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IMPROVING PRE-SERVICE MATHEMATICS TEACHERS' SUBJECR MATTER KNOWLEDGE THROUGH SCHOOL-UNIVERSITY PARTNERSHIP MEDIATED BY LESSON STUDY PROGRAM

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ABSTRACT

The purpose of this study is to explore the power of a school university partnership mediated by lesson study (SUPER-LS) in improving pre-service mathematics teachers' subject matter knowledge (SMK). This study implemented the SUPER-LS program with 10 pre-services teachers (PSTs), 10 in-service teachers (ISTs) and knowledgeable others to accomplish this objective. The study was executed in two phases: one at the school and the other at the university. Throughout the program, they designed a mathematics curriculum based on the concepts of Realistic Mathematics Education (RME), facilitated an open class, and engaged in post-lesson discussions throughout two cycles of lesson study. Data were collected through observations of lesson study activities and objects, and analyzed using transcript-based lesson study following MKT framework. The study revealed that the SUPER-LS program can enhance collaboration among PSTs to augment their Subject Matter Knowledge (SMK), with specialized content knowledge (SCK) being predominant. Nonetheless, a follow-up program to guarantee that PSTs have rigorous training is essential.

Keywords: *School-University Partnership, Lesson Study, Pre-service Teachers, Subject Matter Knowledge, Mathematics Instruction.*

INTRODUCTION

Pre-service programs have frequently faced criticism for emphasizing conventional teaching methods, which may not correspond with the contemporary requirements of 21st-century education (Afkar et al., 2023; Allmendinger et al., 2023; Revina et al., 2020). The deficiency in content understanding and pedagogical training among them adversely affected the quality of mathematics instruction and student achievement (Fitriati et al., 2024). It is essential to progress beyond rote learning to prioritize mathematical reasoning and problem-solving in practical situations. Teacher preparation programs particularly emphasized the enhancement of subject matter knowledge (SMK) and pedagogical content knowledge (PCK) (Chapman, 2013). Researchers have specifically focused on optimal methods to support preservice mathematics teachers via school-university partnerships (Farrell, 2021; Tsui & Law, 2007). Additional research has highlighted the necessity of equipping PSTs with lesson study (Fitriati et al., 2024; Nurwidodo et al., 2018; Saito et al., 2007) and the realistic mathematics education (RME) method (Bray & Tangney, 2016; Fauziah et al., 2022; Meiliasari, 2013). Despite the substantial literature, there is no agreement on the appropriate training methods for prospective mathematics teachers. A rising contingent of researchers advocates for teacher educators to concentrate their endeavors on mathematical knowledge for teaching (MKT) through the SUPER-LS program (Fitriati et al., 2023, 2024; Nguyen & Tran, 2023). Consequently, teacher education programs must augment teachers' mathematical understanding for instruction and reevaluate techniques to more effectively prepare prospective teachers with the requisite skills and knowledge for teaching mathematics in the 21st century.

The SUPER-LS program is a collaborative learning platform for teacher professional development that integrates U.S. school-university relationships with Japanese lesson study. This paradigm seeks to enhance educational quality through ongoing teacher development, commencing with teacher preparation and persisting throughout their professional lives (Fitriati et al., 2022). The SUPER-LS promotes the interchange of ideas, expertise, and experiences among educators, thereby augmenting their capacity to aid student learning. Effective teacher education and professional development programs should prioritize the enhancement of subject matter knowledge to address the educational requirements of the 21st century. Thus, conducted the SUPER-LS program to equip future mathematics teachers is imperative.

METHODS

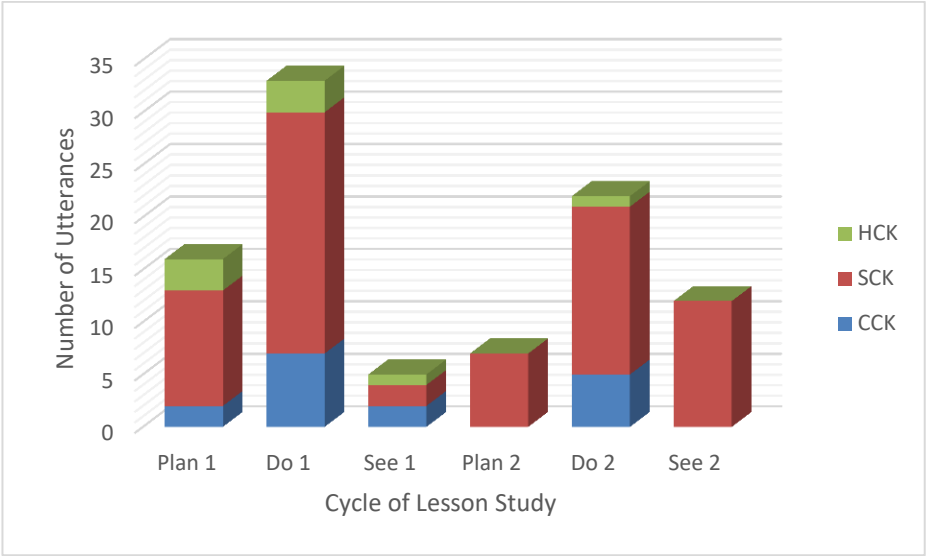
The SUPER-LS program was implemented to promote collaborative learning between PSTs from university and ISTs from schools. The Realistic Mathematics Education (RME) approach was incorporated into the program. Ten PSTs who enrolled in the micro-teaching course participated in the

SUPER-LS program. It was implemented as a school-based teacher professional development model in collaboration with three institutions: Universitas Bina Bangsa Getsempena, Universitas Syiah Kuala's RME Research Centre, and the Teacher Subject Forum for secondary mathematics schools in Banda Aceh, Indonesia. The program was executed over a six-month period, comprising two sessions. In the initial phase, ISTs and PSTs receive training through a series of seminars focused on 21st-century teaching and learning, creating instructional materials utilizing the RME approach and lesson study methodology. The session was conducted by the RME Research Centre and university instructors, who act as "knowledgeable others." Subsequent to the workshop, they initiated the inaugural lesson study cycle by collaboratively devising the lesson utilising the RME approach, executing and monitoring it, and subsequently reflecting on it. The process is reiterated across 2-3 lesson study cycles until effective teaching materials for enhancing students' mathematics are developed. Each educator executed the lesson plan by asking community people to observe their class. Drawing on this expertise and established best practices, university tutors do lesson study with their colleagues in the designated course during the second session.

Video recordings of lesson study activities were conducted to analyse the growth of instructors' SMK. Video recording was employed to document the execution of the lesson study. It encompasses the procedures of lesson study, participant interactions during lesson study meetings, and teachers' instruction during lesson implementation at both the school and university levels. Furthermore, lesson study artefacts, including PSTs' teaching materials (iceberg, lesson design, student worksheets, handouts, and slides), were gathered as data. The observational data, primarily consisting of debates and dialogues involving educators, students, and other subject matter experts, underwent transcript-based lesson analysis. TBLA was employed to ascertain the type of SMK that educators cultivate during their lesson study activities within school-university collaborations. Furthermore, the MKT framework established by (Clivaz & Shuilleabhain, 2019) was employed in the data analysis process.

RESULTS AND DISCUSSION

The results obtained from analysing video observations and artefacts of lesson study pertain to the issues of the sort of Subject Matter Knowledge (SMK) cultivated during the SUPER-LS program. The comprehensive depiction of the SMK domain augmented by PSTs during two cycles of LS practice is illustrated in Figure 1. PSTs acquired a substantial amount of SMK across two cycles of lesson study, with SCK being most prominently utilised during the lesson design, open lesson, and post-lesson discussion stages.



This study notably reveals an absence of horizon content knowledge (HCK) in instructors' LS discussions (Figure 1). This may be attributed to the deficiency of content knowledge among the PSTs during this lesson study cycle. Furthermore, the aforementioned findings demonstrate that lesson planning using the RME approach within the context of lesson study might enhance PSTs' development of their SMK, particularly their SCK, which was predominantly employed. This research corroborates the conclusions of Clivaz and Shuilleabhain (2019) and Nguyen and Tran (2023) that educators require comprehensive knowledge across all areas of SMK during planning sessions.

The SUPER-LS is a significant program aimed at training PSTs. It underscores the need of collaboration in the educational process to improve instruction and learning in mathematics classrooms. The curriculum must to be integral to their professional development at both the university and educational institution levels. PSTs will have the chance to design, execute, and oversee the implementation of a lesson in a classroom setting, with particular emphasis on showcasing the students' learning experiences. These experiences empower educators to autonomously enhance their mathematical proficiency through the RME technique.

CONCLUSION

This study implemented the SUPER-LS program to enhance the Subject Matter Knowledge (SMK) of PSTs. Sub-domains of SMK were evident during the lesson study phase, excluding reflection. The SCK domains were the most predominant over the whole study period, in contrast to CCK and HCK. The study revealed a paucity of evidence on teachers' horizon

content knowledge (HCK) during their lesson study discussions. The limited scope of the SMK acquired by the teachers during the post-session discussion was affected by their ability to monitor and critically assess the lesson.

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