Schools-University Partnerships for Professional Development: an impact assessment of the "Lesson Study" intervention on mathematics teachers in the Free State

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Declaration

I hereby declare that the work which is submitted here is the result of my own investigations and that all sources I have used or quoted have been acknowledged by means of complete references. I further declare that the work is submitted for the first time at this university towards a Master's in Education degree and it has never been submitted to any other university for the purpose of obtaining a degree.

I hereby cede copyright of this product to the University of the Free State.

……. ……

DM LETLOENYANE DATE

Dedication

I dedicate this summary to my wife

Puleng Letloenyane

and my daughter

Atlegang Letloenyane

Thank you both for your patience and understanding throughout the duration of this research study.

Acknowledgements

I wish to express my gratitude to the following people:

- My study leader, Professor LC Jita for his guidance, support and encouragement. Thank you for your patience and for believing in me.

- The teachers who participated in the research study. Thank you for the time you afforded me and for the valuable feedback.

- Lastly, I would like to thank God who gave me the strength, courage and endurance to complete this research study.

Summary of the study

School-University Partnerships for Professional Development: an impact assessment of the Lesson Study intervention on mathematics teachers in the Free State

School-university partnerships for the professional development of teachers continue to be used extensively in South Africa to enhance the quality of teaching and learning, especially in mathematics. The success of such partnerships in changing teachers' classroom practices, however, remains in doubt, in part because very few studies present empirical evidence of the changes. The partnership trained and encouraged teachers to initiate and participate in school-based professional development initiatives through the formation of communities of practice. This study assesses the impact of one such partnership, which resulted in perceived changes in teachers' instructional practices and curriculum decisions after the intervention.

The partnership assisted mathematics teachers from one district within the Free State province to re-examine their teaching practices. Using retrospective pre-testing design and semi-structured interviews, the study established that there were significant differences between teachers' pre- and post-test scores, which suggests that there were perceived changes in teachers' instructional practices and curriculum decisions after the intervention. The findings also suggest that collaboration, peer observation and critical reflection assisted teachers to change and improve their content knowledge, instructional strategies, understanding of student learning processes and their ability to choose and implement effective teaching strategies.

The findings suggest that this partnership through the formation of communities of practice (CoPs) had a positive effect on teachers' classroom practices. The findings provide some empirical evidence that partnerships of this nature, between schools and universities, may prove valuable in attempts to improve the teaching of school mathematics, especially in the South African context.

Key Words: school-university partnerships, lesson study, mathematics teaching, school-based professional development, communities of practice.

Table of Contents

Appendices

SECTION 1: ORIENTATION AND INTRODUCTION TO THE STUDY

1.1 Introduction

The education system in South Africa faces numerous challenges which range from the questionable quality of teachers, school management and leadership problems, inadequate subject preparation of teachers to low student achievement. Some, if not all of the challenges can be minimized through the initiation and formation of partnerships between schools and universities. More than two decades ago, the Jomtien conference on 'Education for All' recognized this and called for the formation of partnerships to try and alleviate challenges concerning teaching and learning in schools. Partnerships provide a way for policy makers to strategically meet educational and economic goals of a country (Amey, Eddy & Ozaki, 2007). Currently, there is an international emphasis on the need for systemic and effective school-university partnerships to improve, amongst others, the preparation of pre-service teachers and to enhance the quality of in-service teachers (Darling-Hammond, 2006). Stevens (1999) explains that effective teacher education not only requires improved practice sites, but the 'simultaneous renewal' of practices by both schools and universities. In the United States, the notion of simultaneous renewal led to the establishment of clinical faculties in universities whose role is to provide professional development opportunities for pre- and in-service teachers (Burton & Greher, 2007). The trend of establishing such school-university partnerships has become the norm in other parts of the world, including South Africa. The present study seeks to investigate the impact of one such school-university partnership for the professional development of mathematics teachers in the Free State province of South Africa. The partnership trained and encouraged teachers to initiate and participate in a school-based professional development approach known as Lesson Study, which is used in numerous countries to influence teachers' classroom practices (Lewis, 2009).

1.2 Background and rationale

Since the Jomtien conference's call for an increase in partnerships in education, various kinds of partnerships have proliferated. These partnerships include school-university partnerships (Bartholomew & Sandholtz, 2009), university-university partnerships (Samoff & Carrol, 2004) and school-university-donor agency partnerships (Bukari & Jita, 2009). The present study involved a school-university partnership, which was designed to improve the teaching and learning of mathematics in the Free State province of South Africa.

For some time, researchers have been calling on universities and schools to collaborate systematically to achieve school reform and teacher development (Allen, Howells & Radford, 2013; Walkington, 2007). Partnerships provide a way of achieving more with less, in that they enable the maximum utilization of available resources to achieve educational goals and to foster innovation (Walkington, 2007). Universities and schools have a symbiotic relationship – one produces and implements knowledge from the other, for reform and research purposes. It is no surprise that researchers such as Borthwick, Stirling, Nauman and Cook (2003) boldly state that 'school and university partnerships are here to stay'.

The partnership in question encouraged teachers to form and participate in school-based professional development intervention through the formation of professional learning communities (which are forms of communities of practice). Certainly, several authors have advocated for situated professional development interventions i.e. teacher learning that is grounded in teachers' school contexts, instruction and students (Ostermeier, Prenzel & Duit, 2010; Putnam & Borko, 2000). In this instance teachers are afforded the opportunity to work in groups and to learn from each other with the specific intention of improving their classroom practices.

South Africa has experimented with a variety of approaches to professional development over the past 20 years or so but very few of them seem to have made a substantial impact on the classroom practices of many teachers across the country (Botha, 2012). The unsatisfactory student achievement data from the Trends in International Mathematics and Science Study (TIMSS) and the Annual National Assessments (ANA) indicate that there is a need to improve the quality of teachers in South Africa. It is in the context of this diversity and multiplicity of innovations around professional development that one local university has adopted the vehicle of Lesson Study to help groups of mathematics teachers reconfigure their classroom practice. According to Stiegler and Hiebert (1999), Lesson Study is one of the main reasons for the consistent improvements of Japanese teachers' instructional practices and students' achievement in mathematics. Lesson Study is a school-based professional development approach that is completely driven by teachers; they work collaboratively to improve instruction and student learning. At its core, the Lesson Study approach involves three main activities, viz. first, research and common planning; second, teaching and peer observation, and third, post-observation group reflection (Lewis, 2009). Whether this latest innovation will succeed or not in South Africa remains an open question at this stage.

1.3 Context of the study

The mathematics workshop was as a product of a partnership between the University of the Free State (UFS) and the Free State Department of Education (FSDoE). The partnership for professional development, which was implemented for six days over a period of six months, sought to provide opportunities for teachers to re-examine their teaching of mathematics topics with a view to improving mathematics teaching and learning across the schools in the Free State province. Furthermore, the partnership aimed to develop a sustained, intense and focused school-based professional development intervention that addresses the challenges encountered by teachers and learners in the daily teaching and learning of mathematics in primary and secondary schools using Lesson Studies. The intervention was divided into three modules. The first module introduced the Lesson Study to the teachers by engaging them in exemplary lesson planning, delivery and reflection. The second module was designed to provide teachers with the tools and skills to undertake curriculum analysis where they identified key themes within the mathematics curriculum and worked systematically on ideas for addressing the problematic sections of the curriculum. The third and last module was designed to foster sustainability by providing the participating teachers with the skills to initiate, facilitate and sustain a Lesson Study group in their schools and clusters.

During the implementation of the school-based professional development intervention, teachers were expected to initiate and sustain Lesson Study groups in their respective schools even after the workshop had ended.

1.4 Problem statement

The ever increasing pressures of accountability from various stakeholders in the education system have forced schools to identify ways of enhancing student outcomes and, for those in higher education, to find ways that lead to better preparation of novice teachers. Some researchers (e.g. Guskey, 2003) have advocated the simultaneous renewal of both organizations (schools and universities) and that the organizations should increase their efforts to collaborate i.e. schools and universities to form partnerships. Partnerships in education are formed for various reasons but they are usually formed for the professional development of in-service teachers.

Many studies report that teachers' classroom practices improve as a result of professional learning in a partnership (Mogari & Onwu, 2004; Saito, Imasyar, Kuboki & Hendeyana, 2007), but there is very little work to demonstrate the sustainability of such improvements beyond the life of the learning interventions. Similarly, South Africa grapples with the reality of identifying interventions that can affect teachers' practices and do so beyond the usually brief periods of intervention. Despite the popularity of Lesson Study as a school-based, self-sustaining professional development approach for mathematics teachers in other parts of the world, little is known about its effectiveness in the South African context (Posthuma, 2012).

Lesson Study can be regarded as a form of school-based professional development intervention and one feature that seems to stand out in most of these interventions is its ability to create platforms where teachers can collaborate effectively. In fact, numerous researchers posit that school-based professional development interventions improve teaching and learning by promoting collaboration and reflective dialogue between teachers (Darling-Hammond & Richardson, 2009; Desimone, 2009; Saunders, Goldberg & Gallimore, 2009). This collaboration between teachers normally leads to the formation of professional learning communities (PLCs) at schools where teachers learn the tricks of the trade from each other.

Literature concerning professional learning communities is encouraging but Saunders, Goldberg and Gallimore (2009) suggest that there is a need for measured optimism. Despite the compelling logic of a professional learning community's benefits for teaching and learning, the available evidence is too limited to make informed inferences regarding its effectiveness. Little (2006) supports this stance and argues that literature concerning the effects of professional learning communities is sparse and examples of powerful learning environments created by teachers as a result of their participation in a community of practice (CoP), which is an example of a professional learning community, are particularly rare. Vescio, Ross and Adams (2008) and Botha (2012) also support this argument that there is not enough evidence to indicate that professional learning communities are effective in assisting teachers to reconfigure their classroom practices. Botha (2012) further points out that there is little or no literature in South Africa regarding the effectiveness of professional learning communities; this is surprising considering that the formation of professional learning communities in schools is one of the strategies used by the Department of Education to try and improve the standard and quality of teachers in the country.

1.5 Purpose of the study

The current study investigated the effects of a partnership for professional development on mathematics teachers' classroom practices. Particularly, the researcher was interested in establishing whether teachers change their instructional practices and whether they make better curriculum decisions as a result of their participation in Lesson Study. The researcher further wanted to identify the changes in teachers' curriculum decisions and instructional practices after their participation in Lesson Study. Consequently, the researcher was able to determine the success of the partnership by assessing the effect of the Lesson Studies on mathematics teachers.

1.6 Framework of the study

There are numerous theories that deal with aspects of professional learning and the concept of 'learning on the job' is a major idea within most of them. Putman and Borko (2000) argue that learning and cognition are entrenched in social and physical contexts and learning is thus social in nature. Putman and Borko (2000) further posit that learning is distributed across individuals and artefacts and, if this be the case, it will lead to the formation of communities of practice (CoP).

Communities of practice have three crucial elements which are (i) Domain: area of key issues and shared inquiry, (ii) Community: interaction among members and sense of belonging and (iii) Practice: the body of knowledge, documents, stories, methods, tools and cases (Wenger, McDermott & Snyder, 2002). Schools and universities can be viewed as individual organizations in their own right and so this framework provides a way to study the effect of partnerships between the two organizations which have the same goal but have been historically isolated from each other. Furthermore, the framework allows for a study of the Lesson Study group as a community of practice where teachers plan together, observe each other and reflect on their practice.

1.7 Research questions

The current research study sought to assess the impact of a school-university partnership for professional development on mathematics teachers in the Free State using Lesson Study as a vehicle. To realize the goal of this research study, the following questions were answered:

- What are the effects of Lesson Study intervention on curriculum decisions and decision-making by the teachers?
- What are the effects of Lesson Study intervention on teacher's instructional practices?
- How can the effects or lack thereof be understood and/or explained?

1.8 Aims of the study

The study aimed to assess the effectiveness of a school-university professional development intervention on teacher's instructional practices and decision making. The secondary aims were to:

- determine the extent to which elements of Lesson Study (research and common planning, teaching and peer observation and post-observation group reflection) affect curriculum decision making,
- determine the extent to which elements of Lesson Study (research and common planning, teaching and peer observation and post-observation group reflection) affect teacher's instructional practices, and
- understand the logic behind the determined effects. This means that the researcher is interested in determining which curriculum decisions and instructional decisions changed after the intervention and the elements of Lesson Study that supported the perceived changes, if any.

1.9 Method

Explanatory sequential design was preferred because the researcher sought to assess changes in teachers' curriculum decisions and instructional practices, if any, using the quantitative approach and at a later stage collect qualitative data to explain and support the quantitative findings. Surveys and semi-structured interviews were used to collect the data. Cohen, Manion and Morrison (2007) lament that the 'snapshot' of a survey enables researchers to do either a prospective or retrospective enquiry from the data collected. The type of survey used in this study is known as retrospective pre-testing and numerous researchers (e.g. Hetcher, 2010; Kistler & Brier, 2003) have shown that it is a more desirable method for measuring the impact of PD interventions than the traditional pre- and post-test methodology when employing self-reports.

The participants in the research project were 85 mathematics teachers who participated in the mathematics workshop. The participants were from various schools within one district in the Free State province. The teachers were nominated by their employers for the intervention. At a later stage, the researcher randomly sampled teachers (10%) who had participated in the survey to participate in the semi-structured interviews.

The researcher selected and modified items from unpublished dissertations and published articles for the construction of the questionnaire to answer the research questions. Since the intervention under assessment uses Lesson Study as a vehicle, the researcher used items that addressed instructional practices and curriculum decisions, mindful of the three activities of Lesson Study which are research and common planning, teaching and peer observation, and post-observation group reflection. The researcher then grouped the items for instructional practices and curriculum decisions using the three activities of Lesson Study as the underlying sub-scales in each case. The quantitative instrument was a five-point Likert-scale questionnaire, with items ranging from 'strongly disagree' to 'strongly agree' and it contained a 'before' and 'after' the intervention sections. Participants in the study completed a short questionnaire about their curriculum decisions and instructional practices. The questionnaire took about 30 minutes to complete and the researcher personally administered the questionnaire and explained it to the teachers on their last day of the workshop. Time was negotiated with the teachers at the end of the last workshop so that those who wished to exercise their right not to participate in the study were free to leave. The semi-structured interviews protocol was designed to elicit changes in teachers' curriculum decisions and instructional practices to allow the researcher to determine the elements of the intervention that supported the changes. The researcher ensured that the teacher interviews occurred outside of instruction time or when the teachers indicated that they had free time.

Frequencies, percentages and mean ranks were calculated from the quantitative data, and the Wilcoxon signed rank test was used to determine whether the changes in pre- and post- test scores were significant. The data from semi-structured interviews was used to corroborate and explain the quantitative data findings. The interview transcripts were read, transcribed, fragmented and coded to allow the researcher to categorize the fragments into themes. Similar fragments were assigned similar codes and from the emerging themes and quotes, overarching themes were built.

1.10 Significance of the study

The study attempts to fill the gap in the current literature in the key areas described below.

From a practical perspective, the research study sought to provide valuable information regarding partnerships of this nature. This study helped us understand whether there was a need to pursue these types of partnerships and whether they had a significant effect on mathematics teachers' classroom practices.

Lesson Study is relatively new to South Africa. As far as the researcher is aware, the approach was first adopted in a partnership between the University of Pretoria (UP), the Mpumalanga Department of Education (MDoE) and the Japan International Co-operation Agency (JICA) in a project named the Mpumalanga Secondary Science Initiative (MSSI). In their reflection, Ono and Ferreira (2010) concede that the partnership failed to institutionalize the Lesson Study approach as a model for school-based professional development. The current study seeks to assess whether this latest attempt by another local university will yield better results.

To the researcher's limited knowledge, most impact studies in South African literature concerning the Lesson Study approach employ qualitative designs. Although qualitative designs are useful in describing the impact of the Lesson Study approach, the sample is usually limited to about a handful of teachers. The current study employs a quantitative approach and a number of perspectives with regard to the effectiveness of the approach will be analysed.

Although CoPs are preferred as a means of school-based professional development, there is limited evidence regarding their effectiveness (Saunders, Goldberg & Gallimore, 2009). This study attempted to add to the available evidence regarding the effectiveness of school-based professional development interventions on teacher change.

1.11 Ethical considerations

As with any study, there were ethical considerations that were observed by the researcher. Before data collection, the researcher requested and obtained permission to conduct the research from the Free State Department of Education and the Faculty of Education at the

University of the Free State (ethical clearance reference: UFS-EDU-2014-011). Ethical issues concerning participating teachers are described below.

1.11.1 Voluntary participation

Voluntary participation means that no one was required or coerced to partake in the study and no one was forced to participate (McMillan & Schumacher, 2010). This refers to anyone who does not want to participate even if the participants are being studied as a group. McMillan and Schumacher (2010) warn against bribing potential participants and recommends subtle coercion like explaining the importance of the study being undertaken to participants. As such, participation in the study was completely voluntary. Participants were informed of their right to withdraw at any stage of the research process. The researcher provided snacks for the semi-structured interviews.

1.11.2 Informed consent

Informed consent refers to the participants' agreement to be part of the study after having been informed of the purpose, risks, procedures, benefits and risks regarding the study (Cohen, Manion & Morrison, 2007). Before the commencement of any research study, the researcher should explain all the processes to be followed in the study as this would probably influence the prospective participant's decision to part take. Moreover, the researcher should not withhold any information that might sway the participant's decision to take part as this is deception. As such, the participants were required to fill in a consent form before participation where the nature and purpose of the study were clearly stated.

1.11.3 Confidentiality, anonymity and privacy

Confidentiality means the researcher will not reveal the identity of participants to a third party besides the researcher's staff (Johnson & Christen, 2010). The researcher and participants must have a contract in which they agree on what the collected data can be utilized for.

Anonymity means that the identities of the participants should be kept a secret even from the researcher. Privacy is the combination of anonymity and confidentiality; the idea of privacy involves controlling who has access to the collected data (Johnson & Christen, 2010). The collected data was only accessible to the researcher and/or his supervisor. The researcher personally transcribed the data and performed all the necessary statistical calculations.

1.12 Limitations

Firstly, the study used teachers' self-reports and interviews. There are indications that what teachers say is not necessarily what they do in classrooms (Supovitz & Christman, 2003) and as such, the findings should be approached with caution.

Secondly, the methodology used to collect data, viz. retrospective pre-testing, has its own inherent weaknesses. For example, participants in the study may feel the need to score the intervention in a way that makes it seem more effective than it actually is. The effects of memory also present a challenge when the assumption is that participants will remember their initial state after a period of time (six months in this case).

Another methodological limitation is the fact that we could not categorically ascertain the external consistency (Confirmatory Factor Analysis, CFA) of the instrument because the number of participants was not sufficient to obtain meaningful results from the analysis.

1.13 Clarification of terms

Lesson Study:

Lesson Study is a Japanese form of school-based professional development approach where teachers work collaboratively to plan, implement, and reflect on a limited number of lessons designed to improve student learning on a particular topic (Lewis, 2009).

School-based professional development interventions:

School-based professional development interventions are interventions that occur on-site within a school.

Professional learning communities:

Professional learning communities in our case refer to the kinds of school-based professional communities that are formed for the purposes of professional learning.

Communities of practice:

Wenger, McDermott and Snyder (2002) define CoP as a group of people who share a problem, concern or enthusiasm about a certain topic, and improve their expertise and knowledge by frequent interaction.

1.14 Titles of articles

1. School-University Partnerships for Professional Development and their impact on teachers: a case of the Lesson Study intervention in mathematics

2. School-Based Professional Development Interventions: The Effects of a Lesson Study Approach on Mathematics Teachers in the Motheo District of the Free State Province.

Notes:

1. Each article is presented in a format that is required by the specific journal for publication purposes.

2. The title of the first article as captured in the CTR was modified to the title as stated above

Article 1

School-University Partnerships for Professional Development and their impact on teachers: a case of the Lesson Study intervention in mathematics

School-University Partnerships for Professional Development and their impact on teachers: a case of the Lesson Study intervention in mathematics

Abstract

School-university partnerships for professional development of teachers continue to be used extensively in South Africa to enhance the quality of teaching and learning, especially in mathematics. The success of such partnerships in changing teachers' classroom practices, however, remains in doubt, in part because very few studies present empirical evidence of the changes. This paper assesses the impact of one such partnership, which resulted in perceived changes in teachers' instructional practices and curriculum decisions after the intervention. Using retrospective pre-testing design, the study established that there were significant differences between teachers' pre- and post-test scores, which suggests perceived changes in teachers' instructional practices and curriculum decisions. The findings provide some empirical evidence that partnerships of this nature, between schools and universities, may prove valuable in attempts to improve the teaching of school mathematics, especially in the South African context.

Key Words: school-university partnerships, lesson study, mathematics teaching, professional development.

1. Introduction

Since the Jomtien conference on Education for All, in 1990, called for an increase in partnerships in education, various kinds of partnerships have proliferated. These partnerships include school-university partnerships (Bartholomew & Sandholtz, 2009), university-university partnerships (Samoff & Carrol, 2004) and school-university-donor agency partnerships (Bukari & Jita, 2009). The present study involved a school-university partnership, which was designed to improve the teaching and learning of mathematics in the Free State province of South Africa.

Researchers have, for some time, been calling on universities and schools to collaborate systematically to achieve school reform and teacher development (Allen, Howells & Radford, 2013; Walkington, 2007). Partnerships provide a way of achieving more with less, in that they enable maximum utilisation of available resources to achieve educational goals and to foster innovation (Walkington, 2007). Universities and schools have a symbiotic relationship

– both organisations produce and implement knowledge for reform and research purposes. It is no surprise that researchers such as Borthwick, Stirling, Nauman and Cook (2003) boldly state that 'school and university partnerships are here to stay'.

Schools and universities often work together in initial teacher preparation, when universities place their pre-service teachers in schools for work-integrated learning (Zimpher & Howey, 2005). In some cases, the partnership may be for research purposes, where teachers are encouraged to conduct research by themselves and with university academics (Burton & Greher, 2007). There are also reports on the use of partnerships for the preparation and empowerment of school principals (Browne-Ferrigno & Barber, 2010). Internationally, there is renewed interest in systemic and effective school-university partnerships that could help to improve, for instance, the quality of in-service teachers through professional learning (Walkington, 2007).

School-university partnerships create opportunities for teachers and university academics to learn by drawing on each organisation's knowledge and expertise (Bartholomew & Sandholtz, 2009). These opportunities are possible because universities are well placed to identify new instructional strategies that have been empirically tested and have a theoretical base (Walsh & Backe, 2013). In the same vein, schools assist universities to comprehend the realities of the classroom, and thereby assist in the design of professional learning interventions that address challenges faced by teachers in the classroom. A number of researchers (e.g. Darling-Hammond & Richardson, 2009; Desimone, 2011; Guskey & Yoon, 2009) describe ideal conditions for professional learning to occur effectively, and the best way to create most of these conditions is through partnerships.

The school-university partnership described in this paper uses Lesson Study, an approach that, according to Stiegler and Hiebert (1999), is one of the main reasons for the consistent improvement of the Japanese teachers' instructional practices and student achievement in mathematics. Lesson Study is a school-based professional development approach that is completely driven by teachers; they work collaboratively to improve instruction and student learning. At its core, the Lesson Study approach involves three main activities, viz. first, research and common planning; second, teaching and peer observation, and third, post-observation group reflection (Lewis, 2009).

Many studies report that teachers' classroom practices improve as a result of professional learning in a partnership (Mogari & Onwu, 2004; Saito, Imasyar, Kuboki & Hendeyana, 2007), but there is very little work to demonstrate sustainability of such improvements beyond the life of the learning interventions. Similarly, South Africa grapples with the reality of identifying interventions that can impact teachers' practices and do so beyond the usually brief periods of intervention. Given the popularity of Lesson Study as a school-based, self-sustaining professional development approach for mathematics teachers in other parts of the world, little is known about its effectiveness in the South African context (Posthuma, 2012). This paper assesses the impact of a school-university partnership by answering the following research questions:

- What are the effects of Lesson Study intervention (i.e. research and common planning, teaching and peer observation and post-observation group reflection) on teachers' curriculum decisions?
- What are the effects of Lesson Study intervention (i.e. research and common planning, teaching and peer observation and post-observation group reflection) on the participating teachers' instructional practices?

2. Review of relevant literature

2.1 School-university partnerships

As mentioned above, in many countries partnerships are regarded as valuable structures for facilitating the professional development of teachers. A study conducted in Indonesia, for example, assessed the impact of a school-university partnership on teachers and the university faculty (Saito, Imasyar, Kuboki & Hendeyana, 2007). The intervention used a derivative of the Lesson Study approach, called Piloting Activities, to improve teacher attributes. The findings suggest that teachers' ability to deal with 'visible practices' (students' worksheets, students' process skills and lesson planning) improved as a result of participation in the Piloting Activities.

Similarly, in the South African context, a partnership was established between the University of Venda and the Limpopo Department of Education, and referred to as UNIVEMALASHI (Mogari & Onwu, 2004). Here too, the authors reported success regarding the ability of the approach to assist teachers to alter their classroom behaviour. The teachers reportedly worked

more closely with their learners and improved their questioning skills, which led to increased curiosity and autonomy on the part of the learners.

Many similar studies that report on the positive impact of school-university partnerships on teachers' classroom practices have, in some ways, prompted the present investigation into the impact of Lesson Study in a partnership in the Free State province of South Africa.

2.2 Lesson study

Lesson Study is, in essence, a reflective teaching approach, where teachers work collaboratively to examine teaching and learning in the classroom. Although Lesson Study has been employed by Japanese schools for over four decades, it was only brought to the attention of the international education community in the 1990s by the Third International Math and Science Study (Stiegler and Hiebert, 1999). Lesson Study has since spread and is practiced in many countries, including the Unites States of America (USA), Australia, Kenya, Malaysia, and South Africa.

The aim of the Lesson Study is, fundamentally, to improve instruction by promoting collaboration and sharing of practice. The underlying principles of Lesson Study are that teachers are likely to alter and improve their instructional practices after observing other teachers who are knowledgeable about the subject matter and pedagogy (Perry & Lewis, 2009). The Lesson Study group usually comprises four to six members who teach the same subject or grade. The activities of a Lesson Study group are usually referred to as a cycle that begins with research and common planning of a lesson and concludes with further research and (re)planning or refinement of the lesson.

2.2.1 Research and common planning

After the formation of the Lesson Study group, the members choose a research theme (Lewis, 2009). The members then identify a unit of study, plan for a series of selected lessons from a unit and one research lesson to be presented by one member of the group.

2.2.2 Teaching and peer observation

The research lesson is then presented by one member using the formulated lesson plan, while the other members of the group observe the lesson presentation. The observations focus

mainly on the students' learning and their engagement during the lesson (Perry & Lewis, 2009).

2.2.3 Post-observation group reflection

After the presentation and observation, the group reflects on the lesson and discuss strong and weak points of the lesson (Lewis, 2009). If necessary, the group then revises the lesson plan and nominates another member of the group to present the revised lesson to a second group of students, thus completing the cycle.

Lesson Study is not completely new to South Africa. It was used, for example, as an approach to professional development in the Mpumalanga Secondary School Initiative (MSSI) partnership (Jita, Maree & Ndlalane, 2008). In their final reflections about the MSSI partnership, Ono and Ferreira (2010) note that the partnership failed to institutionalise Lesson Study as a form of school-based in-Service education and training, partly due to implementation difficulties. While the Lesson Study approach struggled to take root in the province of Mpumalanga, Ono and Ferreira (2010) note that the partnership in general had a positive impact on teacher practices, although the impact varied from teacher to teacher. Jita *et al,* (2008) believe that the MSSI partnership contributed to reducing the gap between professional development interventions and teachers' classroom practices.

In yet another study, also in South Africa, five teachers were introduced to a derivative of Lesson Study in the Free State province (Posthuma, 2012). Posthuma (2012) reports that the participating teachers were able to reshape their behaviour and to critically reflect on avenues for improving their instructional practices in order to enhance student achievement.

The studies provide tentative evidence of the effects of Lesson Study on South African teachers. The present study therefore continues this strand of research by presenting quantitative data on a South African case of a Lesson Study intervention for mathematics classroom improvement using a relatively large sample of primary- and secondary-school teachers from the Free State province.

3. Conceptual Framework

3.1 Teacher learning

Teachers are likely to consider altering or improving their practices in a classroom if they acquire new perspectives on their current practices. The acquisition of these new perspectives constitutes what we call teacher learning. Teachers require quality and sustained learning opportunities to change their 'traditional' practices (Hubbard, Mehan & Stein, 2006). Furthermore, as Putnam and Borko (2000) argue, learning and cognition are entrenched in social and physical contexts, thus making learning a social process. For this reason, many scholars believe that teacher learning will be more effective when undertaken collegially (Borko, 2004; Darling-Hammond & Richardson, 2009; Desimone, 2011). That is, teachers are likely to learn more within communities of practice (CoP) (Wenger, 1998).

3.2 Communities of practice

Communities of practice, as described by Wenger 1998 have been used in numerous contexts. Wenger, McDermott and Snyder (2002) define a CoP as a group of people who share a problem, concern or enthusiasm about a certain topic, and improve their expertise and knowledge by frequent interaction. While research on CoPs is positive regarding their potential benefits to members, questions have been raised regarding the sustainability of CoP. Supovitz (2002) notes that CoP are usually successful initially, but tend to disintegrate over time. Buysse, Sparkman and Wesly (2003) argue that CoPs flourish when they endure over time and offer sufficient learning opportunities for teachers. This study originated from the premise that Lesson Study groups constitute a form of CoP, where teachers examine their own classroom practices with the goal of improving it. The partnership between the schools and university in this study also represents a CoP, where the teachers are supported to enhance their skills through collaborative professional learning in the Lesson Study groups. The situated nature of Lesson Study and the fact that the intervention is driven largely by the mathematics teachers themselves may, in this case, address the concern raised by Buysse *et al* (2008) relating to the longevity of a CoP.

While teachers may learn a variety of skills in a CoP such as Lesson Study, this paper will limit itself to the impact of CoP on the teachers' instructional practices and curriculum decisions. Curriculum decisions are central to events in the classroom, and shape the teachers' classroom practices, which, in turn, determine the students' opportunities to learn (Chabongora & Jita, 2013).

3.3 Curriculum decisions

As early as 1983, Shavelson (1983) recognised that teachers' decisions, both conscious and unconscious, are an important part of quality teaching and learning. Curriculum decisions refer to what students are taught as well as planned and unplanned skills, attitudes and information. In his book, Klein (1991) categorises the decisions that should be considered when dealing with curriculum, *viz.* decisions about (i) content; (ii) purposes, goals and objectives; (iii) materials and resources; (iv) activities and teaching strategies; and (v) evaluation, grouping, time and space. This paper draws on Klein's framework to examine the changes resulting from the Lesson Study intervention, if any.

3.4 Instructional practices

It is widely accepted in the education community that enhanced instructional practice could have a positive impact on student achievement. Windschitl, Thompson, Braaten and Stroupe (2012) propose a core set of instructional practices for teachers that, in our context, we adapted for mathematics teachers. The set includes (i) developing active learners; (ii) orchestrating collaborative discourse; (iii) varying teaching formats; (iv) employing integrated learning; and (v) encouraging critical thinking, and engaging in reflective practice. These practices are similar, in many ways, to those that were proposed authoritatively by the National Council of Teachers of Mathematics (NCTM), for instance (NCTM, 2000).

4. Method

We used a survey to assess the impact of the Lesson Study intervention on the decisions and practices of mathematics teachers who participated in the study (Creswell, 2014). Retrospective pre-testing was the preferred approach for data collection in this study. Howard, Schmek and Brey (1979) describe a discrepancy called 'response shift bias', which confounds most pre- and post-test self-reports. Response shift bias is a phenomenon that involves participants evaluating themselves from different frames of reference. To overcome this phenomenon, Howard and his colleagues suggest that the pre-test should be administered around the same time as the post-test. Researchers agree that retrospective pre-testing may be a more effective approach for assessing the impact of interventions using self-reports than the traditional pre- and post-test approaches (Hetcher, 2010; Kistler & Brier, 2003).

4.1 Participants

The sample consisted of primary- and secondary-school teachers of mathematics from the Free State province who participated in the Lesson Study intervention. The participants (n =

110) were nominated by their employers for the intervention. In total 93 questionnaires were completed and returned, with only 85 participants (77% of the original sample) answering the questionnaire correctly to enable analysis. The biographical data profile of the participants is presented in Table 1 below:

Table 1: Biographical information

Variable	Description	Quantity
Gender		
	Male	36.5% (n = 31)
	Female	63.5 % (n = 54)
Age		
	Under 25	2.4% (n = 2)
	26 - 29	7.1% (n = 6)
	30 – 39	12. 9% (n = 11)
	40 – 49	57.6% (n = 49)
	50 – 59	20.0% (n = 17)
	Over 60	0% (n = 0)
Teaching experience		
	Under 2	3.5% (n = 3)
	2 – 4	14.1% (n = 12)
	5 – 9	15.3% (n = 13)
	10 – 15	14.1% (n = 12)
	16 – 20	24.7% (n = 21)
	Over 20	28.2% (n = 24)
Qualifications		
	3 year Diploma (Education)	15.3% (n = 13)
	3 year Diploma + ACE	28.2% (n = 24)
	4 year Bachelors (Education)	14.1% (n = 12)
	3 year Bachelors + Teaching certificate	8.2% (n = 7)
	4 year Diploma (Education)	3.5% (n = 3)
	Senior qualification (Hons, MSc, PhD + Teaching certificate)	8.2% (n = 7)
	Senior qualification (Hons, Med, PhD in Education)	17.6% (n = 15)
	Other	4.7% (n = 4)
Number of interventions		

(previous 2 years)	
None	14.1% (n = 12)
1	20.0% (n = 17)
2	24.7% (n = 21)
3	17.6% (n = 15)
4	10.6% (n = 9)
5	12.9% (n = 11)

4.2 Programme description

The Lesson Study intervention was a product of a partnership between the University of the Free State (UFS) and the Free State Department of Education (FSDoE). The partnership sought to develop a sustained, intense and focused professional development intervention to address the challenges encountered by teachers and students in their day-to-day teaching and learning of mathematics in primary and secondary schools. The backdrop of the intervention is the unsatisfactory performance of primary and secondary school mathematics students in South Africa over the past few years (HSRC, 2011).

The Japanese Lesson Study approach was used as a vehicle for the intervention and the workshops were presented over a period of six days spread over six months. The two-day, face-to-face sessions every second month were hands-on and teachers participated interactively in researching, planning and delivering exemplary lessons on selected mathematics topics during the workshop. After each workshop, the teachers were expected to implement what they had learned and compile a portfolio of evidence to document their implementation at school. The implementation began with a request that the teachers set up Lesson Study groups at their schools, where they would practice the ideas learned at the workshops. During the workshops, the teachers engaged in the learning of mathematics through the use of laboratory activities and manipulatives designed to improve the necessary conceptual and process skills that are essential for understanding and presenting content to diverse groups of learners. The intervention was divided into three modules as follows.

4.2.1 Module 1: Lesson Study approach (contact session)

The module introduced teachers to the Japanese version of Lesson Study through both literature and video clips. Furthermore, the module offered the teachers several opportunities to actually engage in the various stages of the Japanese version of a Lesson Study, including

doing preparatory research for a lesson topic, planning a lesson, delivering the lesson and collaborative reflection on the lesson.

4.4.2 Module 2: Mathematical knowledge for teaching (contact session)

In this module, the teachers worked on identifying the key themes of each topic in the mathematics curriculum. Examples were taken from sections of the content that had been identified as the most challenging and problematic for teachers and learners by the FSDoE. The module was designed to improve and develop the teachers' Mathematical Knowledge for Teaching (Ball, Thames, & Phelps, 2008), which includes deeper conceptual understanding of key mathematical topics and the ability to identify common errors by and misconceptions among learners.

4.4.3 Module 3: Teaching and Lesson Study practicum (school based)

This module was designed to provide teachers with the opportunity to create and sustain Lesson Study groups for mathematics in their own schools. The teachers had to take part in at least one Lesson Study cycle at their schools or districts, and had to present at least one collaboratively planned lesson in mathematics to a group of learners. A portfolio of evidence (PoE) also had to be submitted, together with specific endorsements by a school supervisor (such as the principal, deputy and/or head of department).

4.5 Data collection

In the last session of the workshop (six months later), the teachers were requested to complete a questionnaire regarding changes in their instructional practices and curriculum decision-making that resulted from participating in the intervention. One of the researchers personally administered the 45-minute questionnaire to the teachers.

4.6 Instrument design

The instrument was a five-point Likert-scale questionnaire with responses ranging from *strongly disagree* to *strongly agree*. The questionnaires contained before- and after-the-intervention parts, in line with retrospective pre-testing protocols.

Using guidance from Klein (1991) on curriculum decisions, and framing on instructional practice components by Windschitil *et al* (2012) we developed items and/or modified others from accessible unpublished theses and published research papers (for example, Rock &

Wilson, 2005; Wright, 2009) that measured the impact of Lesson Study on teachers. The items were then grouped into their respective subscales.

4.7 Reliability

Cronbach's alphas were calculated to determine the internal consistency of the instrument (McMillan & Schumacher, 2010). The SPSS (version 22) was used to calculate the Cronbach's alphas and the results (Table 2) indicate that they were all above 0.7. The reliability coefficients of over 0.7 suggest that the items were reliable (Cohen, Manion & Morrison, 2007).

Table 2: Cronbach alphas

Construct	**Subscale**	**Cronbach's Alpha**	**Number of Items**
Teacher Practice			
	Research and Common Planning	0.72	7
	Teaching and Peer Observation	0.73	5
	Post-Observation Group Reflection	0.70	4
Curriculum Decisions			
	Research and Common Planning	0.87	6
	Teaching and Peer Observation	0.72	4
	Post-Observation Group Reflection	0.75	3

4.8 Data analysis

Percentages and mean ranks were calculated, using SPSS, to show differences between the pre- and post-test scores. We further calculated means for the subscales to show general trends in the data. For the purposes of this paper, the means will be used to show differences in pre- and post-test scores together with the mean ranks.

The Wilcoxon signed rank test (see Cohen et al., 2007: p 552) was used to establish if there were significant differences between the pre- and post-test scores. The Wilcoxon signed rank test, which is the non-parametric equivalent of a paired sample t-test, assesses this difference

by comparing mean ranks, not the means of the pre- and post-tests scores for significance. In essence, a *2-tailed* Wilcoxon signed rank test (p = 0.01) was used to test the following null hypotheses:

Curriculum decision

- There is no difference in teachers' perceived curriculum decision scores before and after the intervention as a result of *research and common planning*.
- There is no difference in teachers' perceived curriculum decision scores before and after the intervention as a result of *teaching and peer observation*.
- There is no difference in teachers' perceived curriculum decision scores before and after the intervention as a result of *post-observation group reflection*.

Instructional practices

- There is no difference in teachers' perceived instructional practices scores before and after the intervention as a result of *research and common planning*.
- There is no difference in teachers' perceived instructional practices scores before and after the intervention as a result of *teaching and peer observation*.
- There is no difference in teachers' perceived instructional practices scores before and after the intervention as a result of *post observation group reflection*.

4.9 Ethical considerations

Permission was obtained from the FSDoE and the required ethical clearance processes of the UFS were followed. Informed consent was also obtained from the participants, who were informed of their right to withdraw from the study at any point, should they wish to do so (McMillan & Schumacher, 2010). All the data were secured using encryptions on SPSS.

5. Findings and discussions

5.1 Research Question No. 1

What are the effects of a Lesson Study intervention on the teachers' perceived curriculum decisions?

Retrospective pre-test scores indicated that there were differences in the teachers' curriculum decisions after the intervention. We illustrate this point by means of one of the items in the research and planning subscale.

After the intervention, there was an increase of 42 (49.4%) teachers who *strongly agreed* that they were able to choose the appropriate content for their lessons, bringing the total to 59 (69.4%). The data indicates that most teachers changed their choices to *strongly agree* or *agree* after the intervention, with the majority choosing *strongly agree* (Table 3). This trend could be traced through all the items in the subscales assessing the intervention's impact on teachers' curriculum decisions.

Table 3: Participant scores in *research and common planning* subscale: curriculum decisions

	I choose the appropriate content for my lessons				
	Strongly Agree	**Agree**	**Not Sure**	**Disagree**	**Strongly Disagree**
Before Lesson Study	20.0% (17)	60.0% (51)	16.5% (14)	3.5% (3)	0% (0)
After Lesson Study	69.4% (59)	30.6% (26)	0% (0)	0% (0)	0% (0)
Change	49.4% (42)	-29.4% (25)	-16.5% (14)	-3.5% (3)	0% (0)

The mean ranks for the subscales provided an overall view of the trends in teachers' scores. The mean ranks and means for the subscales *research and common planning, teaching and peer observation* and *post-observation group reflection* before the intervention were 114.08 (2.16), 113.63 (2.19), 111.63 (2.14) and 56.92 (1.47), 57.37 (1.47), 59.37 (1.41) after the intervention respectively (Table 4). The data provided further evidence that most teachers changed their opinions to either *agree* or *strongly agree* after the intervention.

Table 4: Mean ranks and means for the summed curriculum decisions subscales

	Before Lesson Study		**After** Lesson Study	
Subscale	Mean Rank	Mean	Mean Rank	Mean
Research and common planning	114.08	2.16	56.92	1.47
Teaching and peer observation	113.63	2.19	57.37	1.47
Post-observation group reflection	111.63	2.14	59.37	1.41

Furthermore, the Wilcoxon test statistic revealed that all the hypotheses for the curriculum decisions construct were not supported, as the p-value was below 0.01 in each case. There were significant differences in teachers' curriculum decisions as a result of their participation in research and common planning ($Z = -7.52$; $p < 0.01$), teaching and peer observation ($Z = -7.20$; $p < 0.01$) and post-observation group reflection ($Z = -7.11$; $p < 0.01$). Effect sizes (r) for the subscales revealed that the difference between the pre- and post-test scores was moderately large for all the subscales (Table 5).

Table 5: Wilcoxon test statistics and effect sizes: curriculum decisions

Subscale	**Z**	**p-value**	**r**
Research and common planning	-7.54	0.00	-0.82
Teaching and peer observation	-7.20	0.00	-0.78
Post-observation group reflection	-7.11	0.00	-0.77

The findings suggest that teachers' perceived curriculum decisions improved after their participation in Lesson Study. The mean ranks and means show that teachers were aware of improvements in their curriculum decisions after participating in the intervention. This result is further substantiated by the Wilcoxon test statistic and the p-value, which suggest that these improvements in teachers' curriculum decisions were not due to chance. Lastly, the magnitude of the improvement after the intervention is moderately large, as shown by the effect sizes. The findings support the argument of Darling-Hammond *et al* (2009) namely, that professional learning interventions tend to be effective when the focus is on specific curriculum issues in the classroom. Borko (2004) posits that, if teachers are to impact student achievement positively, they must have a thorough understanding of concepts, facts and interconnections that are central to the discipline. It could be suggested that, in line with findings by Lewis, Perry and Hurd (2009), the teachers' understanding of mathematics content changed significantly after the Lesson Study intervention. Thus, our findings demonstrate that teacher interactions during the research and common planning may have led to improvements in knowledge and/or understanding of important concepts in the mathematics curriculum. By observing other teachers and students in the classroom situation, the teachers' awareness of student thinking during the learning process seems to have improved. Posthuma (2012) argues that teachers derive meanings that inform decisions

relating to their actions as a result of group reflection. Reflection is important for teachers, enabling them to assess aspects of their curriculum decision-making; that is, during reflection teachers are able to measure the success of their lessons by evaluating the effectiveness of the decisions taken during the lessons (Lewis, 2009).

5.2 Research Question No. 2

What are the effects of Lesson Study intervention on teachers' perceived instructional practices?

In a pattern similar to that of the first research question, the data showed significant differences in teachers' pre- and post-test scores after the intervention. An item from the subscale post-observation group reflection is used to demonstrate these differences.

After the intervention, there was an increase of 45 (53.0%) teachers who *strongly agreed* that they discuss instruction with their colleagues, bringing the total to 56 (65.9%). Once again, a large number of teachers changed their opinions to *agree* and *strongly agree* after the intervention. This trend could be traced through most of the items on the perceived instructional practices.

Table 6: Participants' scores in the *post-observation group reflection* subscale: instructional practices

	I discuss instruction (teaching) with my colleagues				
	Strongly Agree	**Agree**	**Not Sure**	**Disagree**	**Strongly Disagree**
Before Lesson Study	12.9% (11)	54.1% (46)	12.9% (11)	17.6% (15)	2.4% (2)
After Lesson Study	65.9% (56)	32.9% (28)	1.2% (1)	0% (0)	0% (0)
Change	53.0% (45)	-21.2% (18)	-11.7% (10)	-17.6% (15)	-2.4% (2)

The mean rank for the subscales *research and common planning, teaching and peer observation* and *post-observation group reflection* before the intervention were 113.86 (2.27), 110.92 (2.04) and 117.02 (2.26) and 57.14 (1.59), 60.08 (1.47), 53.98 (1.40) after the

intervention respectively (Table 7). The findings suggest that there were significant changes in teachers' perceived instructional practices as a result of participating in the three activities of Lesson Study.

Table 7: Mean ranks (and means) for the summed instructional practices subscales

	Before Lesson Study		**After** Lesson Study	
Subscale	Mean Rank	Mean	Mean Rank	Mean
Research and common planning	113.86	2.27	57.14	1.59
Teaching and peer observation	110.92	2.04	60.08	1.47
Post-observation group reflection	117.02	2.26	53.98	1.40

Once more, the hypotheses relating to the perceived instructional practices were not supported, as the p-values were below 0.01. There were significant differences in teachers' instructional practices as a result of their participation in research and common planning ($Z = -7.41$, $p < 0.01$), teaching and peer observation ($Z = -7.05$, $p < 0.01$) and post-observation group reflection ($Z = -7.50$, $p < 0.01$). The effect sizes indicate that the magnitude of the difference between the pre- and post-test scores was large for each of the three subscales (Table 8).

Table 8: Wilcoxon test statistics and effect sizes: instructional practices

Subscale	**Z**	**p-value**	**r**
Research and common planning	-7.41	0.00	-0.80
Teaching and peer observation	-7.05	0.00	-0.76
Post-observation reflection	-7.50	0.00	-0.81

The findings therefore show that the teachers' perceived instructional practices may have improved significantly after their participation in the Lesson Study intervention. These findings are indicative of a shift in teachers' perceived instructional practices as a result of the intervention. The Wilcoxon test statistics illustrate that the improvements in teachers' instructional practices were not due to chance and that the magnitude of the differences in

their pre- and post-test scores were, like the finding for the first research question, moderately large. The review of literature carried out by Vescio, Ross and Adams (2008) supports the finding that teachers' practices improve when they focus more on their students. Taylor, Anderson, Meyer, Wagner and West (2005) report that teachers' interactions during research and common planning results in improved lesson plans, which have a positive effect on student learning. Our findings therefore suggest, in agreement with Lewis, Perry and Hurd (2009), that teachers' conceptions of what constitutes students understanding, and the means to help students learn, may have changed significantly as a result of the Lesson Study intervention. Fernandez (2005) argues that it is imperative to consider student thinking when planning a lesson. The observation of a lesson offered teachers the opportunity to observe students learning without the burden of teaching. As such, teachers were able to jointly plan instructional practices that assist students to learn better. Our results also point to the importance of group reflection for the improvement of instructional practices. Taylor *et al* (2005) found that group reflection afforded teachers the opportunity to question assumptions, share information and re-evaluate their practices.

6. Conclusion and recommendations

It is evident from the findings that teachers believe that the partnership for professional development had a positive impact on their perceived curriculum decisions and perceived instructional practices. The teachers' participation in the three major activities of a Lesson Study seems to have each contributed significantly to changes in their perceived decision-making and classroom practice. Specifically, teachers reported improvements in their ability to collaborate with other teachers, which helped to improve their knowledge regarding classroom practices and the way students acquire and process knowledge. These results provide evidence that partnerships of this nature could prove valuable in attempts to enhance the standard of mathematics teaching in South Africa and elsewhere. We therefore recommend that teacher learning should, where possible, be orchestrated within the context of partnerships, such as those that involve schools and universities.

Although our results are encouraging, they should be approached with caution. The methodology used to collect data, viz. retrospective pre-testing, has its own inherent weaknesses. For example, participants in the study may feel the need to score the intervention in a way that makes it seem more effective than it actually is. Memory effects also present a

challenge, where the assumption is that participants will remember their initial state after a period of time (six months in this case).

Another methodological limitation is the fact that we could not categorically ascertain the external consistency (Confirmatory Factor Analysis, CFA) of the instrument because the number of participants was not sufficient to obtain meaningful results from the analysis. As this methodology uses self-reports, it would be interesting to determine if the perceived changes in teachers' instructional practices and curriculum decisions are visible and enacted in their classrooms. There may also be a need to use more robust methods of determining the impact of partnerships for professional development, not only on teachers but on students as well.

The next phase of our study, which is ongoing, involves a qualitative study of the classroom practices and instructional decision-making by the teachers involved in our study.

7. References

Allen, J.M., Howells, K. & Radford, R. (2013). A 'Partnership in Teaching Excellence': ways in which one school–university partnership has fostered teacher development. *Asia-Pacific Journal of Teacher Education*, **41**(1), 99-110.

Ball, D., Thames, M. & Phelps. G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education*, **59**(5), 389-407.

Bartholomew, S.S. & Sandholtz, J.H. (2009). Competing views of teaching in a school-university partnerships. *Teaching and Teacher Education*, **25,** 155-165.

Borko, H. (2004). Professional development and teacher training: mapping the terrain. *Educational Researcher*, **33**(3), 3-15.

Borthwick, A.C., Stirling, T., Nauman, A.D. & Cook, D.L. (2003). Achieving successful school university collaboration. *Urban Education*, **38**(3), 330-371.

Browne-Ferrigno, T. & Barber, M. (2010). *Successful principal-making collaborations: From perspective of a university-partner*. Annual meeting of the American Educational Research Association, Denver, CO.

Bukari, Z. & Jita, L.C. (2009). Partnerships for educational development in Africa: Evidence from Japanese professional development programmes for science teachers in Ghana and South Africa. *Southern African Review of Education*, **15**(1), 7-24.

Burton, S.L. & Greher, G.R. (2007). School-University partnerships: What do we know and why do they matter?. *Arts Education Policy Review*, **109**(1), 13-24.

Buysse, V., Sparkman, K.L. & Wesly, P.W. (2003). Communities of practise: connecting what we know and what we do. *Council for Exceptional Children*, **69**(3), 263-277.

Chabongora, B. & Jita, L. (2013). Opportunities to Learn (OTL) Grade-10 Algebra in three South African Catholic Secondary Schools. Journal of Education Studies. **12**(1), 172-88.

Cohen, L., Manion, L. & Morrison, K. (2007). *Research methods in education.* New York: Routledge.

Cresswell, J.W. (2014). *Research Design: qualitative, quantitative and mixed methods approaches*. Sage Publications, Washington DC.

Darling-Hammond, L. & Richardson, N. (2009). Research review / Teacher learning: what matters?. *How Teacher's Learn*, **66**(5), 46-53.

Desimone, L.M. (2011). A primer on effective professional development. *Phi Delta Kappan*, **92**(6), 68-71.

Fernandez, C. (2005). Lesson Study: A means for elementary teachers to develop the knowledge of mathematics needed for reform-minded teaching?. *Mathematical Thinking and Learning*, **7**(4), 265-289.

Guskey, T.R. & Yoon, K.S. (2009). What works in professional development?. *Phi Delta Kappan*, **90**(7), 495-500.

Hetcher, R.P. (2011). Changes in pre-service elementary teachers' personal science teaching efficacy and science teaching outcome expectancies: the influence of context. *Journal of Science Teacher Education*, **22**, 187-202.

Howard, G.S., Schmek, R.R. & Bray, J.H. (1979). Internal invalidity in studies employing self-report instruments: A suggested remedy. *Journal of Educational Measurement*, **16**(2), 129-135.

Hubbard, L., Mehan, H. & Stein, M.K. (2006). *Reform as learning*. Routledge, New York.

Human Science Research Council (2011). *Highlights from TIMSS 2011: South Africa*. HSRC: Pretoria.

Jita, L.C., Maree, J.G. & Ndlalane, T.C. (2008). Lesson Study (Jyugyo Kenkyu) from Japan to South Africa: a science and mathematics intervention program for secondary school teachers. In: Atweh et al (eds.), *Internationalisation and Globalisation in Mathematics and Science Education.* Springer Science, Dordrecht.

Kistler, M.J. & Brier, G.E. (2003). Change in knowledge and practices as a result of adults' participation in the Texas A & M ranch to rail program. *Journal of Southern Agricultural Education Research*, **53**(1), 212-223.

Klein, F. (1991). *The politics of curriculum decision making: Issues in centralizing the curriculum*. State University of New York Press, Albany.

Lewis, C.C. (2009). What is the nature of knowledge development in lesson study? *Educational Action Research*, **17**(1), 95-110.

Lewis, C.C., Perry, R.R. & Hurd, J. (2009). Improving mathematics instruction through lesson study: a theoretical model and North American case. *Journal of Mathematics Teacher Education,* **12**, 285-304.

McMillan, J.H. & Schumacher, S. (2010). *Research in education: evidence based enquiry.* Pearson Education Incorporated, New Jersey.

Mogari, D. & Onwu, G.O.M. (2004). Professional development for outcomes based education curriculum implementation: the case of UNIVEMALASHI, South Africa. *Journal of Education for Teaching: International Research and Pedagogy*, **30**(2), 161-177.

National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics*. NTCM Inc, Reston, VA.

Ono, Y. & Ferreira, J. (2010). A case study of continuing teacher professional development through lesson study in South Africa. *South African Journal of Education*, **30**, 59-74.

Perry, R.R. & Lewis, C.C. (2009). What is successful adaptation of Lesson Study in the U.S.? *Journal of Educational Change*, **10**(4), 365-391.

Posthuma, A.B. (2012). Mathematics teachers' reflective practice within the context of adapted lesson study. *Pythagoras*, **33**(3), 1-9.

Putnam, R. & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher*, **29**(1), 4-15.

Rock, T.C. & Wilson, C. (2005). Improving teaching through lesson study. *Teacher Education Quarterly*, **32**(1), 77-92.

Samoff, J. & Carrol, B. (2004). The promise of partnership and continuities of dependence: external support to higher education in Africa. *African Studies Review*. **47**(1), 67-199.

Saito, E., Imansyar, H., Kuboki, I. & Hendeyana, S. (2007). A study of the partnership between schools and universities to improve science and mathematics education in Indonesia. *International Journal of Educational Development.* **27**(2), 194-204.

Shavelson, R.J. (1983). Review of research on teachers' pedagogical judgments, plans, and decisions. *The Elementary School Journal*, **83**(4), 392-413.

Stigler, J. & Hiebert. J. (1999). *The Teaching Gap*. Free Press, New York.

Supovitz, J.A. (2002). Developing communities of instructional practice. *Teachers College Record*, **104**(8), 1591-1626.

Taylor, A.R., Anderson, S., Meyer, K., Wagner, M.K. & West, C. (2005). Lesson study: A professional development model for mathematics reform. *The Rural Educator*, **26**(2), 17-22.

Vescio, V., Ross, D. & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education*, **24**, 80-91.

Walkington, J. (2007). Improving partnerships between schools and universities: professional learning with benefits beyond pre-service teacher education. *Teacher Development: An International Journal of Teacher's Professional Development*, **11**(3), 277-294.

Walsh, M.E. & Backe, S. (2013). School–University partnerships: reflections and opportunities. *Peabody Journal of Education*, **88**(5), 594-607.

Wenger, E. (1998). *Communities of Practice: Learning, meaning and identity*. Cambridge University Press, New York.

Wenger, E., McDermott, R. & Snyder, W.M. (2002). *Cultivating communities of practice: a guide to managing knowledge*. Harvard Business School Press, Boston.

Windschitl, M., Thompson, J., Braaten, M. & Stroupe, D. (2012). Proposing a core set of instructional practices and tools for teachers of science. *Science Education*, **96**(5), 878-903.

Wright, T.D. (2009). Investigating teachers perspectives on the impact of the Lesson Study process on their mathematical content knowledge, pedagogical knowledge and the potential for student achievement. PhD Dissertation. University of New Orleans, New Orleans.

Zimpher, N.L. & Howey, K.R. (2005). The politics of partnerships for teacher education redesign and school renewal. *Journal of Teacher Education*, **56**(3), 266-271.

Article 2

School-Based Professional Development Interventions: The Effects of a Lesson Study Approach on Mathematics Teachers in the Motheo District of the Free State Province.

School-Based Professional Development Interventions: The Effects of a Lesson Study Approach on Mathematics Teachers in the Motheo District of the Free State Province

Abstract

School-based professional development interventions are regarded as one of the most efficient way to facilitate teacher learning. However, the available evidence supporting their effectiveness is somewhat limited. This paper discusses some findings on the effects of a school-based professional development intervention that uses a Lesson Study approach to foster improvements in the teaching and learning of primary and secondary school mathematics. Retrospective pre-testing and semi-structured interviews reveal that teachers perceive significant changes in their curriculum decisions and instructional practices after participating in the Lesson Study Intervention. Furthermore, the findings suggest that collaboration, peer observation and critical reflection are critical in assisting teachers with the selection and implementation of effective teaching strategies. The findings suggest that the school-based professional development intervention can be very effective in improving teachers' instructional practices and curriculum decisions. We therefore recommend a deliberate shift towards more situated, collaborative and school-based professional development approaches to help teachers in South Africa to change their instructional practices.

Key words: School-based professional development, communities of practice, instructional practices, curriculum decisions, professional learning communities.

Introduction

Professional development (PD) is often used in many countries, including South Africa, as a means of improving the quality of teaching and learning in the classrooms. Teachers are exposed to a variety of professional development interventions that may take the form of seminars, workshops and conferences. Although these PD approaches are favoured by many in-service training providers, they are often criticised for being incoherent, short and sporadic encounters that do not address the fundamental challenges related to real classroom change (Darling-Hammond & Richardson, 2009; Desimone, 2009). Researchers thus argue that PD interventions should address classroom practice and student achievement more directly, if they are to be successful (Desimone, 2009; Guskey & Yoon, 2009).

In the last two decades or so, our understanding of what is required for effective professional development has progressed dramatically. We know from the recent literature that quality and effective PD is content focused, extended over a period of time, continuous, collaborative, based on the daily duties of a teacher, coherent and integrated, inquiry based, teacher driven, informed by student performance and has the capability to self-evaluate (Darling-Hammond & Richardson, 2009; Desimone, 2009; Kedzior & Fifield, 2004; Mokhele & Jita, 2012). Furthermore, there is some emerging literature on the effects of PD carried out at different sites with different facilitators (Sandholtz, 2002) and the complexities of up-scaling such PD interventions (Anderson & Herr, 2011) to complement our understanding of the conditions that facilitate effective teacher learning.

One of the ever growing facets of PD that has received much attention in the recent literature but is not adequately understood is on school-based professional development (SBPD). Indeed, several authors have advocated for PD interventions that are situated i.e. teacher learning that is grounded in their school contexts, instruction and students (Ostermeier, Prenzel & Duit, 2010; Putnam & Borko, 2000). Teachers, in this instance, are afforded the opportunity of working in groups and learning from one another with the specific intention of improving classroom practices.

It is thus not surprising that South Africa has also experimented with a variety of approaches to professional development over the past 20 years or so. Very few of the PD experiments seem to have made a substantial impact on the classroom practices of many teachers across the country (Botha, 2012; Mokhele & Jita, 2012). It is in the context of this diversity and multiplicity of innovations around professional development that one local university decided to adopt the vehicle of Lesson Study, to help groups of mathematics teachers reconfigure their classroom practices. Lesson Study is a SBPD approach where teachers work collaboratively to plan, implement, and reflect on a limited number of lessons designed to improve student learning on a particular topic (Lewis, 2009). Whether this latest innovation will succeed or not, in the context of South Africa, remains an open question at this stage.

This paper discusses some findings on the effects of the Lesson Study intervention on the classroom practices of a group of mathematics teachers from the Motheo district of the Free State province in South Africa. We specifically discuss the effects of a school-based

intervention programme that uses Lesson Study, on the mathematics teachers, by answering the following questions:

1. What are the effects of Lesson Study (*research and common planning, teaching and peer observation, and post-observation group reflection*) on teachers' curriculum decisions?
2. What are the effects of Lesson Study (*research and common planning, teaching and peer observation and, post-observation group reflection*) on teachers' instructional practices?
3. How can these effects or lack thereof, be understood?

Review of the relevant literature

The 'school' as a site for professional development

Numerous professional development interventions occur outside the school and while some of them have merit, many questions have often been asked regarding their ability to initiate and sustain changes in teachers' classroom practices. This is because many of these interventions do not seem to address the challenges faced by teachers in their day-to-day teaching and learning of mathematics, for example. Consequently, there is a call for researchers and developers to look at schools as possible sites for PD. This call stems from the general concerns with the so-called 'one size fits all' type of PD interventions that occurs mostly in seminars, workshops and conferences (De Clercq & Phiri, 2013). The argument is that a school is the context in which most of the teacher's work occurs and therefore it makes sense that teacher learning should also be deliberately structured to occur within a similar context and space. Moreover, a school is the place where teaching and learning occurs; where teaching and curricular expertise are enhanced and where deficiencies and needs with regard to teaching and learning emerge (Boaduo, 2010). Cochran-Smith and Lytle (1999: p. 250) explain that

> it is assumed that the knowledge teachers need to teach well is generated when teachers treat their own classrooms and schools as sites for intentional investigation at the same time that they treat the knowledge and theory produced by others as generative material for interrogation and interpretation.

The establishment of SBPD interventions is deemed necessary to simplify the process of a needs analysis and to ensure that the training provided links to and addresses those needs adequately (Mabuza, 2005 as cited in Boaduo, 2010). According to Mabuza, SBPD

interventions are more likely to lead to the disappearance of implementation barriers that commonly present themselves in most PD interventions.

SBPD interventions may take many forms. For instance, they may take the form of teacher coaching or mentoring, critical friends, collaborative action research, communities of practice and teacher clusters, to name but a few. Vescio, Ross and Adams (2008) explain that these SBPD approaches occur through the formation of professional learning communities (PLCs). Lesson Study represents one form of PLCs in that the teachers who constitute a Lesson Study group become a community who are brought together by the goal of seeking to make changes to their instructional practices. When such Lesson Study PLCs involve teachers in one or more schools, they become another example of a SBPD. Thus, in this paper, we use the terms SBPDs and PLCs interchangeably. The point is not that all SBPDs take the form of a Lesson Study or a PLC, but that in our context this was more often the case. Jita, Maree and Ndlalane (2008) contend that the mere formation of these PLCs does not necessarily lead to effective teachers, and that there are some preconditions that have to be taken into account. The main focus of the PLCs should be to address teacher performance with a view to improve student achievement (Jita et al., 2009). This contention is supported by Little (2006: p. 7) when she states that

> Professional development with a sustained focus on subject teaching-strongly tied to the curriculum, instruction, and assessment that students would encounter-produces the most consistent effect on subject teaching and student learning. Other professional development emphases, such as using hands-on activities, organizing cooperative small groups, taking steps to increase gender equity, or preparing teachers for leadership roles, certainly respond to widespread interests and concerns. However, none of them shows a consistent relationship to teachers' conceptions of subject teaching or reported practices of subject teaching. Only the professional development focused on subject knowledge for teaching does so.

Furthermore, some researchers have argued that while SBPD interventions may encourage teachers to alter their classroom practices through collaboration and reflection, there should be sufficient expertise in the group to initiate and drive change in the participating teachers (Maistry, 2008). Lesson Study is ideally suited to address these concerns because firstly, it focuses mainly on improving instruction and student achievement; and secondly, it provides

for an external expert to observe the functioning of the group and to offer advice and assistance to the group where necessary.

Communities of practice

One feature that seems to stand out in most SBPD interventions is their ability to create platforms where teachers can collaborate effectively. In fact, numerous researchers posit that SBPD interventions improve teaching and learning by promoting collaboration and reflective dialogue between teachers (Darling-Hammond & Richardson, 2009; Desimone, 2009; Saunders, Goldberg & Gallimore, 2009). This collaboration between teachers approximates what Wenger, McDermott and Snyder (2002) describe as communities of practice (CoPs). A CoP describes a situation where people come together to share a problem, concern or enthusiasm on a certain topic, and to improve their expertise and knowledge through frequent and deliberate interaction (Wenger, McDermott & Snyder, 2002). More than just a CoP, SBPD interventions further enable the creation of a community of learners. In these communities for example, teachers learn new ways of presenting content in dynamic and meaningful ways to their students.

The underlying assumption is that teachers are likely to learn more from PD initiatives that are collaborative, school-based and supported by knowledgeable external partners. Indeed, SBPDs are more effective if the participants form professional learning communities, such as a CoP (Harris & Jones, 2010). CoPs are characterised by features, such as meeting regularly over extended periods of time, sharing of experiences of practice, critiquing of practice and most importantly, collaboration between teachers (Bianchini & Cavazos, 2007). Therefore, Lesson Study in our case represents a form of CoP where teachers work together to enhance teaching and learning by focusing on the complexities of classroom instruction.

The problem

While the literature on PLCs is encouraging, Saunders, Goldenberg and Gallimore (2009) suggest that there is a need to pause and reconsider. Despite the compelling logic of PLC's benefits regarding teaching and learning, the available evidence is too limited to make strong inferences regarding their effectiveness. The literature on the effects of PLCs is sparse and examples of the powerful learning environments created as a result of participation in CoPs, which is an example of a PLC, are particularly rare (Little, 2006). There are, however, a few promising examples. Andrews and Lewis (2007) found that learning in professional

communities not only enhances teachers' knowledge, but also affects their classroom work as well. Cordingley, Bell, Evans and Firth (2005) agree that collaborative learning within communities lessens teachers' anxiety about being observed and consequently, teachers show a commitment to changing their practices and trying out new things. On the other hand, Bryk, Camburn and Lewis (1999) contend that the link between improved instructional practices and professional communities may not necessarily be direct. These authors argue that instead of promoting change in classroom practices, some of these communities may emphasise conserving the current ones. Furthermore, Vescio, Ross and Adams (2008) note that most studies concerning CoPs indicate changes in teachers' practices but do not specify how teaching practice is changed as a result of participating in the professional community. Part of the reason is that most of these studies do not present data on pre-intervention practices and as a result, the claims that they make regarding teacher changes are somewhat weakened. In their study of PD interventions, Supovitz and Christman (2003) also noted changes in teachers' instructional practices after participation in PLCs, although they note that in some cases, the changes were not widespread; they were uneven and tended to be somewhat superficial. Additionally, Botha (2012) notes that there is no research-based evidence in South Africa pointing to the effects of CoPs on teaching and learning. This is surprising considering the recent efforts by the national Department of Education to encourage the formation of functional PLCs in schools as captured in the latest policy documents (Department of Basic Education, 2011). There is, therefore, a need to study what and how teachers learn in CoPs and to understand the kinds of conditions and knowledge that instigates changes in teachers' classroom practices. This is essential in part, because this knowledge will enable policy makers and PD providers to make informed decisions regarding appropriate SBPD initiatives.

Previous scholarship has already suggested that effective teaching is promoted through PD interventions that take into account the teachers' knowledge and content skills that form the basis for curricular and instructional decisions (Opfer & Pedder, 2010). This study uses teacher perceptions to assess the degree of change, if any, in their instructional practices and curriculum decisions as a result of participating in a Lesson Study intervention over a period of 6-12 months.

Framework for the study

Lesson Study

Lesson Study is premised on the idea that teachers will likely alter and improve their classroom practices by observing other teachers' lessons and critiquing those lessons. Teachers who are knowledgeable about subject matter and pedagogy should share their knowledge and skills on how to spark student interest and be attentive to student learning (Burghes & Robinson, 2010). While there are many variations of the lesson study model from country to country, the common stages a Lesson Study group go through, in terms of the main components, include collaborative planning, peer observation and post-observation reflection. In the next section, we discuss the components of the lesson study process as implemented in the Free State intervention under discussion.

Research and common planning

Once a Lesson Study group has been formed, the group chooses a research theme to work on during intervention. The research theme is usually dependent on the school's mission or vision and includes the knowledge, skills and values the school seeks to impart to the students. A research theme is identified to bridge the gap between the ideal and the actual qualities of students in a school (Lawrence & Chong, 2010). The group then identifies a unit of study which focuses on what the students need to be engaged in to achieve the knowledge, skills and values set in the research theme. In most cases, the unit is selected because of known student misconceptions or if teachers find the unit difficult to teach or if it is a new topic (Alvine, Judson, Schein & Yoshida, 2007). Lastly, the group selects a lesson or a series of lessons from a unit, plans the lessons together, using a lesson plan template and one research lesson to be presented by one of the group members. In their planning of the research lesson, the group anticipates sections which learners would likely find difficult or where misconceptions are likely to occur (Burghes & Robinson, 2010).

Teaching and peer observation

In the second stage, the research lesson is presented by one member using the formulated lesson plan while other members of the group observe the lesson presentation. The research lesson is a genuine lesson with actual students and is normally recorded. The observations and collected data do not focus only on the teacher's ability to teach but on the students' learning and their engagement in the lesson (Puchner & Taylor, 2006). In other models, other

members from the school are invited to observe the lesson together with the group members (Marble, 2007).

Post-observation group reflection

The group comes together after the presentation of the lesson to discuss their lesson observations. In this discussion, strong and weak points of the lesson are discussed in terms of learner engagement and learning. If necessary, the group will revise the lesson plan and one member from the group will present the lesson (Fernandez, 2010). Once the members have agreed that the lesson plan is sufficiently effective, they document their findings and usually present them in a conference or to their colleagues.

This paper seeks to determine whether teachers from the Free State province changed their curriculum decisions and instructional practices after participating in the three activities of Lesson Study which are: *research and common planning; teaching and peer observation; and post-observation group reflection*. We also assessed how teaching practice is changed as a result of participating in the CoP and then attempted to identify aspects of the CoP that are responsible for the perceived changes in practice.

Method

Description of the intervention

The mathematics workshop was as a product of a partnership between the University of the Free State (UFS) and the Free State Department of Education (FSDoE). The partnership for professional development, which was implemented for 6 days over a period of 6 months, sought to provide opportunities for teachers to re-examine their teaching of mathematics topics with a view to improve teaching and learning in the schools in the Free State province. Furthermore, the partnership aimed at developing a sustained, intense and focused school-based professional development intervention that addresses the challenges encountered by teachers and learners in the daily teaching and learning of mathematics in primary and secondary schools by using Lesson Study as a vehicle for change. The intervention was divided into three modules. The first module introduced the Lesson Study to the teachers by involving them in exemplary lesson planning, delivery and reflection. The second module was designed to provide teachers with the tools and skills to undertake curriculum analysis, wherein they identified key themes in the mathematics curriculum and worked systematically on ideas for addressing the problematic sections of the curriculum. The third and last module

was designed to foster sustainability by providing the participating teachers with the skills to initiate, facilitate and sustain a Lesson Study group in their schools and clusters.

During the implementation of the school-university PD intervention, teachers were expected to initiate and sustain Lesson Study groups in their respective schools even after the intervention has ended. This paper, in a sense, seeks to assess teachers' changes in classroom practice as a result of their participation in Lesson Studies in their respective schools.

Sample

The participants were fairly experienced primary and secondary teachers (n = 85) from various schools within the Motheo district of the Free State province. The teachers were nominated randomly by their employer from a population of mathematics teachers within the identified population of schools in the said district. Approximately 8% (n = 6) of the original sample of the participants were randomly requested to participate in the semi-structured interviews.

Measures

The study used surveys and semi-structured interviews to assess the effects of the Lesson Study on the mathematics teachers' curriculum decisions and instructional practices. For quantitative data, retrospective pre-testing was used for data collection (Howard, Schmek & Bray, 1979). Retrospective pre-testing, which addresses a phenomenon known as 'response shift bias', is regarded as a more desirable approach for assessing the effects of PD interventions than traditional pre- and post-test approaches (Hetcher, 2011). A 5-point Likert-scale (1 = *strongly agree*; 2 = *agree*; 3 = *not sure*; 4 = *disagree*; 5 = *strongly disagree*) self-administered questionnaire, which contained a *before* and *after* the intervention sections was used to collect the data. Items for the questionnaire were developed and modified from sources in the literature with items that measure Lesson Study's effects on teachers. The items were based on Klein's (1991) categories of curriculum decisions and Windschitl, Thompson, Braaten and Stroupe's (2012) ideas regarding instructional practices.

The semi-structured interview protocol was designed to assess if there were changes in teachers' instructional practices and curriculum decisions after participating in the intervention. The interview protocol required teachers to talk about changes they had

experienced from the previous interventions attended. This allowed the researchers to discern the changes that were brought about by other interventions and by the Lesson Study.

Reliability

The Cronbach alpha for the subscales (*research and common planning*, *teaching and peer observation*, and *post-observation group reflection*) indicated that items were sufficiently reliable ($\alpha > 0.7$) for both curriculum decisions and instructional practice constructs.

Table 1: Cronbach alpha for the subscales

Construct	Subscale	Cronbach's Alpha	Number of Items
Instructional Practices			
	Research and Common Planning	0.72	7
	Teaching and Peer Observation	0.73	5
	Post-observation Group Reflection	0.70	4
Curriculum Decisions			
	Research and Common Planning	0.87	6
	Teaching and Peer Observation	0.72	4
	Post-observation Group Reflection	0.75	3

The semi-structured interview protocol was checked and verified by knowledgeable others to confirm its utility for eliciting responses that would address the research questions.

Analysis

Percentages, mean ranks and means were calculated to show the differences in teachers' pre- and post-test choices. Additionally, the null hypotheses were tested for significance, using the Wilcoxon signed rank test which is the non-parametric equivalent of the paired sample t-test (Cohen, Manion & Morrison, 2007). Effect sizes were also calculated to determine the relative size of the effects on teachers.

The recorded interviews were transcribed and the researchers read and re-read the transcripts to understand each participant's point of view. The researchers then identified recurrent and common themes in the data that were coded and categorised. Similar codes were given to

fragments of the data which addressed the same theme or topic. The qualitative data from the semi-structured interviews were used to corroborate the quantitative data finding.

Ethical considerations

For both qualitative and quantitative data collection, the teachers were informed that their participation was voluntary and the researchers used pseudonyms for confidentiality. The interviews occurred outside of class during the teachers' "free time".

Findings

The findings on the first research question are presented first, followed by the second and third research questions.

The first research question sought to determine if there were changes in the teachers' curriculum decisions as a result of participating in Lesson Study. The data indicated that there were differences in teachers' pre- and post-test scores. There was a general shift in teachers' choices to mostly *agree* and *strongly agree* as indicated by means of each subscale (Table 1).

Table 1: Means for the summed curriculum decision subscales

Subscale	**Mean (Before** Lesson Study**)**	**Mean (After** Lesson Study**)**
Research and common planning	2.16	1.47
Teaching and peer observation	2.19	1.47
Post-observation group reflection	2.14	1.41

The first research question was a test of the following hypotheses:

- There is no difference in teachers' curriculum decision scores before and after the intervention as a result of *research and common planning*.
- There is no difference in teachers' curriculum decision scores before and after the intervention as a result of *teaching and peer observation*.
- There is no difference in teachers' curriculum decision scores before and after the intervention as a result of *post-observation group reflection*.

The Wilcoxon test statistic indicated that the hypotheses for the curriculum decisions construct were not supported. The test revealed that there were significant differences in the teachers' curriculum decisions as a result of their participation in *research and common planning* ($Z = -7.52$; $p < 0.01$), *teaching and peer observation* ($Z = -7.20$; $p < 0.01$) and *post-observation group reflection* ($Z = -7.11$; $p < 0.01$). Effect sizes (r) for the subscales revealed that the difference between the pre- and post-test scores was moderately large for all the subscales (Table 2).

Table 2: Wilcoxon test statistics and effect sizes: curriculum decisions

Subscale	**Z**	**p-value**	**r**
Research and common planning	-7.54	0.00	-0.82
Teaching and peer observation	-7.20	0.00	-0.78
Post-observation group reflection	-7.11	0.00	-0.77

The second research question sought to determine if there were changes in teachers' instructional practices as a result of participating in Lesson Study. Similar to the first research question, there was a general shift in teachers' choices to mostly *agree* and *strongly agree* as indicated by the means (Table 3).

Table 3: Means for the summed instructional practices subscales

Subscale	**Mean (Before** Lesson Study)	**Mean (After** Lesson Study)
Research and common planning	2.27	1.59
Teaching and peer observation	2.04	1.47
Post-observation group reflection	2.26	1.40

The second research question was a test of the following hypotheses:

- There is no difference in teachers' instructional practices scores before and after the intervention as a result of *research and common planning*.
- There is no difference in teachers' instructional practices scores before and after the intervention as a result of *teaching and peer observation*.
- There is no difference in teachers' instructional practices scores before and after the intervention as a result of *post observation group reflection*.

Similarly, the hypotheses for the instructional practice subscales were also not supported. The Wilcoxon test statistic revealed that there were significant differences in teachers' instructional practices as a result of their participation in *research and common planning* ($Z = -7.41$, $p < 0.01$), *teaching and peer observation* ($Z = -7.05$, $p < 0.01$) and *post-observation group reflection* ($Z = -7.50$, $p < 0.01$). The effect sizes indicated that the magnitude of the difference between the pre- and post-test scores was large for the three subscales (Table 4).

Table 4: Wilcoxon test statistics and effect sizes: instructional practices

Subscale	Z	p-value	r
Research and common planning	-7.41	0.00	-0.80
Teaching and peer observation	-7.05	0.00	-0.76
Post-observation reflection	-7.50	0.00	-0.81

To answer the third research question, which was to understand the perceived effects of Lesson Study, we sought to find out which curriculum decisions and instructional practices changed and which elements of the Lesson Study activities instigated and supported these perceived changes.

Collaboration

Collaboration between teachers was an important factor in their attempt to reconfigure their practices. Most teachers suggested that planning collaboratively with their colleagues led to improvements in their content knowledge or at least, it assisted the teachers to recall and engage with content they had earlier learnt. This is illustrated when Miss Pitso* commented that

> I did not imagine probabilities could be so tricky because we teach it to relatively young students and one typically teaches it up to a certain level. ... with the *Lesson Study*, we learnt exactly how "deep" we should delve into this concept with the students. Some of these things we did back in *teacher education colleges* but since we do not teach them now, we sort of forgot about them but now we have renewed interest in these things.

Teachers also indicated that through this collaboration, they were able to learn a variety of methods and strategies that enabled them to present content in an understandable way to learners. Mr Selikane* explained that

> When sitting around a table planning ... maybe you have this idea and then the other teacher, when discussing the planning will say 'No, don't do it that way, do it this way, it will be easier'.

Teachers reported meeting more regularly and planning for lessons collaboratively and in one instance, teachers reported that they started planning for the whole term in advance. Ms Pitso* indicated that

> Like now when the term ends, we are going to meet and plan together for the next term. We even do the pace setters together and the lesson plans for the next term so that we have all the lesson plans done ... it helps a lot.

Interactions and discussions with other teachers presented an opportunity for teachers to increase the breadth of their teaching methods which may result in quality instruction in the classroom. Mr Mokgadinyana* noted that

> Initially, I used only my ideas because we did not share ideas; it mattered very little whether they work or not. With Lesson Study, we plan as a group and individuals bring different ideas when we deal with a particular concept and at the end of the day, these ideas will influence the way I will present the lesson.

Teachers even started to engage in common marking and the analysis of assessments. In a sense, teachers started to use student assessment data to gauge student learning. Mr Selikane* pointed out that

> We even came up with this thing of common marking where we ... sit together as mathematics teachers and *assess*, let's say grade four answer sheets together and each and every one will pick up errors or problems of that class with a particular question. Even when you move to another grade, then you can see that with this class, the problem might be learners or teachers, with this concept. So from that point of view, we can even sit down and improve from there.

Observation

All the teachers mentioned that as a result of the intervention, particularly observing other teachers, they employed more student centred approaches in their classrooms. In one case, Mr Mahabuke* noted that he had attended numerous mathematics interventions but they did not

lead to a change in his classroom practices. While the interventions he had attended, to some extent, increased his mathematics content knowledge, he remained a "chalk and talk" type of a teacher. Mr Mahabuke* explained that although they were continually 'told' about student centred approaches in workshops, as teachers, they often had a difficult time with the implementation of such approaches. He added that observing other teachers helped him make sense of some of the approaches that he always considered too impractical for a secondary school mathematics classroom. Mr Selikane* held a similar view as he commented that

> I think after the Lesson Study I understood that I have to ... guide and allow students to do the *work* on their own while I monitor the situation. At the end of the day, you show them that you made a mistake here and this is how you should have done it. What is important is that you should encourage the students to work on their own.

Some teachers suggested that participation in peer observation increased their awareness of student interactions and learning. Teachers looked for signs of learning during the lesson and they took appropriate measures if learning was not successful. Mr Masuha* illustrates this point as follows:

> When you present *a lesson*, you can't see where the mistakes are but when you are observing someone, you can see them and you think to yourself 'maybe I could have done it this way'. If the reaction from the students is not satisfactory, you know that this approach is not effective and another approach is required.

Reflection

All the teachers seemed to value constructive criticism from their colleagues in the reflection sessions. Although teachers cited some sort of anxiety regarding being criticised, they also mentioned that their confidence increased because of the positive feedback they received from their colleagues. Mr Selikane* commented that

> After the lesson, colleagues ... will start telling you how your lesson can be improved and then you consider what they said and try to improve *on* those elements of your lesson the next time you present the lesson.

In one school, the idea of reflection became so popular that it was extended to students as well. Students were afforded the opportunity to reflect on the lesson after tuition hours which led to the establishment of a mathematics centre at the school. Mr Masuha* explained that

> Maybe I extended the idea we were exposed to at the University; we come here and reflect on what was done in class that day.... If we did not get to certain points in class, after school we have something like reflection where we discuss what we learnt on the day and it is more like a summary to determine if the learners understood the concept.

Mr Masuha* further explained that in these sessions, learners are afforded the opportunity to suggest possible ways and strategies that the teacher could have used if learning was not successful in a lesson.

Discussions

The school is a place where knowledge is produced and where this knowledge is used to ignite conceptual change which ultimately leads to a change in the way teachers think and act (Katz & Earl, 2010). It is no surprise that Vescio, Ross and Adams (2008) believe that teacher PD should thus be based in the school and its focus should be on teacher learning and improving teacher practices. This study sought to determine if teacher curriculum decisions and instructional practices changed as a result of their participation in this SBPD and the possible reason for these changes.

The Wilcoxon signed rank test indicated that there were significant changes in teachers' curriculum decisions and instructional practices after participating in Lesson Study. Furthermore, the means indicate that the changes were positive, which suggests that not only did their curriculum decisions and instructional practices change, but they improved as well. This study therefore confirms that this SBPD, through the formation of PLCs where teachers were able to plan collaboratively, observe one another and reflect together provided a powerful learning environment which, in turn, instigated changes in teachers' practices. Similar to our findings, Sandholtz and Ringstaff (2013) find that rural teachers' instructional practices in science improve after participating in a PLC. They attribute the success of their intervention to its ability to create a platform for increasing teachers' knowledge and motivation.

In our attempts to understand the findings, we quickly realised that collaboration was important for teacher learning in PLCs. Teachers appreciated the different ideas in terms of planning and teaching that their colleagues shared with them. Some teachers even began to plan for the entire term together and this supported their perceived changes in practice as a

result of different ideas and methods that emerged from such interactions. The support teachers received from their colleagues, in such collaborations, increased their confidence and lessened their anxiety when presenting lessons to students and when being observed by their colleagues. This is not unlike what Tam (2014) observes that most teachers shed their conservatism and take an active stance in curricular planning and decision making after participating in PLCs.

Teachers supported one another in their attempts to understand and correctly implement effective strategies. Cordingley, Bell, Evans, and Firth (2005) found that teachers' use of inquiry-based methodologies increased, together with their ability to correctly implement new teaching strategies when they undertook professional learning collaboratively. Through mutual support and collaboration, teachers were prepared to incorporate useful ideas and strategies that were suggested by their colleagues into their lessons. All the teachers reported a shift towards more student centred approaches and this was critical because of the known deficiencies of the lecture method in schools. Similarly, Tam (2014) finds that teachers participating in PLCs recognised the value of student-centred approaches and they lessened their use of the "transmission of knowledge" approach. The different ideas teachers were exposed to led to improvements in teachers' content knowledge and effective teaching strategies for the specific topics in mathematics. Teachers in this instance had the opportunity to observe the implementation of these student centred approaches and therefore, their subsequent implementation in their own classrooms was easier. These increases in content and pedagogical content knowledge may result in quality lessons which may have a profound effect on student achievement.

One other factor that provided the impetus for change was the student achievement data. It was clear that teachers used student data to diagnose and detect problem areas that students encounter and to discuss possible solutions for such problems. Teachers also thought of the future in that they compared their assessment data with other data from different grades in an attempt to understand the problems faced by learners as they progress through the grades. One spinoff that resulted from the Lesson Study was the reflection session that involved students and teachers. It is important for learners to direct their own learning according to the constructivists' view of learning and this practice was exemplary in this regard.

There was an overall appreciation of the opportunity to observe learners during a lesson. Prolonged interaction between teachers assisted them with a new understanding of student learning and the teachers' perspectives changed from viewing student learning as static, to a more constructive view (Tam, 2014). Through these observations, teachers noticed signs of student learning and in cases where the signs from students were not satisfactory, teachers indicated that they were prepared to change and look for better methods of presenting a topic. Teachers, in this case, indicated that they were more attentive to student needs than previously and that they focused mainly on student learning. Strahan (2003) also finds that PLCs become more successful when the focus is on students' needs and learning.

Teachers were very enthusiastic regarding the reflection sessions. This was as a result of the constructive feedback they had received from their peers during reflection. In their review of collaborative PD interventions, Cordingley, Bell, Evans and Firth (2005) found that collaboration increased teachers' awareness of student learning and that teachers reflected more deeply on their lessons as a result.

Conclusion

This paper sheds more light on the SBPD's ability to provide a space where teachers reflect on and reconfigure their classroom practices. Additionally, some empirical evidence on the effectiveness of SBPD interventions in South Africa is presented. The paper also concludes that the SBPD intervention has a positive effect on classroom practices. Moreover, the paper identifies specific classroom practices which change as a result of SBPD, together with the elements of SBPD that support or instigate the changes. The findings therefore suggest that teachers improve their content knowledge, instructional strategies and manage to change their approach if learning has not been successful. Furthermore, teachers are more attentive to their students' needs and their awareness of how students learn increases. Teachers start to use student data to inform their practices and students engage with the teachers regarding best practices in the teaching of mathematics.

The collaborative nature of the intervention played a major role in ensuring that teachers change and improve their classroom practices. Regular meetings and support from colleagues play a pivotal role in ensuring that teachers are confident regarding teaching some of the problematic sections in the curriculum. Subsequently, teachers will not be afraid of trying new things in the classroom which may result in increases in student achievement. If the

results of the present experiment are anything to go by, then we suggest the need for a deliberate shift towards more situated, collaborative and school-based professional development approaches for teachers in South Africa.

We do realise, however, that the findings of this one study represent just a beginning in the attempts to map out the effects of SBPD on teachers' instructional practices. The results should therefore be approached with the necessary caution. For one, the findings are derived from teachers' perceptions and may thus need to be confirmed against what actually occurs in the classroom (Supovitz & Christman, 2003).

Note:

Pseudonyms are represented by '*' at the end of the name.

References

Alvine, A., Judson, T.W., Schein, M. & Yoshida, T. (2007). What graduate students (and the rest of us) can learn from lesson study. *College Teaching*, *55*(3), 109-113.

Anderson, G.L. & Herr, K. (2011). Scaling up ''evidence-based'' practices for teachers is a profitable but discredited paradigm. *Educational Researcher*, *40*, 287-289.

Andrews, D. & Lewis, M. (2007). Transforming practice from within: The power of the professional learning community. In L. Stoll & K.S. Louis (Ed.), *Professional learning communities: Divergence, depth and dilemmas*. Maidenhead: Open University Press.

Bianchini, J.A. & Cavazos, L.M. (2007). Learning from students, inquiry into practice, and participation in professional communities: Beginning teachers' uneven progress toward equitable science teaching. *Journal of Research in Science Teaching*, *44*, 586-612.

Boaduo, N.A. (2010). School based continuing professional teacher development: A study of alternative teacher development initiatives in the Eastern Cape. *The African Symposium, 10*(2), 75-83.

Botha, E.M. (2012). Turning the tide: creating Professional Learning Communities (PLC) to improve teaching practice and learning in South African public schools. *Africa Education Review*, *9*, 395-411.

Bryk, A., Camburn, E. & Louis, K.S. (1999). Professional community in Chicago elementary schools: Facilitating factors and organizational consequences. *Educational Administration Quarterly*, *35*, 751-781.

Burghes, D. & Robinson, D. (2010). *Lesson study: enhancing mathematics teaching and learning,* CBfT Education Trust, UK.

Cohen, L., Manion, L. & Morrison, K. (2007). *Research methods in education*. New York: Routledge.

Cordingley, P., Bell, M., Evans, D. & Firth, A. (2005). *The impact of collaborative CPD on classroom teaching and learning review: What do teacher impact data tell us about collaborative CPD?* London: EPPI-Centre.

Cochran-Smith, M. & Lytle, S. L. (1999). Relationships of knowledge and practice: Teacher learning in communities. In A. Iran-Nejar & P. D. Pearson (Ed.), *Review of research in education* (pp. 249-305). Washington, DC: AERA.

Darling-Hammond, L. & Richardson, N. (2009). Research review / Teacher learning: what matters? *How Teacher's Learn*, *66*(5), 46-53.

De Clercq, F. & Phiri, R. (2013). The challenges of school-based teacher development initiatives in South Africa and the potential of cluster teaching. *Perspectives in Education*, *31*(1), 77-86.

Department of Basic Education, 2011. *Integrated Strategic Planning Framework for Teacher Education and Development in South Africa, 2011–2025*. Pretoria.

Desimone, L.M. (2009). Improving impact studies of teachers' professional development: toward better conceptualizations and measures. *Educational Researcher*, *38*(3), 181-199.

Fernandez, M.L. (2010). Investigating how and what prospective teachers learn through microteaching lesson study. *Teaching and Teacher Education*, 26, 351-362.

Guskey, T.R. & Yoon, K.S. (2009). What works in professional development? *Phi Delta Kappan*, *90*(7), 495-500.

Harris, A. & Jones, M. (2010). Professional learning communities and system improvement. *Improving Schools*, *13*(2), 172-181.

Howard, G.S., Schmek, R.R. & Bray, J.H. (1979). Internal invalidity in studies employing self-report instruments: A suggested remedy. *Journal of Educational Measurement*, *16*(2), 129-135.

Hetcher, R.P. (2011). Changes in pre-service elementary teachers' personal science teaching efficacy and science teaching outcome expectancies: the influence of context. *Journal of Science Teacher Education*, *22*, 187-202.

Jita, L.C., Maree, J.G. & Ndlalane, T.C. (2008). Lesson Study (Jyugyo Kenkyu) from Japan to South Africa: a science and mathematics intervention program for secondary school

teachers. In: Atweh et al. (eds.), *Internationalisation and Globalisation in Mathematics and Science Education.* Dordrecht: Springer Science.

Katz, S. & Earl, L. (2010). Learning about networked learning communities. *School Effectiveness and School Improvement, 21*(1), 27-51.

Kedzior, M.S. & Fifield, S. (2004). Teacher professional development. *Education Policy Brief*, 15, 1-6.

Klein, F. (1991). *The politics of curriculum decision making: Issues in centralizing the curriculum*. Albany: State University of New York Press.

Lawrence, C.A. & Chong, W.H. (2010). Teacher collaborative learning through the lesson study: identifying pathways for instructional success in a Singapore high school. *Asia Pacific Educ. Rev.*, *11*, 565-572.

Lewis, C.C. (2009). What is the nature of knowledge development in lesson study? *Educational Action Research*, *17*(1), 95-110.

Little, J.W. (2006). *Professional community and professional development in the learning-centered school*. National Education Association, Berkeley.

Mokhele, M.L. & Jita, L.C. (2012). When professional development works: South African teachers' perspectives. *Anthropologist*, *14*(6), 575-585.

Maistry, S. (2008). Towards collaboration rather than cooperation for effective teacher professional development in South Africa. *Southern African Research in Education*, *14*(1/2):119-141.

Marble, S. (2007). Inquiring into teaching: lesson study in elementary science methods. *Journal of Science Teacher Education, 18*, 935-953.

Opfer, V.D. & Pedder, D. (2011). Conceptualizing teacher professional learning. *Review of Educational Research, 81*(3), 376-407.

Ostermeier, C., Prenzel, M. & Duit, R. (2010). Improving science and mathematics instruction: The SINUS project as an example for reform as teacher professional development. *International Journal of Science Education*, *32*(3), 303-327.

Puchner, L.D. & Taylor, A.R. (2004). Lesson study, collaboration and teacher efficacy: Stories from two school-based math lesson study groups. *Teaching and Teacher Education*, *22*, 922-934.

Putnam, R. & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher*, *29*(1), 4-15.

Sandholtz, J.H. (2002). In-service training or professional development: contrasting opportunities in a school/university partnership. *Teaching and Teacher Education*, *18*, 815-830.

Sandholtz, J.H. & Ringstaff, C. (2013). Assessing the impact of teacher professional development on science instruction in the early elementary grades in rural US schools. *Professional Development in Education.* 1-122.

Saunders, M.W., Goldenberg, C.N. & Gallimore, R. (2009). Increasing Achievement by Focusing Grade-Level Teams on Improving Classroom Learning: A Prospective, Quasi-Experimental Study of Title I Schools. *American Educational Research Journal*, *46*(4), 1006-1033.

Strahan, D. (2003). Promoting a collaborative professional culture in three elementary schools that have beaten the odds. *The Elementary School Journal*, *104*(2), 127-133.

Supovitz, J. A. & Christman, J. B. (2003). Developing communities of instructional practice: Lessons for Cincinnati and Philadelphia. *CPRE Policy Briefs*. Pennsylvania: University of Pennsylvania.

Tam, A.C.F. (2014). The role of a professional learning community in teacher change: a perspective from beliefs and practices. *Teachers and Teaching: Theory and Practice*, 1-22.

Vescio, V., Ross, D. & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education,* **24**, 80-91.

Wenger, E., McDermott, R. & Snyder, W.M. (2002). *Cultivating communities of practice: a guide to managing knowledge*. Boston: Harvard Business School Press.

Windschitl, M., Thompson. J., Braaten, M. & Stroupe, D. (2012). Proposing a core set of instructional practices and tools for teachers of science. *Science Education*, *96*(5), 878-903.

SECTION 2: SUMMARY OF THE KEY RESULTS

2.1 Introduction

This section shows how each of the research questions has been answered in the study. The researcher attempts to determine if there are changes in teachers' curriculum decisions and instructional practice. The researcher further identifies elements of the intervention that supported the perceived changes. The section is divided into three sub-sections and data for each of the three research questions is presented separately.

2.2 Research question No. 1

What are the effects of a Lesson Study intervention on the teachers' perceived curriculum decisions?

Retrospective pre-test scores indicated that there were differences in the teachers' curriculum decisions after the intervention. This point is illustrated by means of one of the items in the research and planning subscale.

Table 2.1: Participant scores in *research and common planning* subscale: curriculum decisions

I choose the appropriate content for my lessons

	Strongly agree	**Agree**	**Not sure**	**Disagree**	**Strongly disagree**
Before Lesson Study	20.0% (17)	60.0% (51)	16.5% (14)	3.5% (3)	0% (0)
After Lesson Study	69.4% (59)	30.6% (26)	0% (0)	0% (0)	0% (0)
Change	49.4% (42)	-29.4% (25)	-16.5% (14)	-3.5% (3)	0% (0)

After the intervention, there was an increase of 42 (49.4%) teachers who *strongly agreed* that they were able to choose the appropriate content for their lessons, bringing the total to 59 (69.4%). The data indicates that most teachers changed their choices to *strongly agree* or *agree* after the intervention, with the majority choosing *strongly agree* (Table 4.1). This trend

could be traced through all the items in the subscales assessing the intervention's impact on teachers' curriculum decisions.

The mean ranks for the subscales provided an overall view of the trends in teachers' scores. The mean ranks and means for the subscales *research and common planning, teaching and peer observation* and *post-observation group reflection* before the intervention were 114.08 (2.16), 113.63 (2.19), 111.63 (2.14) and 56.92 (1.47), 57.37 (1.47), 59.37 (1.41) after the intervention respectively (Table 4). The data provided further evidence that most teachers changed their choices to either *agree* or *strongly agree* after the intervention

Table 2.2: Mean ranks and means for the summed curriculum decisions subscales

	Before Lesson Study		**After** Lesson Study	
Subscale	Mean Rank	Mean	Mean Rank	Mean
Research and common planning	114.08	2.16	56.92	1.47
Teaching and peer observation	113.63	2.19	57.37	1.47
Post-observation group reflection	111.63	2.14	59.37	1.41

The Wilcoxon test statistic revealed that all the hypotheses for the curriculum decisions construct were not supported, as the p-value was below 0.01 in each case. There were significant differences in teachers' curriculum decisions as a result of their participation in research and common planning ($Z = -7.52$; $p < 0.01$), teaching and peer observation ($Z = -7.20$; $p < 0.01$) and post-observation group reflection ($Z = -7.11$; $p < 0.01$). Effect sizes (r) for the subscales revealed that the difference between the pre- and post-test scores was moderately large for all the subscales (Table 4.3).

Table 2.3: Wilcoxon test statistics and effect sizes: curriculum decisions

Subscale	Z	p-value	r
Research and common planning	-7.54	0.00	-0.82
Teaching and peer observation	-7.20	0.00	-0.78
Post-observation group reflection	-7.11	0.00	-0.77

The findings suggest that teachers' perceived curriculum decisions improved after their participation in Lesson Study. The mean ranks and means show that teachers were aware of improvements in their curriculum decisions after participating in the intervention. This result is further substantiated by the Wilcoxon test statistic and the p-value, which suggest that these improvements in teachers' curriculum decisions were not due to chance. Lastly, the magnitude of the improvement after the intervention is moderately large, as shown by the effect sizes.

2.3 Research question No. 2

What are the effects of Lesson Study intervention on teachers' perceived instructional practices?

In a pattern similar to that of the first research question, the data showed differences in teachers' pre- and post-test scores after the intervention. An item from the subscale post-observation group reflection is used to demonstrate these differences.

After the intervention, there was an increase of 45 (53.0%) teachers who *strongly agreed* that they discuss instruction with their colleagues, bringing the total to 56 (65.9%). Once again, a large number of teachers changed their opinions to *agree* and *strongly agree* after the intervention. This trend could be traced through most of the items on the perceived instructional practices.

Table 2.4: Participants' scores in the *post-observation group reflection* subscale: instructional practices

	I discuss instruction (teaching) with my colleagues				
	Strongly agree	**Agree**	**Not sure**	**Disagree**	**Strongly disagree**
Before Lesson Study	12.9% (11)	54.1% (46)	12.9% (11)	17.6% (15)	2.4% (2)
After Lesson Study	65.9% (56)	32.9% (28)	1.2% (1)	0% (0)	0% (0)
Change	53.0% (45)	-21.2% (18)	-11.7% (10)	-17.6% (15)	-2.4% (2)

The mean rank for the subscales *research and common planning, teaching and peer observation* and *post-observation group reflection* before the intervention was 113.86 (2.27), 110.92 (2.04) and 117.02 (2.26) and 57.14 (1.59), 60.08 (1.47), 53.98 (1.40) after the intervention respectively (Table 4.5). The findings suggest that there were significant changes in teachers' perceived instructional practices as a result of participating in the three activities of Lesson Study.

Table 2.5: Mean ranks (and means) for the summed instructional practices subscales

	Before Lesson Study		**After** Lesson Study	
Subscale	Mean rank	Mean	Mean rank	Mean
Research and common planning	113.86	2.27	57.14	1.59
Teaching and peer observation	110.92	2.04	60.08	1.47
Post-observation group reflection	117.02	2.26	53.98	1.40

Once more, the hypotheses relating to the perceived instructional practices were not supported, as the p-values were below 0.01. There were significant differences in teachers' instructional practices as a result of their participation in research and common planning ($Z = -7.41$, $p < 0.01$), teaching and peer observation ($Z = -7.05$, $p < 0.01$) and post-observation group reflection ($Z = -7.50$, $p < 0.01$). As with the first research question data, the effect sizes indicate that the magnitude of the difference between the pre- and post-test scores was moderately large for each of the three subscales (Table 4.6).

Table 2.6: Wilcoxon test statistics and effect sizes: instructional practices

Subscale	Z	p-value	r
Research and common planning	-7.41	0.00	-0.80
Teaching and peer observation	-7.05	0.00	-0.76
Post-observation reflection	-7.50	0.00	-0.81

The findings are indicative of a shift in teachers' perceived instructional practices as a result of the intervention. The Wilcoxon test statistics illustrate that the improvements in teachers' instructional practices were not due to chance and that the magnitude of the differences in their pre- and post-test scores were, like the finding for the first research question, moderately large.

2.3 Research question No. 3

How can these effects or lack thereof, be understood or explained?

To answer the third research question, which was to understand or explain the perceived effects of Lesson Study, the researcher sought to find out which curriculum decisions and instructional practices had changed and which elements of the Lesson Study activities instigated and supported these perceived changes.

2.3.1 Collaboration

Collaboration between teachers was an important factor in their attempt to reconfigure their practices. Most teachers suggested that planning collaboratively with their colleagues led to

improvements in their content knowledge or at least, it assisted the teachers to recall and engage with content they had earlier learned. This is illustrated when Miss Pitso* commented that:

> I did not imagine probabilities could be so tricky because we teach it to relatively young students and one typically teaches it up to a certain level. ...with *Lesson Study*, we learnt exactly how 'deep' we should delve into this concept with the students. Some of these things we did way back in *teacher education colleges* but since we do not teach them now, we sort of forgot about them but now we have renewed interest in these things.

Teachers also indicated that through this collaboration, they were able to learn a variety of method and strategies that enabled them to present content in an understandable way to learners. Mr Selikane* explained that:

> When sitting around a table planning ...maybe you have this idea and then the other teacher, when discussing the planning will say no, don't do it that way, do it this way, it will be easier.

Teachers reported meeting more regularly and planning for lessons collaboratively and in one instance, teachers reported that they started planning for the whole term in advance. Ms Pitso* indicated that:

> Like now when the term ends, we are going to meet and plan together for the next term. We even do the pace setters and the lesson plans together for the next term so that we have all the lesson plans done ... it helps a lot.

Interaction and discussions with other teachers presented an opportunity for teachers to increase the breadth of their teaching methods which may result in quality instruction in the classroom. Mr Mokgadinyana* noted that:

> Initially, I used only my ideas because we did not share ideas, it mattered very little whether they work or not. With Lesson Study, we now plan as a group and individuals bring different ideas when we deal with a particular concept and at the end of the day, these ideas will influence the way I will present the lesson.

Teachers even started to engage in common marking and analysis of assessments. In a sense, teachers started to use student assessment data to gauge student learning. Mr Selikane* pointed out that:

> We even came up with this thing of common marking where we ... sit together as mathematics teachers and *assess*, let's say grade 4 answer sheets together, and each and every one will pick up errors or problems of that class concerning a particular question. Even when you move to another grade, you can then see that with this class, the problem might be learners or teachers with this concept. So from that point of view, we can even sit down and improve from there.

2.3.2 Observations

All the teachers mentioned that as a result of the intervention, particularly after having observed other teachers, they employed more student-centred approaches in their classrooms. In one case, Mr Mahabuke* indicated that he had attended numerous mathematics interventions but they did not lead to a change in his classroom practices. While these other interventions had increased his mathematics content knowledge to some extent, he remained a 'chalk and talk' type of a teacher. Mr Mahabuke* explained that although they were continually 'told' about student centred approaches in workshops, as teachers they often had a difficult time with the implementation of such approaches. He added that observing other teachers helped him make sense of some approaches that he always considered too impractical for a secondary school mathematics classroom. Mr Selikane* held a similar view and he commented that:

> I think after Lesson Study I understood that I have to ... guide and allow students to do the work on their own while I monitor the situation. At the end of the day, you show them that [they] made a mistake here and this is how [they] should have done it. What is important is that you should encourage the students to work on their own.

Some teachers indicated that participation in peer observation increased their awareness of student interactions and learning. Teachers looked for signs of learning during the lesson and they took appropriate measures if learning was not successful. Mr Masuha* commented that:

> When you present *a lesson*, you can't see where the mistakes are but when you are observing someone, you can see them and you think to yourself, maybe I could have done it this way. If the reaction from the students is not satisfactory, you know that this approach is not effective and another approach is required.

2.3.3 Reflection

All the teachers seemed to value constructive criticism from their colleagues in the reflection sessions. Although teachers cited some sort of anxiety regarding being criticized, they also mentioned that their confidence increased because of the positive feedback they received from their colleagues. Mr Selikane* commented that:

> After the lesson, colleagues ... will start telling you how your lesson can be improved and then you consider what they said and try to improve *on* those elements of your lesson the next time you present the lesson.

In one school, the idea of reflection became so popular that it was extended to students as well. Students were afforded the opportunity to reflect on the lesson after tuition hours which led to the establishment of a mathematics centre at the school. Mr Masuha* explained that:

> Maybe I extended the idea we were exposed to at the university, we come here and reflect on what was done in class that day .... If we did not get to certain points in class, after school we have something like a reflection session where we discuss what we learnt on the day and it is more like a summary to determine if the learners understood the concept.

Mr Masuha* further explained that, in these sessions, learners are afforded the opportunity to suggest possible ways and strategies that the teacher could have used if learning was not successful in a lesson.

SECTION 3: DISCUSSION, CONCLUSION AND IMPLICATIONS

3.1 Discussions

This section illustrates how the two articles relate to each other and how they help to answer the proposed research questions in the introductory section.

The school is a place where knowledge is produced and where this knowledge is used to ignite conceptual change which ultimately leads to a change in the way teachers think and act (Katz & Earl, 2010). It is of no surprise that Vescio, Ross and Adams (2008) believe that teachers' PD should be based at school and its focus should be on teachers' learning and the improvement of their practice.

The study sought to assess if teachers change their curriculum decisions and instructional practices after participating in a school-university partnership which encouraged the formation of PLC in schools using the Japanese Lesson Study approach.

3.1.1 Professional learning communities and communities of practice

The findings indicate that there were significant changes in teachers' curriculum decisions and instructional practices after participating in Lesson Study. Furthermore, the means indicate that the changes were positive – which suggests that not only did their curriculum decisions and instructional practices change, but they improved as well. This study confirms that this SBPD through the formation of CoPs where teachers were able to plan collaboratively, observe each other and reflect together provided a powerful learning environment which in turn instigated changes in teachers' practices. Similar to our findings, Sandholtz and Ringstaff (2013) find that rural teachers' instructional practices in science improved after participating in a CoP. They attribute the success of their intervention to its ability to create a platform for increasing teachers' knowledge and motivation.

In the attempt to understand the findings, the researcher quickly realized that collaboration was important for teacher learning in CoPs. Teachers appreciated the different ideas in terms of planning and teaching that their colleagues shared with them. Some teachers even began to plan for the entire term together and this supported their perceived changes in practice as a result of different ideas and methods that emerged from such interactions. The support teachers received from their colleagues in such collaborations increased their confidence and lessened their anxiety when presenting lessons to students and when being observed by their

colleagues. Tam (2014) argues that most teachers shed their conservatism and take an active stance in curricular planning and decision making after participating in CoPs.

Teachers supported each other in their attempts to understand and correctly implement effective strategies. Cordingley, Bell, Evans and Firth (2005) find that teachers' use of inquiry-based methodologies increased together with their ability to correctly implement new teaching strategies when they undertook professional learning collaboratively. Through mutual support and collaboration, teachers were prepared to incorporate useful ideas and strategies that were suggested by their colleagues into their lessons. All the teachers reported a shift towards more student-centred approaches and this was critical because of the known deficiencies of the lecture method at schools. Similarly, Tam (2014) discovers that teachers who have participated in CoPs recognized the value of student-centred approaches and they lessened their use of 'transmission of knowledge' approaches.

The different ideas teachers were exposed to led to improvements in teachers' teaching strategies for the specific topics in mathematics. Teachers in this instance had the opportunity to observe the implementation of these student-centred approaches and so their subsequent implementation of such an approach in their own classrooms was easier. The increases in pedagogical content knowledge may result in quality lessons which may have a profound effect on students' achievement.

The findings support the argument of Darling-Hammond & Richardson (2009), namely that professional learning interventions tend to be effective when the focus is on specific curriculum issues in the classroom. Borko (2004) posits that, if teachers are to have a positive influence on student achievement, they must have a thorough understanding of concepts, facts and interconnections that are central to the discipline. It could be suggested that, in line with findings by Lewis, Perry and Hurd (2009), the teachers' understanding of mathematics content improved significantly after the Lesson Study intervention. Thus, our findings demonstrate that teachers' interactions during the intervention have led to improvements in their knowledge and/or understanding of important concepts in the mathematics curriculum.

One other factor that provided an impetus for change was the data on students' achievement. It was clear that teachers used student data to diagnose and detect problem areas that students encounter and to discuss possible solutions for such problems. Teachers also thought of the

future in that they compared their assessment data with other data from different grades in an attempt to understand the problems faced by learners as they progress through the grades. One spin-off that resulted from Lesson Study was the reflection session that involved students and teachers. It is important for learners to direct their own learning according to the constructivists' view of learning and this practice was exemplary in this regard.

There was an overall appreciation of the opportunity to observe learners during a lesson. Prolonged interaction between teachers assisted them with a new understanding of students' learning and the teachers' perspectives changed from viewing students' learning as static to a more constructive view (Tam, 2014). Through these observations, teachers noticed signs of students' learning and in cases where the signs from students were not satisfactory, were prepared to change and to look for better methods of presenting a topic. Teachers in this case indicated that they were more attentive to students' needs than before and they focused mainly on students' learning. The review of research carried out by Vescio, Ross and Adams (2008) supports the finding that teachers' practices improve when they focus more on their students. Similar to Vescio, Ross and Adams (2008), Strahan (2003) also finds that CoPs become more successful when the focus is on students' needs and learning. Our findings therefore suggest, in agreement with those of Lewis, Perry and Hurd (2009), that teachers' conceptions of what constitutes students' understanding, and the means to help students learn may have changed significantly as a result of the Lesson Study intervention.

Teachers were very enthusiastic about the reflection sessions. This was as a result of the constructive feedback they received from other teachers during reflection. In their review of collaborative PD interventions, Cordingley, Bell, Evans and Firth (2005) reveal that collaboration increased teachers' awareness of students' learning and teachers reflected more on their lessons as a result. By observing other teachers and students in the classroom situation, the teachers' awareness of students' thinking during the learning process seems to have improved. Posthuma (2012) argues that teachers derive meanings that inform decisions relating to their actions as a result of group reflection. Reflection is important for teachers, enabling them to assess aspects of their curriculum decision-making; that is, during reflection teachers are able to measure the success of their lessons by evaluating the effectiveness of the decisions taken during the lessons (Lewis, 2009). Taylor, Anderson, Meyer, Wagner and West (2005) maintain that group reflection afforded teachers the opportunity to question assumptions, share information and re-evaluate their practices.

3.2 Conclusion

The qualitative and the quantitative data presented in the two articles suggest that there were changes in teachers' curriculum decisions and instructional practices after their participation in the partnership. It is therefore evident from the findings that this partnership for professional development had a positive impact on teachers' perceived classroom practices. Teachers' participation in the three major activities of Lesson Study seems to have each contributed significantly to changes in their perceived decision-making and instructional practices. Specifically, teachers reported improvements in their ability to collaborate with other teachers, which helped to improve their knowledge regarding classroom practices and the way in which students acquire and process knowledge. The partnership was therefore successful in supporting teachers with the initiation and sustenance of this SBPD intervention through the formation of CoP as indicated by the teachers who were interviewed. The findings also suggest that the partnership was effective in instigating middle- and deep-level changes in the participating teachers which may have a significant effect on student achievement. The results provide evidence that partnerships of this nature could prove valuable in attempts to enhance the standard of mathematics teaching in South Africa and elsewhere.

The study also shed more light on SBPDs' ability to provide a space where teachers reflect on and reconfigure their classroom practices. The study managed to show that CoPs have a positive effect on classroom practices and moreover, it identified classroom practices which changed as a result of SBPD together with the elements of SBPD that supported or instigated the changes. The findings suggest that teachers improved their content knowledge, instructional strategies and they changed their approach if learning was not successful. Teachers were more attentive to their students' needs and their awareness of how students learn increased. Teachers then started to use student data to inform their practices and students engaged the teachers regarding best practices regarding the teaching of mathematics. The collaborative nature of the intervention played a major role in ensuring that teachers change and improve their classroom practices. Regular meeting and support form colleagues played a pivotal role in ensuring that teachers are confident when teaching some problematic sections of the curriculum. Subsequently, teachers were not afraid of trying new things in the classroom which may result in increases in student achievement.

5.4 Implications

First and foremost, the study provides evidence on the effectiveness of partnerships on teachers and, considering that the effects are mostly positive, the researcher therefore recommends that teachers' learning should, where possible, be orchestrated within the context of partnerships, such as those that involve schools and universities.

Secondly, the study provides much needed data on PLC's ability to instigate changes in teachers' practices. Numerous countries around the world, including South Africa, have 'put the cart before the horse' in advocating for the formation of PLCs at schools to improve teaching without actually having enough evidence of the their effects on teachers' practices. This study then adds to the available literature in suggesting that the formation of PLCs may assist teachers to reconfigure their classroom practices with a view to improve students' learning and achievement.

References

Allen, J.M., Howells, K. & Radford, R. (2013). A 'Partnership in Teaching Excellence': ways in which one school–university partnership has fostered teacher development. *Asia-Pacific Journal of Teacher Education*, **41**(1), 99-110.

Amey, M.J., Eddy, P.L., & Ozaki, C.C. (2007). Demands for partnership and collaboration in higher education: A model. In Amey, M. J. (Eds.), *Collaborations across educational sectors*, (New Directions for Community Colleges, No. 139, pp. 5-14). Jossey-Bass: San Francisco.

Bartholomew, S.S. & Sandholtz, J.H. (2009). Competing views of teaching in a school-university partnerships. *Teaching and Teacher Education*, **25,** 155-165.

Borthwick, A.C., Stirling, T., Nauman, A.D. & Cook, D.L. (2003). Achieving successful school university collaboration. *Urban Education*, **38**(3), 330-371.

Botha, E.M. (2012). Turning the tide: creating Professional Learning Communities (PLC) to improve teaching practice and learning in South African public schools. *Africa Education Review*, **9**, 395-411.

Borko, H. (2004). Professional development and teacher training: mapping the terrain. *Educational Researcher*, **33**(3), 3-15.

Bukari, Z. & Jita, L.C. (2009). Partnerships for educational development in Africa: Evidence from Japanese professional development programmes for science teachers in Ghana and South Africa. *Southern African Review of Education*, **15**(1), 7-24.

Burton, S.L. & Greher, G.R. (2007). School-University partnerships: What do we know and why do they matter? *Arts Education Policy Review*, **109**(1), 13-24.

Cohen, L., Manion, L. & Morrison, K. (2007). *Research methods in education.* Routledge: New York.

Cordingley, P., Bell, M., Evans, D. & Firth, A. (2005). *The impact of collaborative CPD on classroom teaching and learning review: What do teacher impact data tell us about collaborative CPD?* London: EPPI-Centre.

Darling-Hammond, L. (2006). Constructing 21st-century teacher education. *Journal of Teacher Education*, **57**, 300-314.

Darling-Hammond, L. & Richardson, N. (2009). Research review / Teacher learning: what matters? *How Teacher's Learn*, **66**(5), 46-53.

Desimone, L.M. (2009). Improving impact studies of teacher's professional development: toward better conceptualizations and measures. *Educational Researcher*, **38**(3), 181-199.

Guskey, T.R. (2003). Analyzing lists of the characteristics of effective professional development to promote visionary leadership. *NASSP Bulletin*, **87**(4), 4-20.

Hetcher, R.P. (2011). Changes in pre-service elementary teachers' personal science teaching efficacy and science teaching outcome expectancies: the influence of context. *Journal of Science Teacher Education*, **22**, 187-202.

Johnson, B. & Christen, L. (2012). *Educational research: quantitative, quantitative and mixed approaches*. Sage Publication: Thousand Oaks.

Katz, S. & Earl, L. (2010). Learning about networked learning communities. *School Effectiveness and School Improvement, 21*(1), 27-51.

Kistler, M.J. & Brier, G.E. (2003). Change in knowledge and practices as a result of adults' participation in the Texas A & M ranch to rail program. *Journal of Southern Agricultural Education Research*, **53**(1), 212-223.

Lewis, C.C. (2009). What is the nature of knowledge development in lesson study? *Educational Action Research*, *17*(1), 95-110.

Lewis, C.C., Perry, R.R. & Hurd, J. (2009). Improving mathematics instruction through lesson study: a theoretical model and North American case. *Journal of Mathematics Teacher Education*, **12**, 285-304.

Little, J.W. (2006). *Professional community and professional development in the learning-centered school*. National Education Association, Berkely.

McMillan, J.H. & Schumacher, S. (2010). *Research in education: evidence based enquiry.* Pearson Education Incorporated: New Jersey.

Mogari, D. & Onwu, G.O.M. (2004). Professional development for outcomes based education curriculum implementation: the case of UNIVEMALASHI, South Africa. *Journal of Education for Teaching: International Research and Pedagogy*, **30**(2), 161-177.

Ono, Y. & Ferreira, J. (2010). A case study of continuing teacher professional development through lesson study in South Africa. *South African Journal of Education*, **30**, 59-74.

Ostermeier, C., Prenzel, M. & Duit, R. (2010). Improving science and mathematics instruction: The SINUS project as an example for reform as teacher professional development. *International Journal of Science Education*, **32**(3), 303-327.

Posthuma, A.B. (2012). Mathematics teachers' reflective practice within the context of adapted lesson study. *Pythagoras*, **33**(3), 1-9.

Putnam, R. & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher*, **29**(1), 4-15.

Saito, E., Imansyar, H., Kuboki, I. & Hendeyana, S. (2007). A study of the partnership between schools and universities to improve science and mathematics education in Indonesia. *International Journal of Educational Development.* **27**(2), 194-204.

Samoff, J. & Carrol, B. (2004). The promise of partnership and continuities of dependence: external support to higher education in Africa. *African Studies Review*. **47**(1), 67-199.

Sandholtz, J.H. & Ringstaff, C. (2013). Assessing the impact of teacher professional development on science instruction in the early elementary grades in rural US schools. *Professional Development in Education.*1-122.

Saunders, M.W., Goldenberg, C.N. & Gallimore, R. (2009). Increasing Achievement by Focusing Grade-Level Teams on Improving Classroom Learning: A Prospective, Quasi-Experimental Study of Title I Schools. *American Educational Research Journal*, **46**(4), 1006-1033.

Stevens, D. (1999). The ideal, real, and surreal in school-university partnerships: Reflections of a boundary spanner. *Teaching and Teacher Education*, **15** (3), 287-299.

Stigler, J. & Hiebert, J. (1999). *The Teaching Gap*. Free Press, New York.

Strahan, D. (2003). Promoting a collaborative professional culture in three elementary schools that have beaten the odds. *The Elementary School Journal*, **104**(2), 127-133.

Supovitz, J.A. & Christman, J.B. (2003). Developing communities of instructional practice: Lessons for Cincinnati and Philadelphia. *CPRE Policy Briefs*. University of Pennsylvania: Pennsylvania.

Tam, A.C.F. (2014). The role of a professional learning community in teacher change: a perspective from beliefs and practices. *Teachers and Teaching: Theory and Practice*, 1-22.

Taylor, A.R., Anderson, S., Meyer, K., Wagner, M.K. & West, C. (2005). Lesson study: A professional development model for mathematics reform. *The Rural Educator*, **26**(2), 17-22.

Vescio, V., Ross, D. & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education,* **24**, 80-91.

Walkington, J. (2007). Improving partnerships between schools and universities: professional learning with benefits beyond pre-service teacher education. *Teacher Development: An International Journal of Teacher's Professional Development*, **11**(3), 277-294.

Wenger, E., McDermott, R. & Snyder, W.M. (2002). *Cultivating communities of practice: a guide to managing knowledge*. Harvard Business School Press: Boston.

Appendix 1

Permission letter to conduct research in the Free State Department of Education

Enquiries: Motshumi KK
Reference:
Tel: 051 404 9290
Fax: 086 667 8678
E-mail: motshumikk@edu.fs.gov.za

education
Department of Education
FREE STATE PROVINCE

OFFICE OF THE DIRECTOR:
STRATEGIC PLANNING, POLICY & RESEARCH

03 MARCH 2014

Mr. Letloenyane

RE: APPROVAL TO CONDUCT RESEARCH IN THE FREE STATE DEPARTMENT OF EDUCATION

1. This letter serves as an acknowledgement for receipt of your research request in the Free State Department of Education.

2. **Research topic: Schools and University Partnerships for Professional Development: an Impact assessment of the "Lesson Study" Intervention for mathematics teachers in the Free State.**

3. Approval is granted for you to conduct research in the Free State Department of Education.

4. This approval is subject to the following conditions:-

   4.1 The names of participants involved remain confidential.

   4.2 The structured questionnaires are completed and the **interviews are conducted outside normal tuition time or during free periods**.

   4.3 This letter is shown to all participating persons.

   4.4 A bound copy of the research document and a soft copy on a computer disc should be submitted to the Free State Department of Education (Strategic Planning, Policy & Research).

   4.5 You will be expected, on completion of your research study, to make a presentation to the relevant stakeholders in the Department.

   4.6 The attached ethics document must be adhered to in the discourse of your study in our department.

5. The costs relating to all the conditions mentioned above are your own responsibility.

6. You are requested to confirm acceptance of the above conditions in writing, within seven days after receipt of this letter. Your acceptance letter should be directed to:

   DIRECTOR: STRATEGIC PLANNING, POLICY AND RESEARCH;
   Old CNA Building, Maitland Street OR Private Bag X20565, BLOEMFONTEIN, 9301

Thank you for choosing to research with us. We wish you every success with your study.

Yours faithfully,

MJ MOTHEBE (DIRECTOR: STRATEGIC PLANNING, POLICY & RESEARCH)

Appendix 2

Letter to the Dean of the Faculty of Education

Library Building
UFS Qwaqwa Campus
Kestell Road
Phuthaditjhaba
18 March 2014

Dean: Faculty of Education
Winkie Direko Building
University of the Free State
Bloemfontein

REQUEST FOR PERMISSION TO CONDUCT RESEARCH WITH TEACHERS

Dear Sir
My name is David Maleho Letloenyane, and I am a Master's degree (Higher Education Studies) student at the University of the Free Sate in Bloemfontein.

For my Master's dissertation, I am doing research on the topic of "Schools and University Partnerships for Professional Development: an impact assessment of the 'Lesson Study' intervention for mathematics teachers in the Free State" The Lesson Study intervention is partnership between the UFS and the FSDoE and is sponsored by the ETDP-SETA. My research project, which is supervised Professor Loyiso C Jita , who is also the leader of the Short Learning Workshop on Lesson Study.

I hereby request permission to conduct research with the mathematics teachers, who are enrolled for a short learning workshop, at the University of the Free State. The research involves no interference with teaching or learning time, as it will conducted during the workshops at the University of the Free State (and not in the schools). Informed consent will be requested from the teachers, who will be free to participate or not. No names of teachers and/or schools will be used in any reports of the study.

Attached is a letter of recommendation from the supervisor of the study.

If you need any further information and/or have suggestions, please do not hesitate to contact me and/or my supervisor (jitalc@ufs.ac.za or 051-401 7522).

Yours sincerely,

David Maleho Letloenyane
University of the Free State
Tel: 058 718 5355/66
Fax: 078 718 5365
e-mail: letloenyanemd@qwa.ufs.ac.za

Appendix 3

Teachers informed consent form

Researcher
Library Building
UFS Qwaqwa campus
Kestell Road
Puthaditjhaba
T: +27(0)58 718 5366
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Facilitator
Office No: 6
New Education Building
UFS Main campus
Bloemfontein
T: +27(0)51 401 7522
F: +27(0)86 269 9453

Date

QUESTIONNAIRE: AN IMPACT ASSESSMNT OF LESSON STUDY INTERVENTION FOR MATHEMATICS TEACHERS IN THE FREE STATE

Dear Participant

We are conducting a research survey with teachers to understand the contribution, if any, of the partnership between the University of the Free State (UFS) and your school (or Department of Education) to your own Professional Development. The title of the research study is:

Schools and University Partnerships for Professional Development: an impact assessment of the "Lesson Study" intervention for mathematics teachers in the Free State.

You have been identified as an important participant for this research study, because of your participation in such a partnership when you attended the 'Lesson Study' workshops in 2013-14.

The data from the interviews will help us determine if the intervention has assisted you in enhancing your instructional practices and curriculum decisions.

There is no risk involved in participating in the study given that your names and names of your schools will not be mentioned in any of the reports about the study. The study may benefit you and other educators through its findings on whether the programme is effective to address your professional development needs and how it can be improved further, if necessary

While I greatly appreciate your participation in this important study and the valuable contribution you can make, your participation is entirely voluntary and you are under no obligation to take part in this study. If you do choose to take part, and an issue arises which makes you uncomfortable, you may at any time stop your participation with no further repercussions.

If you experience any discomfort or unhappiness with the way the research is being conducted, please feel free to contact me directly to discuss it or contact the facilitator (Prof. LC Jita).

Once more, thank you for your kind assistance and cooperation on this study

Yours sincerely,

Maleho Letloenyane

- I hereby give free and informed consent to participate in the abovementioned research study.
- I understand what the study is about, why I am participating and what the risks and benefits are.
- I give the researcher permission to make use of the data gathered from my participation, subject to the stipulations he/she has indicated in the above letter.

Name and Surname:_____

Signature: _____ Date: _____

Appendix 4

Retrospective pre-testing questionnaire

Part 1: Biographical information

Place an "X" on the appropriate answer

1. What is your gender?

Gender	Male	Female

2. What is your age range? (in years)

Age Range	Under 25	26 - 29	30 - 39	40 - 49	50 - 59	Over 60

3. How long have you been teaching mathematics? (in years)

Teaching Experience	Under 2	2 - 4	5 - 9	10 - 15	16 - 20	Over 20

4. Highest qualification

Type of qualification	3 year Diploma (Education)	3 year Diploma + ACE	4 year Bachelors (Education)	3 year bachelors + Teaching certificate
	4 year Diploma (Education)		Senior Qualification Hons, Msc, PhD + Teaching certificate	
	Senior Qualification (Hons, Med, PhD in Education)		Other (please specify)	

5. How many professional development interventions in mathematics have you attended in the last 2 years?

Number of Interventions	None	1	2	3	4	5	Over 5

What are these interventions (names): _____; _____; _____

Part 2: Survey

Please give an indication of your teaching practices and curriculum choices **before** and **after** the LESSON STUDY intervention:

SA: Strongly Agree; **A**: Agree; **NS**: Not Sure; **D**: Disagree; **SD**: Strongly Disagree

Before the Lesson Study		**After** the Lesson Study
SA A NS D SD	**1.** I choose the appropriate content for my lessons	SA A NS D SD
SA A NS D SD	**2.** I anticipate problem areas students might encounter	SA A NS D SD
SA A NS D SD	**3.** I watch for signs of student learning while teaching	SA A NS D SD
SA A NS D SD	**4.** I evaluate the success of every lesson presented	SA A NS D SD
SA A NS D SD	**5.** I continually challenge my students with problems during their learning	SA A NS D SD
SA A NS D SD	**6.** I align my teaching with the required national standards	SA A NS D SD
SA A NS D SD	**7.** I revise my lesson if needed	SA A NS D SD
SA A NS D SD	**8.** I create assessments that give me a better understanding of students' thinking about a concept	SA A NS D SD
SA A NS D SD	**9.** I think more reflectively about my own teaching.	SA A NS D SD
SA A NS D SD	**10.** I focus more on the goals I have set for my students when evaluating lessons	SA A NS D SD
SA A NS D SD	**11.** I discuss instruction (teaching) with my colleagues	SA A NS D SD
SA A NS D SD	**12.** I use continuous assessment to evaluate my progress	SA A NS D SD
SA A NS D SD	**13.** I change my teaching strategy if learning was not successful	SA A NS D SD
SA A NS D SD	**14.** I ask students to consider alternative methods and solutions for a problem	SA A NS D SD

SA A NS D SD	**15.** I encourage students to use mathematical concepts to interpret and solve applied problems	SA A NS D SD
SA A NS D SD	**16.** I prepare lesson in a way that elicit active discussions from students	SA A NS D SD
SA A NS D SD	**17.** I often try to increase the breadth of my instructional strategies	SA A NS D SD
SA A NS D SD	**18.** I use inquiry and problem focused lessons very often	SA A NS D SD
SA A NS D SD	**19.** I analyze the success of my lesson through student data.	SA A NS D SD
SA A NS D SD	**20.** I encourage critical thinking and knowledge application skills in most of my lessons	SA A NS D SD
SA A NS D SD	**21.** I mostly use student centred teaching approaches	SA A NS D SD
SA A NS D SD	**22.** I ensure that there is adequate time for learners to complete tasks	SA A NS D SD
SA A NS D SD	**23.** I use teaching strategies that allow me to gain insights to students understanding	SA A NS D SD
SA A NS D SD	**24.** I provide engaging and relevant experiences for my students	SA A NS D SD
SA A NS D SD	**25.** I ensure that there is adequate space for learners to complete tasks	SA A NS D SD
SA A NS D SD	**26.** I make real life connections in my lessons	SA A NS D SD
SA A NS D SD	**27.** I discuss alternate solutions to problems with my students	SA A NS D SD
SA A NS D SD	**28.** I am able to pace my teaching in line with student understanding	SA A NS D SD

Appendix 5

Semi-structured interviews protocol

Semi- Structured Interview Protocol

Teacher:_____ School:_____

1. Tell me a little bit about yourself, your qualifications, when and where you received your education.

2. Where and what subjects did you teach before taking up this position at your present school?

3. How long have you been at the present school?

4. Let me take you back to the time before you attended the Lesson Study workshop at UFS: Which other workshops related to the teaching of mathematics did you attend before the Lesson Study workshop?

5. How helpful were they for your teaching of mathematics? (listen to areas of change, if any).

6. How would you describe your teaching of mathematics before you attended the Lesson Study workshop?

7. Let us now focus on the Lesson Study Workshop:
   7.1 What did you think of the workshop? [probes: the content of the workshop; the approach; the activities; the duration or amount of time spent; the class assignments; the portfolio]

7.2 What were the main benefits of the Lesson Study process for you? Explain. [probes: Opportunity to share ideas, Focus on understanding how students learn]

7.3 Did Lesson Study affect the way you plan for a mathematics lessons? Explain.

7.4 Did lesson study affect your instructional ability (mathematics teaching)? Explain. [probes: Teaching and peer observation, Post observation group reflection]

7.5 Did you change your classroom practices after Lesson Study? Explain

8. What were your main challenges in implementing the lesson study at your school?

9. Did you manage to continue with the Lesson Study after the workshops? [probes: why or why not].

10. What do you think would need to be done to get the Lesson study adopted by all schools in the Free State province?

11. Are there any other ideas or issues you want to make regarding the Lesson Study workshops and implementation in schools?

Once again, thank you very much for your time!