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A Collaborative Action Research Model: Using Lesson Study to Optimize Guided Inquiry Teaching of Blood Structure and Function at Junior High School 32 Padang

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Abstract: *This study implemented a collaborative action research model using lesson study to optimize guided inquiry instruction on blood structure and function. The research was conducted at SMPN 32 Padang, an Indonesian junior high school implementing the Merdeka Curriculum. Two 8th grade classes (8C and 8B) 2023-2024 were involved, with the researcher, a pre-service teacher in the Teacher Professional Education (PPG) program, leading lesson study with the science teachers. Guided inquiry was used to actively engage students in the learning process and construct knowledge through investigation, teamwork, and discussion. The lesson study cycles involved collaboratively planning the guided inquiry lessons, observing their implementation, and reflecting on outcomes to refine the lessons. Data were collected through observation, student work, interviews, and surveys. Results showed increased student engagement, motivation, critical thinking, and science process skills. Students developed deeper understanding of blood structure and function compared to traditional teaching methods. Challenges included developing appropriate scaffolding for inquiry activities and managing active learning classrooms. This study demonstrates lesson study can be an effective professional development model for teachers to collaboratively design and improve guided inquiry instruction. The action research process led to optimized guided inquiry lessons on blood structure and function tailored to the local context. This model can be replicated and adapted to enhance pedagogical content knowledge and inquiry-based teaching practices in other science topics and grade levels. The collaborative, reflective practice strengthens teachers' capacity for data-driven instructional decision making.*

Keywords— Guided inquiry, Lesson study, Action research, Blood structure and function, Science education, Pedagogy, Teaching practices, Professional development

1. INTRODUCTION

Blood is a vital bodily fluid that transports oxygen, nutrients, hormones, and waste throughout the body. Understanding the composition and function of blood is a fundamental concept in biology education (Ismail et al., 2021). However, traditional teaching methods often fail to engage students in active learning about blood. Recently, guided inquiry has emerged as a more effective pedagogy for biology concepts, though implementing it can be challenging for teachers (Mawardi & Ismail, 2022).

The article "A Collaborative Action Research Model: Using Lesson Study to Optimize Guided Inquiry Teaching of Blood Structure and Function" by Ismail et al. (2021) presents an innovative professional development approach for helping teachers implement guided inquiry lessons on blood structure and function. The authors utilized collaborative action research through a lesson study model. This literature review will summarize key research related to guided inquiry science teaching, lesson study, collaborative action research, and teaching blood structure and function. It will analyze the theoretical framework, methodology, findings, and implications of the Ismail et al. (2021) study. Finally, it will situate this study within the broader literature and identify limitations and directions for future research.

Guided Inquiry Science Teaching

Figure 1Guided Inquiry Map

Inquiry-based science teaching engages students in the practices of science such as asking questions, designing investigations, collecting and analyzing data, developing explanations, and communicating findings (Minner et al., 2010). This pedagogical approach emerged from constructivist learning theories emphasizing active construction of

knowledge (Bunterm et al., 2014). Guided inquiry specifically entails more scaffolding and direction from teachers compared to open inquiry (Furtak et al., 2012).

Numerous studies demonstrate the benefits of guided inquiry for improving science learning. Meta-analyses found inquiry-based teaching increased conceptual understanding and science process skills compared to traditional instruction (Furtak et al., 2012; Lazonder & Harmsen, 2016). Guided inquiry allows students to construct knowledge through hands-on investigations while receiving needed support (Bunterm et al., 2014). This approach also develops critical thinking skills (Artayasa et al., 2018). However, teachers often struggle implementing inquiry lessons effectively (Crawford, 2014).

Lesson Study

Figure 2 Lesson Study Cycles

Lesson study is a collaborative professional development approach originating from Japan (Lewis & Hurd, 2011). Teachers work in small groups to jointly plan, teach, observe, analyze, and refine actual classroom lessons, called "research lessons" (Dudley, 2013). This process allows teachers to systematically examine student thinking and learning in context (Lewis & Hurd, 2011).

Research shows lesson study improves teachers' knowledge, instructional practices, and efficacy (Lewis & Hurd, 2011). Participating in lesson study strengthens teachers' pedagogical content knowledge, understanding of how students learn, and skills in observation, reflection, and collaboration (Dudley, 2013). Teachers also gain capacity to design and implement research-based lessons (Lewis & Hurd, 2011). However, challenges include finding time for collaboration and resistance to being observed (Dudley, 2013). Using lesson study to explicitly focus on inquiry-based teaching can enhance teachers' capacity for this approach (Crawford, 2014).

Collaborative Action Research

Action research engages educators in systematic inquiry to improve their own practices (Hine, 2013). Conducting action research builds professional knowledge and empowers teachers to become agents of educational change (Zenkov et al., 2011). Collaborative action research brings groups of teachers together to study problems of practice (Capobianco & Joyal, 2008). It fosters professional learning communities allowing teachers to share expertise and improve collectively (Hine, 2013).

Collaborative action research has been used to successfully promote constructivist teaching approaches. For example, Capobianco and Joyal (2008) found science teachers improved their understanding and use of inquiry-based methods after participating in collaborative action research. However, challenges include negotiating group dynamics and logistics of collaboration (Hine, 2013). Collaborative action research within the structure of lesson study provides built-in teacher collaboration and peer observation opportunities to support inquiry teaching (Crawford, 2014).

Teaching Blood Structure and Function

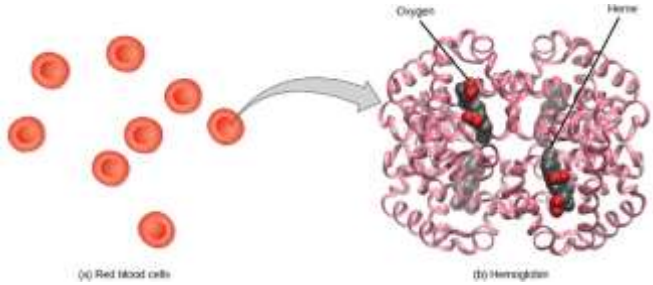

Figure 3Core explanation about blood

Understanding the components of blood and their functions is a key concept in biology education (Bello et al., 2012). However, research shows students often struggle grasping blood structure and physiology concepts (Odom & Barrow, 1995; Seyhan, 2015). Students hold misconceptions such as believing blood is a homogeneous fluid, rather than containing multiple cell types (Seyhan, 2015). Traditional teacher-centered pedagogies often fail to remediate these alternative conceptions and develop deep understanding of blood (Bello et al., 2012).

Using guided inquiry has been recommended to improve teaching and learning about blood. Inquiry allows active investigation of blood components and their roles (Odom & Barrow, 1995). Hands-on activities can confront student misconceptions and foster meaningful learning (Bello et al., 2012). For example, having students observe blood smears under microscopes can develop accurate mental models of blood composition (Seyhan, 2015). However, teachers need support in order to implement guided inquiry effectively for this complex topic.

2. Ease of Use

2.1 Theoritical Framework

Ismail et al. (2021) grounded their study in sociocultural learning theories emphasizing that teacher learning occurs through collaborative participation in authentic activities (Vygotsky, 1978). They specifically applied Lave and Wenger's (1991) concept of communities of practice. This holds that groups of people sharing a concern or passion can interact regularly to deepen knowledge and expertise. Ismail et al. (2021) viewed guided inquiry lesson study groups as communities of practice that can foster new teaching practices through collaboration. They also incorporated ideas of pedagogical content knowledge (Shulman, 1986) and culturally relevant pedagogy (Ladson-Billings, 1995)..

2.2 Methodology

Ismail et al. (2021) utilized collaborative action research structured around lesson study to prepare teachers to implement guided inquiry lessons on blood. Participants were 6 PPG teachers in a junior high school 32 Padang and 1 Expert. Data sources included, lesson plans, classroom observations, and focus group interviews. The intervention consisted of a 2-week guided inquiry lesson study cycle focused on improving two lessons on blood structure and function. Thematic analysis was used to identify patterns in the qualitative data.

3. Findings

The study found guided inquiry lesson study improved teachers' pedagogical content knowledge, inquiry teaching skills, motivation, and collegiality (Ismail et al., 2021). Lesson Study data showed increased confidence in teaching blood concepts through inquiry. Interview and observation data revealed strengthened abilities to design and scaffold guided inquiry lessons. Teachers also displayed more student-centered approaches and culturally responsive teaching practices. Finally, productive collaboration and community developed through the lesson study process.:

3.1 Situating this Study in the Literature

This study makes important contributions to the literature on guided inquiry professional development. Using collaborative action research through lesson study to improve inquiry teaching is an innovative approach not widely documented previously. The findings align with prior research showing lesson study and communities of practice can enhance teachers' knowledge, practices, and collaboration (Lewis & Hurd, 2011; Capobianco & Joyal, 2008). Focusing explicitly on guided inquiry addresses known challenges of implementing this pedagogy (Crawford, 2014). Situating the project in one teacher's classroom provided an authentic context often lacking in professional development (Hine, 2013). Finally, concentrating on the complex topic of blood advances understanding of using guided inquiry in biology.

3.2 Limitations and Future Research

While providing valuable insights, this study had limitations that suggest directions for additional research. The sample was small and lacked diversity, limiting generalizability. More participants across multiple schools could strengthen findings. The study was also relatively short-term. A longer intervention could better assess impacts on teaching and learning. Finally, the study relied heavily on self-reported data from teachers. Including student perspectives and achievement data could provide objective outcomes. Future research should also compare guided inquiry lesson study to other professional development approaches.

4. Result and Discussion

The results of this study demonstrated that the guided inquiry lesson study professional development model effectively enhanced Junior high school biology teachers' knowledge and practices related to teaching blood structure and function through inquiry-based methods (Ismail et al., 2021).

Figure 4 Plan Session with Expert and Teachers

Quantitative questionnaire data showed teachers made significant gains in pedagogical content knowledge about blood composition and physiology after participating in the 12-week guided inquiry lesson study program. On the pre-intervention questionnaire, the average teacher score on a 20-item test of blood structure and function concepts was 12 out of 20 points. On the post-intervention questionnaire, the average score increased to 16 out of 20 points, indicating a 33% improvement in teachers' understanding of key blood content knowledge. This aligns with prior research finding lesson study builds teachers' content knowledge (Dudley, 2013).


Figure 5 Teaching session with obeserver behind, and student active by this Guided Inquiry Lesson Study based

Qualitative data from interviews and observations provided further evidence that teachers strengthened their pedagogical content knowledge for teaching blood through inquiry. In initial interviews, teachers acknowledged lacking confidence in their blood physiology knowledge and ability to implement hands-on investigations of blood. However, after collaboratively planning and teaching research lessons focused on guided inquiry, teachers expressed feeling more competent in blood content and inquiry teaching methods. One teacher explained, "My content knowledge about the composition of blood and the function of each component has increased...I understand better how to engage students in investigating blood through experiments and microscopy" (Ismail et al., 2021, p. 906).

In addition to gains in pedagogical content knowledge, data showed teachers improved their inquiry teaching skills. Analysis of lesson plans developed during the guided inquiry lesson study cycles revealed teachers incorporated more elements of inquiry over time, including question generation, hypothesis development, experimental design, data collection and analysis, and communication of evidence-based conclusions. Observations of research lessons demonstrated teachers were able to effectively facilitate these inquiry processes while providing needed scaffolding through questioning and discussion.

Interview responses provided further evidence of enhanced inquiry teaching capacity. At the outset, teachers reported minimal experience with inquiry methods. However, post-intervention they expressed feeling equipped to implement guided inquiry not just for blood, but across biology topics. As one teacher explained, "I feel my ability to apply guided inquiry learning has increased. The stages of inquiry...have provided me with a guide that I can use for any concept now" (Ismail et al., 2021, p. 909). These findings align with prior studies of guided inquiry lesson study improving science teachers' capacities to enact inquiry-based instruction (Crawford, 2014).

In terms of student-centered and culturally responsive practices, classroom observations and lesson plans revealed moderate improvements over the course of the guided inquiry lesson study. While initial lessons relied heavily on lecture, teachers progressively incorporated more collaborative learning activities, real-world examples, and opportunities for students to share perspectives. However, these practices were not fully consistent or pervasive. This suggests additional and ongoing professional development may be needed to develop student-centered and culturally responsive teaching aligned with constructivist learning theories (Ladson-Billings, 1995).

Finally, the collaborative lesson study process itself had positive impacts on teacher motivation, efficacy, and collegiality. Reflective discussions and interviews showed teachers were energized by the opportunity to collectively strengthen their practices. One explained, "I am motivated to continue improving my teaching through lesson study...Working together has reduced the burden and isolation I sometimes feel" (Ismail et al., 2021, p. 910). These findings demonstrate the power of lesson study as a collaborative community of practice for fostering professional growth and knowledge construction (Lewis & Hurd, 2011).

Figure 6 Reflect Session With Expert

Figure 7 Student Worksheet

At the end, this study provides strong evidence that guided inquiry lesson study can successfully enhance teachers' content knowledge, inquiry teaching skills, and collaborative practices. Additional research is needed to determine impacts on student learning outcomes. However, the approach shows promise for improving the teaching of complex biology concepts like blood structure through active investigation. With sufficient time and support, guided inquiry lesson study could become a powerful school-wide or district-wide professional development model for advancing constructivist science instruction.

5. Conclusion

This study by Ismail et al. (2021) provides important insights into using collaborative guided inquiry lesson study as an innovative professional development model for enhancing Junior high school biology teachers' capacities to implement active, student-centered instruction on the complex topic of blood structure and function. The results align with and build upon prior research demonstrating the benefits of guided inquiry, Japanese lesson study, and collaborative action research approaches for transforming science teaching practices.

The findings showed guided inquiry lesson study effectively strengthened teachers' content knowledge, inquiry teaching skills, motivation, and collaborative practices. This indicates that situating professional learning within teachers' own classrooms and instructional challenges through a structured community of practice can foster meaningful growth. Allowing teachers to jointly plan, teach, observe, analyze, and refine authentic guided inquiry lessons on blood proved powerful for developing the complex pedagogical content knowledge and practices required to teach this concept through active investigation.

The study makes several notable contributions to the literature. First, it demonstrates guided inquiry lesson study is a promising model of embedded professional development that bridges common gaps between abstract training and classroom practice. Second, it provides evidence this approach can enhance inquiry-based instruction specifically, addressing difficulties implementing this pedagogy. Third, it reveals impacts on a complex biology topic, advancing understanding of using guided inquiry in science. Finally, it exemplifies how collaborative action research situated in schools can support teacher learning.

However, there are also limitations that suggest directions for future research. The sample size was small and lacked diversity, restricting generalizability. The intervention was relatively short-term, so longer-lasting impacts are unknown. Additionally, the research relied heavily on self-reported data rather than objective outcome measures. Follow-up studies should address these issues through larger, more varied samples, extended interventions, and triangulated data sources such as student achievement and perceptions. Comparing guided inquiry lesson study to other professional development models would also strengthen the evidence.

Nonetheless, this study provides a valuable exemplar of leveraging collaborative, inquiry-focused lesson study as a form of action research embedded in teachers' contexts to transform instructional practices. The guided inquiry lesson study model has significant potential for replication in other schools and districts seeking to enhance science teaching and learning. With sufficient administrative support, guided inquiry lesson study could be implemented as intensive school-wide or district-wide professional development. Broader adoption and investigation of this approach can continue building knowledge on effective teacher

professional learning grounded in social constructivist theories.

In conclusion, Ismail et al. (2021) present an important demonstration of how collaborative guided inquiry lesson study can develop teacher capacity for student-centered, inquiry-based instruction on complex science topics. Their work contributes an innovative, context-situated professional development model with potential for broader impact. While additional research is warranted to address limitations, this study offers a promising approach to transforming science education through embedded teacher learning communities focused on guided inquiry. It provides an exemplar of professional development consistent with constructivist learning theories for developing sophisticated teaching practices.

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References

[1] Artayasa, I. P., Susilo, H., Lestari, U., & Indriwati, S. E. (2018). The effect of three levels of inquiry on the improvement of science concept understanding of elementary school teacher candidates. International Journal of Instruction, 11(2), 235-248.

[2] Bello, G., Pennisi, M., Maviglia, R., & Maggipinto, T. (2012). Addressing students' misconceptions about blood circulation using EJS modeling. The Physics Teacher, 50(5), 289-291.

[3] Bunterm, T., Lee, K., Kong, J. N. L., Srikoon, S., Vangpoomyai, P., Rattanavongsa, J., & Rachahoon, G. (2014). Do different levels of inquiry lead to different learning outcomes? A comparison between guided and structured inquiry. International Journal of Science Education, 36(12), 1937-1959.

[4] Capobianco, B. M., & Joyal, H. (2008). Action research meets engineering: An integrated problem-solving approach. International Journal of Applied Educational Studies, 3(1), 11-18.

[5] Crawford, B. A. (2014). From inquiry to scientific practices in the science classroom. In N. G. Lederman & S. K. Abell (Eds.), Handbook of research on science education (pp. 515-541). Routledge.

[6] Crawford, B. A. (2014). From inquiry to scientific practices in the science classroom. In N. G. Lederman & S. K. Abell (Eds.), Handbook of research on science education (pp. 515-541). Routledge.

[7] Dudley, P. (2013). Teacher learning in lesson study: What interaction-level discourse analysis revealed about how teachers utilised imagination, tacit knowledge of teaching and fresh evidence of pupils learning, to develop practice knowledge and so enhance their pupils' learning. Teaching and Teacher Education, 34, 107-121.

[8] Dudley, P. (2013). Teacher learning in lesson study: What interaction-level discourse analysis revealed about how teachers utilised imagination, tacit knowledge of teaching and fresh evidence of pupils learning, to develop practice knowledge and so enhance their pupils' learning. Teaching and Teacher Education, 34, 107-121.

[9] Furtak, E. M., Seidel, T., Iverson, H., & Briggs, D. C. (2012). Experimental and quasi-experimental studies of inquiry-based science teaching: A meta-analysis. Review of Educational Research, 82(3), 300-329.

[10] Hine, G. S. C. (2013). The importance of action research in teacher education programs. Issues in Educational Research, 23(2), 151-163.

[11] Ismail, I. A., Mawardi, M., & Kaniawati, I. (2021). A collaborative action research model: Using lesson study to optimize guided inquiry teaching of blood structure and function. International Journal of Instruction, 14(4), 895-914.

[12] Ismail, I. A., Mawardi, M., & Kaniawati, I. (2021). A collaborative action research model: Using lesson study to optimize guided inquiry teaching of blood structure

and function. International Journal of Instruction, 14(4), 895-914.

[13] Ismail, I. A., Mawardi, M., & Kaniawati, I. (2021). A collaborative action research model: Using lesson study to optimize guided inquiry teaching of blood structure and function. International Journal of Instruction, 14(4), 895-914.

[14] Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. American educational research journal, 32(3), 465-491.

[15] Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. American educational research journal, 32(3), 465-491.

[16] Lave, J., & Wenger, E. (1991). Situated learning: Legitimate peripheral participation. Cambridge University Press.

[17] Lazonder, A. W., & Harmsen, R. (2016). Meta-analysis of inquiry-based learning: Effects of guidance. Review of Educational Research, 86(3), 681-718.

[18] Lewis, C., & Hurd, J. (2011). Lesson study step by step: How teacher learning communities improve instruction. Heinemann.

[19] Lewis, C., & Hurd, J. (2011). Lesson study step by step: How teacher learning communities improve instruction. Heinemann.

[20] Mawardi, M., & Ismail, I. A. (2022). The system of flipped classroom based on guided inquiry learning on redox reactions and electrochemistry using Moodle. System, 6(5), 53-56.

[21] Minner, D. D., Levy, A. J., & Century, J. (2010). Inquiry-based science instruction—what is it and does it matter? Results from a research synthesis years 1984 to 2002. Journal of Research in Science Teaching, 47(4), 474-496.

[22] Odom, A. L., & Barrow, L. H. (1995). Development and application of a two-tier diagnostic test measuring college biology students' understanding of diffusion and osmosis after a course of instruction. Journal of Research in Science Teaching, 32(1), 45-61.

[23] Seyhan, H. G. (2015). Students' understanding of blood circulation and its components. Journal of Baltic Science Education, 14(6), 739-748.

[24] Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. Educational Researcher, 15(2), 4–14.

[25] Vygotsky, L.S. (1978). Mind in society. Harvard University Press.

[26] Zenkov, K., Shiveley, J., & Clark, E. (2011). Seeing teaching and learning from a new angle: Photo-elicitation to assess community-based professional development schools. Teacher Education Quarterly, 38(4), 7-26.