presented a compelling argument that “a theory of action for professional development” follows a particular sequence, characterised by teachers’ exposure to professional development; increased teacher knowledge and skills; application of acquired knowledge and skills; and increased student learning, this seems to assume that the process is seamless and will not be stymied during execution. However, our view is that, notwithstanding the pathways of impact, when teachers co-create knowledge and test it in the natural setting (the classroom) through LS, they are likely to also experience challenges. These challenges are likely to stem from the knowledge co-creation process (cognitive conflict) or collaborative participation (situated environment). Building on Desimone’s (2009) and Lewis’s (2016) frameworks, we propose a conceptual framework which considers the possible positive experiences as well as the challenges experienced by teachers when implementing the LS (Figure 2).

Although the LS stages in framework are presented linearly (left of Figure 2) to illustrate their link with the teachers’ experiences and perspectives (right of Figure 2), in actual practice they are implemented cyclically as shown in Figure 1.

Regarding teachers’ experiences with LS exposure, the five themes on the right hand side of Figure 2 were identified from the literature, as reported in the previous section.

The five stages of the LS and the five themes of teachers’ experiences with LS, as shown in Figure 2, were central to our study. We were interested in exploring teachers’ experiences with: firstly, the individual LS stages instead of with aggregated experience of the integrated LS cycle; and secondly, LS affordances such as the themes mentioned in Figure 2.

Methodology

Participants

The study was based on a sample of teachers ($n = 91$) drawn purposively from the implementing districts in two provinces in South Africa.

Table 1: Distribution of teachers

	Grade 1-3	Grades 4-6	Grade 7	Grades 4-7	Total
Eastern Cape	0	27	14	10	51
North West	40	0	0	0	40
Total	40	27	14	10	91

Teachers constituting a sample for this study had been implementing LS in their schools for about 18 months at the time of data collection. From Table 1 it is clear that most teachers (74%) were teaching in junior grades, which was a consequence of LS being introduced in junior grades first, and later in junior secondary grades. All teachers participating in the study were trained in the LS process by their respective subject advisors, who were exposed to the LS in Japan (observed and participated in the process), courtesy of JICA. In both provinces LS groups consisted (on average) of about seven teachers.

Since the introduction of the LS in 2017, the participating district in EC had had 19 lesson cycle sessions altogether for Intermediate Phase (Grades 4-6) and Senior Phase (Grades 7-9) and five district-wide LS seminars in 2017 and 2018 and three provincial LS seminars. The participating district in NW province conducted three training sessions to orientate teachers in preparation for the inception of mainly cluster-based (groups of schools) LS in primary schools. Schools were clustered according to their proximity in terms of distance. In addition, the district had completed nine LS cycles since its inception and had held nine LS cycle overview meetings. So as researchers we assumed that after this exposure they have had fair knowledge of LS..

Data Collection and Analysis

Data were collected through a questionnaire and unstructured interviews. In EC data were collected during the district-wide LS seminar while in NW data were collected during the LS cycle overview meeting. These events were attended by all implementing teachers in the relevant district. The questionnaire covered four key areas, excluding the demographical information: (1) the stage of LS that teachers perceived as most useful for their teaching and the justification thereof (multiple choice questions), (2) their experiences with LS (rating scale items), (3) the stages that they perceive as most enjoyable and as least enjoyable and justification thereof (multiple choice questions), and (4) their perceived challenges with LS together with possible solutions for these challenges (open-ended question).

Unstructured interviews were used to corroborate and/or gain in-depth understanding of data collected through the questionnaire. From each province teachers volunteered to participate in the focus group interviews and eleven teachers in EC and twelve teachers in NW were interviewed. Grade specificity was not considered because data collection and analysis were not necessarily disaggregated by grade. In the focus group interviews, teachers were asked about their experiences and challenges regarding school proximity, the language of teaching and learning, time management, school management and about their experiences in the different LS stages.

Quantitative analysis was conducted using Statistical Package for the Social Sciences (SPSS®) software to do a descriptive statistics analysis. Interview data were transcribed, and responses were categorised according to the themes emanating from our conceptual framework. In addition, qualitative data gleaned from responses in the questionnaire were analysed using Atlas.ti software. This software package assisted us to identify emergent trends and categorise them into themes that were also identified from the literature, which subsequently informed the framework used to present the findings.

Findings

Findings on teachers' experiences with LS are reported from three instruments, items in the questionnaire in which we asked teachers to indicate their preferences; open-ended items where we asked them to explain their preferences and mention challenges that they experienced and suggest solutions; and the feedback that we got from focus group interviews with teachers and with the subject advisor from the Eastern Cape.

LS Stage Perceived as Most Useful for Teaching and Most or Least Enjoyable

Teachers were asked which one of the stages of LS they perceive as most useful for their own teaching. Many teachers (approximately 44%) perceived the lesson planning stage as the most useful stage followed by the lesson presentation stage (approximately 29%). The stage perceived the least useful is the post-lesson reflection stage (approximately 6%).

Teachers were also asked which one of the stages of LS they perceive as most enjoyable and which stage as least enjoyable. The data resonate with what teachers revealed about the usefulness of the different aspects of LS. Results indicate that the lesson planning stage was experienced as most enjoyable by teachers (40%) and that teachers are least impressed with the post lesson reflection stage of LS (28%).

Likelihood of Recommending LS to Other Teachers

Participants were required to rate their likelihood of recommending the LS to their colleagues. More than three-quarters (approximately 81%) of the participants who responded, were very likely to recommend the LS approach to other teachers.

A further open-ended item was included in the questionnaire in which teachers were asked to indicate pertinent challenges they experienced during the implementation of the LS and to provide a possible solution for each challenge identified. Lastly, interviews were conducted with two focus groups to gain more insight into the written inputs where necessary.

Our analysis of teachers' responses to the questionnaire and their inputs from the interviews, confirmed the five main themes as in our conceptual framework (Figure 2). We present the findings according to these themes. Although these experiences and perspectives are presented in seemingly discreet categories, in reality they are interconnected.

Importance of Collaboration or Teamwork

Teachers were asked how they rate the value of collaboration with their colleagues in their LS experience. They had to indicate their level of agreement, choosing between *strongly agree*, *agree*, *not sure* or *disagree* with the three statements as in Figure 3. The horizontal axis indicates the percentage of participating teachers.

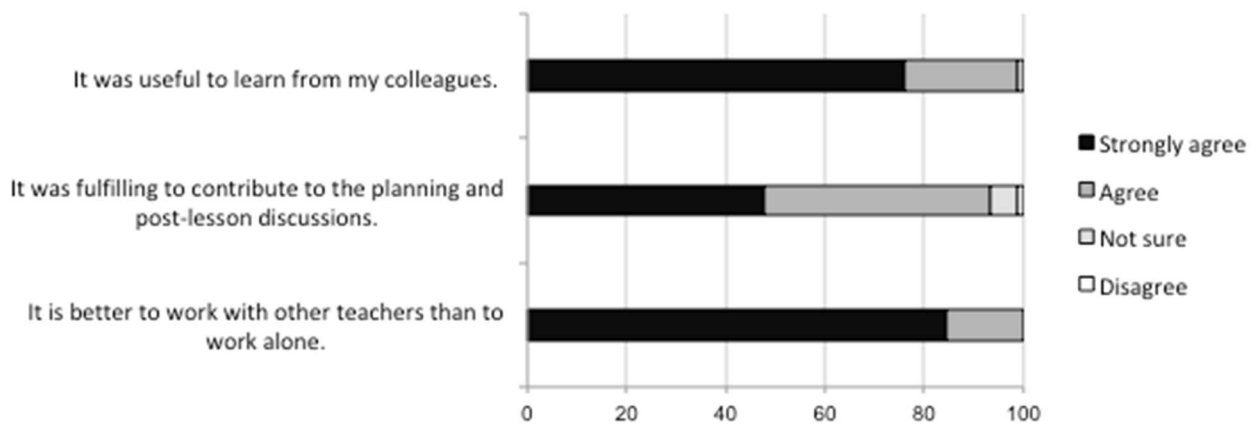


Figure 3: Collaboration

The majority of participants (98.9%) perceived it as useful to learn from other teachers during the LS process. This translates to 21 participants and 69 participants who, respectively, agreed and strongly agreed that they perceived learning from other teachers as useful. With the other two statements, the vast majority of teachers experienced the collaboration as positive. In fact, not a single teacher disagreed when asked whether they agree with the statement *It is better to work with other teachers than alone*.

In the rest of this paper, we illustrate our findings by quoting one or more extracts, from teachers coming from the open ended questions in the questionnaire or from verbal

comments in the interviews. When quoting extracts from teachers' responses, the number of the teacher (e.g. T16 or IT9 in the interviews) is indicated after the extract, as well as the province (EC: Eastern Cape, NW: North West Province).

Teachers liked the lesson planning sessions because in these sessions they experienced working as a team, sharing ideas and different methodologies and they got the opportunity to improve their insight into topics that were challenging:

Different people come with different approaches that makes it easy to present the lesson. (T17, EC).

The subject advisor appreciated the collaboration in the presentations:

I think they are learning from other colleagues that this is how the class should be conducted in real context. The achievements are that teachers are able to work as a team. They are able to share ideas and they are able to stand in front of other teachers to present the lesson. (Subject advisor, EC).

Teachers who indicated the reflection stage as most enjoyable, expressed appreciation for the value of the collaboration that this exposure provided to them. They like the fact that people reflecting on the lesson can show them their mistakes, helping them to improve when they are doing the lesson again:

I enjoyed listening to different educators reflecting on the lesson, mentioning things that I also noticed and also highlighting the ones that I never realised its impressing. (T4, EC).

The most dominant challenge, regarding collaboration, was the prevalence of the *free-riding* effect which is viewed as the tendency of a group member to benefit from the group effort without contributing towards the attainment of the group goal (Aggarwal & O'Brien, 2008) and has a potential to negatively affect the group effectiveness. This was more prominent in the lesson planning meetings:

Most of the time only a few plan while others do nothing and it is always the same people. (T63, NW).

The free riding behaviour was also mentioned in the questionnaire responses:

Challenge	Proposed solution
<i>Some people don't participate at all during lesson planning.</i>	<i>Smaller groups so that each individual has to participate. (T64, NW).</i>

While these responses focus on free riding behaviour during the lesson planning process, a similar challenge permeated the other stages of the LS, including lesson presentation. The following response given by one of the teachers during the focus group interview reinforced our understanding of antecedents of perceived free riding behaviour:

... sometimes it is not easy to teach in front of teachers, knowing that they have been doing this mathematics for a very long time and you are few years doing it [sic]. Now you are standing in front of them teaching this maths knowing that they know more than you know. (IT6, NW)

A further collaboration challenge is the issue of the presenter deviating from the lesson planned collaboratively. Although this perceived challenge did not seem widespread, it was the proposed solution presented by one of teachers that captured our attention:

The presenter must stick to what was agreed upon so that we can all be confident when we receive advice from other colleagues. It becomes easy to take ownership of the lesson presented. (T80, NW)

In addition, the poor quality of the reflection sessions was highlighted by the subject advisor and among the issues raised, was that

... teachers tend to concentrate on the minor mistakes that were made in the lesson and not look at the bigger picture of what was the lesson about. (Subject advisor, EC).

A number of participants in the study raised the issue of the lack of commitment that they experienced with some of their colleagues:

Challenge	Proposed solution
<i>Teachers' lack of commitment</i>	<i>LS need lot of time, individual teacher needs to be committed and have plan for every lesson to be taught. (T47, EC).</i>

The comment above exemplifies the need for commitment of all teachers.

Teachers' Knowledge, Skills and Academic Empowerment

Teachers were asked to indicate their level of agreement with two statements:

My own content knowledge has improved, and

My skills to conduct diagnostic analysis have improved.

Teachers agree or strongly agree with both statements (98% for the first statement and 87% with the second statement) – they are convinced that their content knowledge has improved.

We return to analysing teachers' open ended statements about academic empowerment. In the interview with the subject advisor from the Eastern Cape, he was quite adamant about the error analysis sessions:

The way we conducted it before ... they [the teachers] don't dwell much on learners' misconceptions, unlike now when we are doing the LS that their lesson is informed by misconceptions because you will hear them saying that you know in my school learners are doing like this. (Subject advisor, EC).

It seems that before LS, the lesson plan did not take errors that learners were making into account.

Some teachers who indicated the lesson planning stage as most enjoyable, expressed appreciation for the personal academic empowerment that this exposure provided to them – their experience of their fellow teachers' ideas about lesson planning help them to improve their own skills. They mention gaining new knowledge and new ideas from their colleagues:

Lesson planning with colleagues gives more understanding and new ideas about the context... I am becoming used to use teaching aids and even using them – was my other weak point. (T25, EC).

These views were confirmed in the interviews. A feature that arose is the teachers' pre-emptive thinking during the lesson planning sessions:

I have improved on planning since I started LS. I was preparing the lesson for myself but now I know that when I am preparing the lesson I have to consider when I was teaching this last, what misconceptions did learners do there? (IT9, NW)

The subject advisor mentioned that before LS was introduced, lesson plans were just done for compliance, and there was uncertainty if it was used in the presentation at all. With LS he found that teachers made sure that the lesson plan is so detailed that any other teacher can use it even if the teacher was not part of the preparation.

In the interviews teachers also expressed appreciation for the personal academic empowerment that the actual presentation provided:

I enjoy lesson presentation because this is the interaction between me and my learners and this serves to say I met my objectives or not in class. (T11, EC)

Most of the teachers who indicated the observation stage as most enjoyable, expressed appreciation for the personal academic empowerment that this exposure provided, taking advantage of learning from the different teaching styles and approaches:

I learn a lot from colleagues and it gives me a lot of light on how others teach.

Sometimes I rectify my teaching by observing what others are doing. (T58, NW).

Some teachers used the reflection sessions as an opportunity to take note of how other teachers experience their teaching, seeing where they may have had an incorrect approach:

In reflections I am able to correct my weaknesses, especially when the reflections are on what did not work well because they help me grow and learn more. (T49, EC).

A topic that is often misunderstood by learners is *common fractions* – essential to be able to manipulate different fractions. The following comment by a NW teacher illustrates how s/he was helped by the collaboration with his/her colleagues.

OK, what I realised is that team work is so important ... I didn't know how to tackle this common fractions so I learnt a lot when sharing ideas. (IT12, NW)

On the other hand some teachers expressed concerns about their own skills regarding the mathematical content, the teaching methodology as well as about the language of mathematics:

I am teaching in English. To observe in another language is difficult although we planned together. I feel as if I am not sure what is happening. (T63, NW).

Numerous challenges associated with the intricacies of post-lesson reflection format were raised. It was evident from the written responses and the verbal responses from the interviews that the challenges are occasioned by the insufficient knowledge and skills of conducting reflections according to the prescripts of the LS. Teachers corroborated their limitations in post-lesson reflection competencies:

We are not yet there with the reflection, so by the time we know what we are supposed to do during the time of reflection, maybe we can make the difference. (T3, EC)

In the interviews, teachers mentioned that LS removed misconceptions in their mathematical content knowledge as well as in their professional teaching skills:

I never specialised on mathematics but I just happened to teach mathematics when I came to school. After having this workshops and lesson studies, well I achieved a lot. The misconceptions that I had before, by now I feel at least comfortable. (IT11, NW).

This comment illustrates how LS contributed in removing teachers' misconceptions.

Confidence

Confidence is probably one of the major challenges that teachers experience in the LS project. The most eminent confidence issue is that teachers are uncertain about themselves when presenting a lesson in the presence of their colleagues:

This is a moment whereby I get nervous as people are watching and I tend to forget important aspects. (T56, NW).

However, this is not a problem for all teachers. Teachers were asked to indicate their level of agreement with the statement *I feel confident to be observed while I teach*. Quite surprisingly, the majority of teachers agree or strongly agree with the statement - only about a third of the teachers do not feel confident about being observed by their colleagues while teaching.

Other teachers are concerned about their colleagues - realising that their colleagues may become discouraged by pointing out errors:

Most teachers feel not comfortable to participate in the error analysis as if they are demoralising the presenter. (T40, EC).

The same lack of confidence is sometimes present at the lesson planning sessions but some teachers expressed appreciation for the contribution this exposure made to their confidence:

Enjoyed this aspect [lesson planning] cause it helps the educator to impart knowledge to the learners without hesitation. (IT79, NW).

Teachers mention their own inadequate content knowledge to productively collaborate with colleagues and they experience colleagues focussing on their shortcomings rather than on the actual lesson.

In the lesson observation stage, most of the comments were not about the observer's own confidence but concern that the presenter experiences uncertainty:

Sometimes our colleagues become uncomfortable when you ask to visit them in their classes when they teach. (T9, EC).

Teachers are also concerned about learners' confidence during observation:

Some of the learners find it difficult to participate during the lesson if there are unfamiliar faces. (T17, EC).

On the other hand, some teachers expressed appreciation for the contribution that the observation exposure made to their confidence. They grow in confidence by watching experienced colleagues and also from picking up mistakes that colleagues make in class:

I enjoy watching confident teachers teaching, there is a lot to learn from them. (T64, NW).

Regarding confidence, the reflection sessions proved to be somewhat problematic. Since post-lesson reflection may culminate into high level of robustness, teachers tend to not find this stage useful because of perceived personal attack, which undermines their confidence. Lack of confidence pertaining to articulating content and pedagogical issues featured prominently for their perception not to find post lesson reflection useful.

Teachers are still struggling to do the reflection and are unhappy about being made the focus of reflection instead of focusing on the lesson:

I least enjoy this part because some of the educators criticise the educator instead of reflecting to the lesson. Other educators reflect destructively instead of developing the presenter and all educators. (T8, EC).

We also noted another perspective of the challenges pertaining to the post-lesson reflection that was closely linked to the lack of confidence and the feeling of inadequacy among teachers:

I think we are not yet there because one person if you will be reflecting you think you are attacking him or her, and the other thing is that maybe you don't have that

confidence of helping each other because somebody can be good at certain... maybe we are still struggling to do the reflection. (IT3, EC)

This comment from one of the interviews typifies the feeling of inadequacy with some teachers.

Conceptions about Lesson Study

Some teachers had flawed ideas of what LS really is. Although some of the challenges raised are legitimate challenges, there were issues that point to conceptual flaws exposing perceptions that contradict the ideals of LS.

About the management/coordination of LS, some teachers believe that LS is the sole responsibility of the teachers and school management is not involved:

...you must come back [from the LS session] to teach these learners. (IT3, NW).

On the attitudes on this LS, they say it's time consuming, you go up and down leaving learners... (IT5, NW).

Teachers also have different ideas about what the primary purpose and considerations of collaborative lesson plan should be. Some think, incorrectly, that the lesson plan is expected to always work effectively during teaching:

When we use our lesson plan from the LS after that you have to go and practice in your school then it might not work for you if the class is overcrowded. (IT3, EC).

A second flawed idea about the lesson is that it is planned without considering the classroom context, that the collaboratively planned lesson is a panacea, therefore should be taught rigidly. Teachers believe that they should stick to the lesson plan at all costs and do not realise that deviation from the lesson plan is likely to happen:

The presenter must stick to what was agreed upon [in the lesson plan] so that we can all be confident when we receive advice from other colleagues (T80, NW).

The fact that during the post-lesson reflection the teacher who presented the lesson is normally allowed to be the first person to present his/her views about how the lesson unfolded, is an acknowledgement that there could be a need to take certain instantaneous decisions that were not factored into the collaborative lesson plan: For instance a learner could ask a question that the LS team might not have anticipated, therefore not planned for; in which case prompting the teacher presenting the lesson to deviate from the content of the collaboratively planned lesson.

External Issues: Time and management

Time

The issue of *time* featured prominently as one of the challenges experienced by many teachers in the implementation of the LS. We noted that the views of teachers, pertaining to the time attributes affecting the implementation of LS, were dichotomous: some teachers viewed time as being inadequate in certain aspects of the LS process and advocated for increased time, while others viewed the available time as being ‘too long’.

Notwithstanding this dichotomy, our analysis revealed the different facets of the concept of *time* by the teachers: in one context the concern is about the learners who need more time. Teachers were concerned that the scope of the curriculum does not allow learners sufficient time for developing deep understanding:

Challenge	Proposed solution
<i>Content is too congested. It is difficult to cope with time because learners struggle to read.</i>	<i>Topics to be given time and be sure that learners are not left behind. Emphasis on literacy, reading and writing should be the main focus. (T53, NW).</i>

In the other context, time referred to the amount of additional time the LS activities demanded of the teachers themselves. In relation to the duration of the different activities, teachers raised a concern about the discrepancy between the length of time allocated to a

lesson and the actual time it takes to teach the lesson. One of the teachers complained about the diagnostic analysis stage of the LS cycle:

It takes time, which sometimes there are many papers to analyse [sic]. (T28, EC).

Management of the LS process

The challenges that we categorised in this group were from the management or coordination of the process of the LS. One of the challenges raised by teachers in this category was poor communication by the LS coordinator – the mathematics subject advisor. Teachers claimed that they were often given short notice to attend the LS cluster meetings and this resulted in their late arrival or not being able to attend. Their proposed solutions included sending out dates for the meetings in advance.

It was also evident that the clustering of schools in rural areas posed a problem because while the principle of proximity is used to guide the clustering of schools, it often still required travelling a fairly long distance to the nearest school. Therefore, as a solution, teachers advocated for the school-based LS.

The other area of challenge attributed to the management of the LS process was that the presence of the observation panel sometimes disrupted the class, especially when observing *‘learners while working on their given tasks.’ (T21, EC)*. This problem can add to the discomfort that some learners are subjected to, especially when they are being observed for the first time.

It also emerged from one of the districts that teachers often teach learners who are not from their own schools. Although we view this practice as having merit, it causes anxiety for both teachers and learners because learners do not feel free to be taught by an unfamiliar face. From the proposed solution provided, i.e. *‘they [learners] must be well informed beforehand’ (T17, EC)* we deduced that there was a gap in the management of the LS process.

Systemic challenges

Two systemic challenges arose: scattered schools and class sizes. Long distances separating schools that were in the same LS cluster is the most prevalent challenge in rural areas. This problem leads to other problems such as scarcity of public transport, travelling costs, and time spent on the road. These challenges result in teachers not attending the LS activities regularly. The extent of the challenge was articulated by one of the teachers:

... it might take the whole day to come and plan because of the proximity since we are widely spread. Some of us can't come and plan and go to school because we don't have transport. We have to come for the day – that day will be wasted. (IT2, EC).

The second problem, raised by teachers, was the issue of class sizes. Public schools, especially in rural and township areas in South Africa, commonly have 40-50 learners per class. Large class sizes is one of the main external problems with implementing LS in South Africa.

School management team

Some teachers mentioned challenges that are related to the school management team, in particular, school principals who did not know and understand the LS. This problem is pervasive as it resulted in principals not allowing teachers to attend the LS sessions:

Challenge	Proposed solution
<i>Lack of support from our schools as if we are lazy to teach.</i>	<i>I wish all principals are informed on how LS work and why! (T46, EC).</i>

This view was corroborated during the interview:

...when you have to come to the LS, it seems as if you don't want to teach at school, you just want to vagabond if I can put it like that way. Sometimes you have to come during school hours, so the principal won't understand (IT5, EC).

Given that the LS was introduced in primary schools and only among mathematics teachers, they decried the practice of teacher rotation across the subjects or phases/grades,

especially after the majority of them had internalised the LS and implementing it for about eighteen months.

Discussion

Teacher responses emerged into five main themes, *collaboration; teachers' knowledge, skills and academic empowerment; confidence; conceptions about LS; and external issues, including time concerns of teachers and learners, systemic challenges and school management*, as in our conceptual framework (Figure 2).

Supporting the results of Friedman (2005) and Posthuma (2012), the major advantage of LS for teachers was the collaboration factor. The social constructivistic approach of LS contributed heavily towards the success of LS. Comments from our teachers were in line with the findings of Taylor et al. (2005). They appreciated the opportunity to reflect and think in the company of their colleagues, and the structure allowed for them to share, question assumptions and reassess common practices. LS provided a context for the teachers to derive meaning about their teaching actions through social interaction with their fellow teachers, also supporting the findings of Ogegbo et al. (2019).

Teachers, however, experienced some aspects of the collaboration as challenging. The most prominent of these problems was the 'free-rider' effect, where certain participants do most of the contributions and others ride along as passengers. Many teachers complained about this issue. The phenomenon is, of course, present in any type of group work and it often depends on the personalities of the participants. In other cases, however, it provides evidence of some teachers' lack of interest and commitment to professional development – also mentioned by Ogegbo et al. (2019).

Personal growth, including growth in professional skills as well as mathematical content, features strongly in teacher perspectives on LS. Their comments show how participating in LS develops their knowledge of how learners learn through discussions

around the planned research lesson, supporting the findings of Ogegbo et al. (2019). While most teachers are positive about their personal growth in mathematics content knowledge as well as in their teaching skills during the LS process, some existing inefficiencies, lack of content knowledge, teaching skills and language problems, produce challenges with the implementation of LS. Not only do some teachers admit that their mathematics content knowledge is insufficient, but they are also somewhat uncertain about the actual format of the LS activities, e.g. the do's and don'ts of the reflection sessions – mentioned above. Our results support those of Dave and Takuya (2019) who saw the need for teachers to have greater content knowledge.

Teachers mentioned elements of the LS experience that are likely to have a significant impact on their own teaching. By studying, discussing, and enacting elements of teaching and learning with colleagues, teachers were also able to significantly improve their own understanding of concepts in mathematics. These experiences include emphasis on deeper understanding of the content, ongoing learning, and collective work with colleagues. Joint planning, observation, and reflection on actual instruction have provided better teaching, since the lesson was taught to learners in the presence of colleagues (as in Lewis & Perry, 2017; Takahashi & McDougal, 2016).

The issue of teachers' confidence was emphasised by many teachers in our study - in particular the opening up of the classroom by presenting in the presence of their colleagues, and in the reflection sessions. This is a challenge experienced by other researchers as well. Skott and Møller (2020) experienced a very definite need for how teachers should behave in the joint reflection sessions - to tell a teacher that (s)he actually made an error at the chalkboard can be hurtful for some teachers. They also experienced a resistance from teachers to open up their classrooms to colleagues for observation. Teachers in South Africa seem to have this resistance to open their classroom because of confidence – they are

reluctant to expose their relationship with the students and their overall performance as a teacher. Our findings are in line with those of Dave and Takuya (2019) who reported that teachers are reluctant to be critically evaluated by their peers. However, in our context this could be occasioned by the glocalisation of LS and its attributes. Although the culture of being observed while teaching is an entrenched classroom culture in Japan, this culture is generally uncharacteristic of South African classrooms. This contextual factor, as noted by Grimsaeth and Hallas (2016), might have been overlooked when glocalising LS for South Africa.

However, surprisingly, the majority of teachers do not have confidence problems when observed while they are teaching. Teachers report growing in confidence, in that they get reassurance of their own skills from their discussions with colleagues, as well as removing misconceptions.

Some teachers clearly have flawed perceptions about the LS approach itself. This could be seen as a mismatch of understanding and expectations, between management, advisors and teachers. These misconceptions vary from the role of the school management to the rigidity of the lesson plan. Teaching and learning is a dynamic process and deviation from the lesson plan is bound to happen. The post-lesson reflection session should be used to discuss how the lesson unfolded and to what extent the collaborative lesson plan was useful in presenting the lesson.

It is clear that the observation and reflection sessions should be handled carefully. Teachers felt uncomfortable taking time out of teaching to attend observations. The expected level of observations and reflections is hardly sustainable.

The last identified theme of challenges that teachers experience in LS, is about external issues. The time constraint is a commonly cited challenge that limits teachers' continuous practice and effective participation in LS (Dave & Takuya, 2019; Lewis & Hurd,

2011; Ogegbo et al., 2019). In our study, the time issue was seen as a serious challenge faced by teachers in the implementation of LS. Many teachers are concerned about their learners, in that they think that they are not spending sufficient time in the presentations for the learners to develop deep understanding. A second concern about time is about teachers' own programmes. LS is a time consuming activity and many of the teachers have to find extra time to fit in the LS activities. As also found by Ogegbo et al. (2019), since LS is not accommodated into teachers' normal work plan, teachers in our study considered their participation in this study as an additional responsibility to their professional duties. This perception, we argue, defeats the purpose for which LS is designed – teacher development.

Other external issues include lack of support from the school management, as well as district and the provincial education departments, as in Ogegbo et al. (2019). School management is often hesitant to implement LS because of other commitments and school principals are not always familiar with the LS format and approach, supporting the findings of Groves et al. (2016).

Considering its potential (Quaresma et al., 2018), LS appears to be a well-suited collaborative way for teachers to address the restructuring challenges to the educational system. However, along with Skott and Møller (2020), our study suggests that the challenges raised by teachers should be addressed, to make this approach a success in the South African education system.

We agree with Preciado-Babb and Liljedahl (2008), who argue that teachers have much to contribute to the school and the educational system, and they can enrich the system with their experience and knowledge. So, opportunities for teacher collaboration, as in LS, must be promoted and recognised as part of the professional practice. Relationships between teachers, schools, and the system should be based on mutual support and contribution.

This study contributes to the research on understanding how the process of LS can be

used as a form of collaborative professional development for mathematics teachers in South Africa. Although LS combines several desired elements for effective professional development of mathematics teachers, the challenges mentioned, and factors affecting teachers' participation need to be addressed for continued successful practice of LS. Teachers have a complex collection of wants and needs (Liljedahl, 2014) and these should be taken into account in our professional development programmes. The five themes of teacher perspectives on LS that emanated from literature and were confirmed by the findings in our study, are not independent and are very much interrelated and are experienced all over the world.

Glocalising LS to the South African context, we have to provide for the two important issues that are relevant in South Africa (as mentioned earlier) - that of the language of instruction not necessarily being the first language of teachers or students, and the large class sizes. These notable unique features in South Africa have the potential to stymie the glocalisation of LS.

So, returning to our conceptual framework (Figure 2), we can summarise. External issues, including time limitations, managerial problems, class sizes and language problems in the LS process were experienced as challenges by teachers. Teacher misconceptions about the entire LS approach also impact negatively. A strong connection was found between lesson presentation and teachers' confidence – both positive and as a challenge. Four of the five LS phases connected strongly with teachers' academic empowerment and personal growth and lastly, the lesson planning sessions, lesson presentation and the reflection sessions impacted on teachers' collaborative skills.

Conclusions

Although LS has been extensively researched as a cycle where all stages are viewed as

an amalgam, untangling the stages in the current study has heightened our deep understanding of the underlying issues, characterising teachers' experiences per LS stage. These findings are novel, in that, as far as we know, teachers' experiences with the individual LS stages have not been reported on before. Guided by the expression: *a chain can be as strong as its weakest link*, our view was that for the LS to be effective as a teacher development model, we needed to address the LS stage that inspires or discourages teachers to participate in the LS process. In addition gaining in-depth understanding of the intricate issues contributing to the negative or positive experiences can guide officials responsible for teacher development on the specific and substantive issues to address, thereby strengthening the orchestration of the LS stages.

We recommend that education authorities should be actively involved in the formation and maintenance of organisational structures that support teachers' effective participation in LS. The mentioned challenges in implementing LS should not discourage education authorities from continuing to advocate and support LS in schools in the country.

While the teachers' voices in this study revealed some positive experiences associated with their use of LS, their voices have also unearthed and illuminated underlying challenges, some of which could be attributed to the glocalisation of LS. Certainly, the main focus of glocalising LS in South Africa was on reinforcing the first stage which we refer to as diagnostic assessment/analysis wherein the process of identifying the LS goal is articulated. In recent years diagnostic analysis of learners' written responses in mathematics to identify common errors/misconceptions gained prominence in primary schools and it is becoming an entrenched practice. In the glocalisation process, the Japanese LS cultural attributes entrenched in each stage of LS should be appraised in comparison with the South African classroom culture. Where adaptation of Japanese LS cultural attributes for import into South

African context is necessary it should be done to bridge the gap between the current and the envisaged teacher development practices in South Africa.

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