

Walkthrough Supervision as a Collaborative Supervision Innovation: A Study on Enhancing The Quality of Learning Practices

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ABSTRACT

Objective: This study aims to analyse the implementation of walkthrough supervision as a collaborative supervision strategy in improving the quality of learning practices at junior and senior high school levels. **Method:** This research was conducted using a qualitative approach with a multi-case study design. Data were collected through direct observation, in-depth interviews with principals, teachers and supervisors, and analysis of supervision documents. The analysis process was conducted thematically to identify implementation patterns, challenges, and improvement strategies that emerged from the practice of walkthrough supervision in improving the quality of learning practices at the junior and senior high school levels at Yayasan Nurul Fikri Bina Generasi Bogor. **Results:** The results showed that walkthrough supervision in junior and senior high school of NFBS Bogor is implemented systematically through five stages by emphasising learning authenticity, continuous reflection, and teacher-supervisor collaboration. Obstacles such as time constraints, competency variations, supervisor inconsistency, and cultural factors are overcome through adaptive strategies, so that challenges actually strengthen collaboration. This supervision has an impact on improving teaching skills, classroom management, student engagement, as well as fostering a continuous reflective culture. This model has the potential to be adapted in other schools with adjustments to the vision, culture, teacher competencies and structural support. **Novelty:** The innovation of this research lies in the transformation of walkthrough supervision into a collective reflective culture, the collaborative role of teachers-supervisors, and adaptive strategies to face obstacles. This model not only improves teacher competence and classroom culture, but also has the potential to be replicated with adjustments to the school context.

INTRODUCTION

This study aims to describe the implementation of walkthrough supervision in Bogor NFBS junior and senior high schools, including the implementation process, the involvement of teachers and supervisors, the challenges and adaptive strategies used, and the impact on the quality of learning practices, classroom management, student engagement, and the strengthening of a reflective culture in schools.

The dynamics of global change have logical consequences for the quality of education provision at various levels, which in turn affects learning practices in schools. This is in line with Sustainable Development Goal 4 (SDG 4), which is to ensure quality, inclusive and equitable education for all [1]. The quality of learning can only be realised if supported by professional teachers as the frontline, so academic supervision has a strategic role in improving learning practices, creating a conducive learning environment, and encouraging the improvement of teacher competence and professionalism [2].

Academic supervision is essentially part of the development of educational human resources which includes improving teacher professionalism, competitiveness, functional competence, participatory excellence, and collaboration [3]. The collaborative supervision model is seen as more effective because it encourages the involvement of teachers as reflection partners, not just objects of evaluation, so that it has an impact on improving performance and student learning outcomes [4].

However, studies in Indonesia show that academic supervision still tends to be authoritative and does not fully engage teachers in reflective discussions. About 45 per cent of principals and supervisors do not have an adequate understanding of modern supervision principles such as walkthrough and clinical supervision [5], [6]. Even a USAID survey showed that 55 per cent of primary teachers still perceive supervision as authoritative and not involving reflective discussion [7]. Therefore, it is important to conduct an in-depth study regarding the implementation of Walkthrough Supervision as a collaborative supervision innovation that has the potential to strengthen teacher professionalism, learning quality, and reflective culture in schools.

In this context, walkthrough supervision comes as an innovative approach that emphasises brief observation, quick feedback, and continuous reflection. This approach has been proven effective in strengthening teachers' reflective culture and improving learning quality through teacher-supervisor collaboration [8], [9]. In addition, the quality of learning can be realised when supported by professional teachers as front liners in learning, so academic supervision has a strategic role in improving teacher competence and creating a conducive learning environment [10].

In practice, academic supervision has evolved into various approaches, one of which is Walkthrough Supervision, known as a short, focused and sustained visit to the classroom to provide formative feedback to teachers [11]. Walkthrough Supervision is data-driven, reflective, and orientated towards strengthening the collaborative culture between supervisors and teachers [12]. The implementation of this model allows supervisors to quickly identify strengths and areas of improvement, so that teachers are encouraged to self-reflect and improve their instructional skills.

Academic supervision is essentially a collaborative process of teacher professional development to improve the quality of learning practices and student learning outcomes. According to Glickman, Gordon and Ross-Gordon learning supervision is not just a performance evaluation, but also a continuous professional development strategy that includes mentoring, reflection and reinforcement of instructional practices [13]. Correspondingly, Wiyono asserts that collaborative supervision contributes significantly to the improvement of performance-based learning and impacts on student learning outcomes.

Through walkthrough supervision, supervisors can observe specific aspects of learning such as teaching strategies, classroom management and student engagement and work with teachers to identify strengths and areas for improvement. Thus, this supervision model has the potential to create a culture of continuous professional learning and encourage the transformation of the quality of learning practices [14].

RESEARCH METHOD

This study uses a qualitative approach, which is research that seeks to understand phenomena in depth through the collection of descriptive data in the form of written or spoken words from research subjects and observed behaviour [15]. The qualitative approach is considered appropriate because this research was conducted in a natural context, where the researcher acts as the main instrument as well as an observer who tries to capture the meaning of the implementation of Walkthrough Supervision at Yayasan Nurul Fikri Bina Generasi Bogor without manipulation or intervention [16].

This research design uses a multi-case study design that allows researchers to describe and compare phenomena that occur at the two school levels under study. The multi-case design was chosen because it is considered capable of providing a richer understanding by examining the similarities and differences between cases so as to produce more comprehensive findings [17]. In this case, researchers intensively describe the symptoms that appear at the individual, group and institutional levels according to the research focus [18].

Data collection was conducted through in-depth interviews, participant observation, and documentation studies [18]. The collected data were analysed using an interactive analysis model that includes data collection, data reduction, data presentation, and conclusion drawing [19]. As this research used a multi-case study design, the analysis was conducted in two stages, namely individual case analysis and cross-case analysis, with the aim of finding consistent patterns and meanings between the two cases.

Data validity was maintained through tests of credibility, dependability, transferability, and confirmability [20], [21]. Credibility was obtained through triangulation of sources and methods, member checking, and peer discussion. Dependability was fulfilled by an audit by the research supervisor, while transferability was demonstrated by the applicability of the results to similar contexts. Confirmability was ensured by maintaining the objectivity of the researcher so that the research results were free from researcher bias.

RESULTS AND DISCUSSION

Results

Observations showed consistent improvement from one supervision to the next, while lesson plan documents and supervision reports confirmed an increase in teaching skill scores from "fair" to "good."

Supervision contributed to improved classroom management and student engagement. Teachers were more consistent in enforcing rules, using media that stimulated HOTS, and facilitating student participation through group discussions, games, and question tournaments. Observations showed increased student engagement, less passive behaviour, and a more conducive classroom atmosphere. Class journal documents and supervision reports show a decrease in student discipline violations.

Reflection is an important part of post-supervision, both individually and collectively. Teachers revise lesson plans, improve apperception, and record supervisor

feedback. WIG session forums and weekly surveys support collective reflection. Reflection journal documents and semester checkpoint reports confirm that reflection is consistently documented.

Supervision changed teachers' paradigms from viewing supervision as evaluation to coaching. Reflection is no longer incidental, but has become a school culture. Discussions between teachers are open, teachers are more receptive to feedback, and students find learning more communicative. Supervision documents show a shift in teachers' reflective responses from brief to more in-depth.

The walkthrough supervision model is adapted to the school context. The focus of supervision is on SMART learning and bilingual classroom instruction, with time flexibility, calibration forums, and rewards for supervisors. Accreditation documents and monitoring reports show that adaptations are needed to make supervision relevant to the school's vision.

Based on the results of interviews with principals, curriculum representatives, and teachers at SMP and SMA NFBS Bogor, it was found that the implementation of walkthrough supervision was carried out systematically and gradually.

The planning stage begins with determining the supervisor, preparing a routine supervision schedule, and providing descriptive rubric-based instruments. The observation is conducted briefly (10-15 minutes) without prior notice so that learning takes place naturally. Feedback is given immediately, both verbal and written, emphasising one to two priority aspects. Teachers then reflect and follow up, while supervisors organise calibration forums to harmonise assessment standards. Semester evaluations record the achievement of supervision targets and recommend collective training for teachers if common weaknesses are found.

Classroom observation results show consistency with interview narratives. Supervisors attended in groups, brought observation instruments, and took factual notes without interrupting the learning process. Notes focused on evidence of student engagement as well as clarity of learning objectives. After the observation, the supervisor gave a brief appreciation and suggestions for improvement. At the next meeting, teachers were seen doing follow-up, for example, writing learning objectives on the blackboard or improving classroom interaction patterns. In addition, the supervisor evaluation forum discusses note calibration and general improvement strategies.

Document analysis in the form of SOPs, annual supervision programmes, observation instruments, supervision reports and semester evaluations confirms a systematic pattern of steps. Documents show a target of at least two supervisions per teacher each semester, with observation instruments emphasising positive aspects and areas for improvement. Follow-up reports and semester evaluations record the level of supervision achievement ($\pm 75-80\%$) and emphasise the importance of strengthening through training and supervisor calibration forums.

Overall, the triangulation of interviews, observations and documents concluded that walkthrough supervision in Bogor NFBS junior and senior high schools is implemented in a five-stage cycle: (1) planning, (2) brief unannounced observation, (3)

immediate feedback, (4) teacher and supervisor reflection, and (5) evaluation and system reinforcement. Key elements found are the authenticity of learning without fabrication, the continuity of teacher reflection, and the existence of a supervisor calibration forum that ensures the effectiveness of supervision.

Based on interviews, observations, and document analyses, the involvement of teachers and supervisors in walkthrough supervision in Bogor NFBS junior and senior high schools is participatory and collaborative. Teachers play an active role since the planning stage by preparing teaching tools, modules, and learning media. During implementation, the teacher continues to teach according to the plan without engineering, while the supervisor acts as a mentor who provides brief and constructive feedback. In addition, teachers are also involved as peer supervisors through peer teaching and good practice sharing forums. Supervision documents show two-way communication through feedback columns and teacher responses.

Further findings on the main barriers to the implementation of walkthrough supervision include time and schedule constraints, variations in teachers' competencies (especially in bilingual classroom instruction), and inconsistencies in notes between supervisors. Cultural factors also emerged, such as the reluctance of junior teachers to give feedback to senior teachers. Schools responded to these barriers with adaptive strategies such as flexible scheduling, supervisor calibration forums and peer teaching.

Walkthrough supervision has a positive impact on improving teachers' teaching skills. Teachers are more prepared in preparing teaching tools, improving apperception, using a variety of methods, and are more confident in bilingual instruction.

Discussion

These results support Marzano's findings that effective classroom management is a prerequisite for productive learning [22]. Increased student engagement through collaborative strategies is in line with student engagement theory which emphasises the importance of the teacher's role as facilitator [23]. Supervision that encourages the use of media and HOTS strategies is also in line with the demands of 21st century learning [24], [25]. Thus, walkthrough supervision not only improves teachers' skills but also creates a more participatory classroom.

This finding is in line with Schön's view of reflective practice as the core of teacher professional development [26]. An institutionalised reflective culture supports the formation of a learning organisation [27], where reflection is used for continuous improvement. Darling-Hammond et al. also asserted that reflection facilitated in collective forums strengthens teachers' learning communities [28].

This cultural change supports Fullan's argument that sustainable education system change requires organisational cultural transformation [29]. The shift from evaluation to coaching is consistent with the concept of formative supervision [12], which emphasises competency development over assessment. A collective reflective culture strengthens the professional learning community [3], which has been shown to improve student learning outcomes.

This finding supports Yin who emphasises the importance of adapting implementation design to the context of the case[17]. Contextualised supervision reinforces the idea of context-responsive leadership[30], which is instructional leadership that adapts to the needs of the school. The supervisor reward factor confirms the importance of intrinsic and extrinsic motivation in supervision implementation [31]. With proper adaptation, walkthrough supervision has the potential to be replicated in other schools with effective results.

The findings of this study show that walkthrough supervision in Bogor NFBS junior and senior high schools is implemented in a systematic cyclical pattern, in line with Downey, Steffy, English, Frase, and Poston who emphasise that walkthrough supervision should be brief, focused, and repetitive with the aim of providing immediate feedback to teachers[11]. The five-stage pattern that emerged in this study is consistent with the supervisory cycle framework proposed by Glickman, Gordon, and Ross-Gordon namely planning, observation, feedback, reflection, and follow-up [13].

The authenticity of the learning process observed without fabrication reinforces the principle of formative supervision, where observation focuses on the authenticity of teacher practice in the classroom[32]. Thus, teachers are more encouraged to do real reflection, rather than just showing idealised practices that may not be sustainable. The existence of a supervisor calibration forum is also in line with Danielson's view, which emphasises the importance of consistency in assessment so that supervision is not subjective but oriented towards professional standards [33].

In addition, the practice of teacher reflection after feedback indicates continuous professional learning. Darling-Hammond, Hyler, and Gardner assert that supervision-based reflection plays an important role in improving teaching quality because teachers can internalise feedback into real practice improvements [28]. The recommendation to organise collective training as a follow-up also strengthens the position of walkthrough supervision as an instrument for continuous professional development of teachers, not just as an evaluation mechanism.

Thus, the results of this study confirm that walkthrough supervision implemented in a systematic cycle is able to create a culture of reflection, increase the consistency of supervision standards, and encourage improved learning practices. This finding corroborates the literature that the effectiveness of supervision depends not only on the observation process, but also on the quality of follow-up in the form of reflection, collaboration and continuous training.

This finding is in line with the concept of collaborative supervision that places teachers as reflection partners, not objects of evaluation [13]. Teacher involvement in peer supervision supports the development of professional learning communities[34], where reflective practice is strengthened through shared forums. The supervisor's role of coach rather than evaluator is also consistent with the instructional coaching approach [35] which emphasises strength-based feedback to motivate teachers to make continuous improvement. Thus, the collaborative engagement of teachers and supervisors contributes to building a professional learning culture in schools.

This is consistent with Zepeda's finding that instructional supervision is often constrained by structural (time, workload) and cultural (teacher hierarchy) factors [12]. Variations in the quality of notes between supervisors reinforce Danielson's argument that instrument calibration is necessary for supervision to be consistent and fair [33]. Constraints to teacher competence in the bilingual classroom emphasise the importance of ongoing teacher capacity building [33]. With adaptive strategies, obstacles can be turned into opportunities for improvement, consistent with Fullan's view that effective educational change is born from flexible responses to field challenges [29].

This finding reinforces Marzano, Frontier, and Livingston's research which states that walkthrough supervision can improve teaching effectiveness through short observation cycles and quick feedback [32]. The increased variety of methods and apperception supports Stronge's findings that the quality of teacher instruction is largely determined by preparation and diversity of strategies [36]. Supervision was also shown to promote continuous improvement, consistent with the concept of continuous professional development [28].

CONCLUSION

Fundamental Finding: This study found that Walkthrough Supervision in Bogor NFBS junior and senior high schools is implemented through five systematic stages, namely: (1) planning with the assignment of supervisors, schedules, and instruments; (2) implementation of brief unannounced observations; (3) provision of quick and focused feedback; (4) teacher reflection and supervisor calibration forum; and (5) semi-annual evaluation with follow-up. These findings suggest that the effectiveness of supervision depends not only on observation, but on the continuity of the cycle of reflection and evaluation. **Implication :** This practice has important implications for the development of educational supervision. Firstly, the short and spontaneous observation approach is proven to maintain the authenticity of learning, so that the data obtained is more valid for improvement. Second, providing quick and limited feedback on top priorities helps teachers focus on making real practical changes. Third, the inter-supervisor calibration forum ensures uniformity of assessment standards, which supports a collective culture of learning quality improvement. Thus, Walkthrough Supervision can be a more adaptive, efficient and professional development-oriented collaborative supervision model for teachers. **Limitation :** Overall, Walkthrough Supervision functions not only as a control mechanism, but more as a sustainable, participatory and reflection-based coaching strategy. The consistent implementation of the five stages makes this supervision an effective cycle of strengthening learning quality at the secondary school level. **Future Research :** In other words, the findings of this study confirm that the success of Walkthrough Supervision lies in the combination of authenticity of observation, speed of feedback, teachers' continuous reflection, and supervisor calibration. Therefore, the implementation of this model can be recommended as an innovative supervision practice that is able to improve the quality of learning practices on an ongoing basis.

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REFERENCES

- [1] UNESCO, "SDG 4 Data Digest: National monitoring of SDG 4–Education 2030," UNESCO Institute for Statistics, Paris, 2021.
- [2] I. Iswadi, N. Usman, N. Niswanto, and M. AR, "Implementation of Collaborative Educational Supervision in Improving Teacher Professionalism in Elementary Schools of Pidie Regency," *International Journal of Applied Research and Sustainable Sciences*, vol. 3, no. 5, pp. 443–454, 2025, doi: 10.59890/ijarss.v3i5.13.
- [3] D. E. Velez, "Administrative And Supervisory Skills and Performance of School Heads and Their Relationship to Teachers' Performance," *International Journal of Advanced Multidisciplinary Studies*, vol. V, no. 3, pp. 2799–0664, 2025.
- [4] B. B. Wiyono, A. Rasyad, and Maisyarah, "The Effect of Collaborative Supervision Approaches and Collegial Supervision Techniques on Teacher Intensity Using Performance-Based Learning," *SAGE Open*, vol. 11, no. 2, pp. 1–9, 2021, doi: 10.1177/21582440211013779.
- [5] Kemdikbud, "Laporan supervisi akademik nasional," Jakarta, 2019.
- [6] USAID, "Teacher supervision and instructional quality in Indonesia," 2023.
- [7] USAID, "Education supervision survey in Indonesian primary schools," Jakarta, 2023.
- [8] D. Supriyadi, "Walkthrough supervision sebagai strategi peningkatan kualitas guru," *Jurnal Ilmu Pendidikan*, vol. 28, no. 3, pp. 233–242, 2022.
- [9] N. Fauziyah and R. Hidayat, "Academic supervision in building reflective teacher practice," *Indonesian Journal of Education Research*, vol. 12, no. 1, pp. 77–88, 2021.
- [10] K. A. Acheson and M. D. Gall, *Clinical Supervision and Teacher Development: Preservice and Inservice Applications*, Fifth. 2003.
- [11] C. J. Downey, B. E. Steffy, F. W. English, L. E. Frase, and Jr. William K. Poston, *The Three-Minute Classroom Walk-Through: Changing School Supervisory Practice One Teacher at a Time*. SAGE Publications, 2004.
- [12] S. J. Zepeda, *Instructional Supervision: Applying tools and concepts*. 2013. doi: 10.4324/9781315855523.
- [13] C. D. Glickman, S. P. Gordon, and J. M. Ross-Gordon, *SuperVision and Instructional Leadership: A Developmental Approach*, Sixth. 2001.
- [14] Zunaira Arshad, Azhar Ahmad, and Dr. Jam Muhammad Zafar, "Role of Head Teachers in Instructional Supervision of Secondary School Teachers in Rahim Yar Khan," *The Critical Review of Social Sciences Studies*, vol. 3, no. 3, pp. 442–453, 2025, doi: 10.59075/yc2v1744.
- [15] J. W. Creswell, *Research Design Qualitative, Quantitative, and Mixed Methods Approach Third Edition*. USA: SAGE Publications, Inc., 2010.
- [16] M. Hitka, Z. Zavadzka, D. Jelacic, and Z. Balazova, *Qualitative Indicators of Company Employee Satisfaction and Their Development in a Particular Period of Time*. Drvna Ind, 2015.

- [17] R. K. Yin, *Study Research Design and Methods*, Fourth edi. Thousand Oak: Sage Publication Inc., 2009.
- [18] M. B. Miles, A. M. Huberman, and J. Saldana, *Qualitative Data Analysis A Methods Sourcebook*, Third., vol. 17. United States of America: Sage Publication Inc., 2014.
- [19] A. Yumni and A. M. Azis, "Analisis Peranan Guru Dalam Membina Kedisiplinan Belajar Siswa Kelas Iv Di Sdit Zahra Asy-Syifa," *Jurnal Guru Kita PGSD*, vol. 7, no. 1, p. 181, 2022, doi: 10.24114/jgk.v7i1.43313.
- [20] Y. S. Lincoln and E. G. Guba, *Naturalistic Inquiry*. United States of America: Sage Publication Inc., 1985.
- [21] V. N. Anney, "Ensuring the quality of the findings of qualitative research: looking at trustworthiness criteria," *Journal of Emerging Trends in Educational Research and Policy Studies*, vol. 5, no. 2, pp. 272–281, 2015.
- [22] R. J. Marzano, *Classroom management that works*, no. March. Book Club Facilitator Guide, 2004.
- [23] J. A. Fredricks, P. C. Blumenfeld, and A. H. Paris, "School engagement: Potential of the concept, state of the evidence," *Review of Educational Research*, vol. 74, no. 1, pp. 59–109, 2004, doi: 10.3102/00346543074001059.
- [24] J. Confrey, *A synthesis of research on learning trajectories/progressions in mathematics*, no. 2018. 2019.
- [25] M. Taguma and A. Frid, *Curriculum Frameworks and Visualisations Beyond National Frameworks: Alignment with the OECD Learning Compass 2030*, vol. 9, no. 314. 2024.
- [26] J. Kitchen and B. M. Butler, "Self-Study As Reflective Practice and Active Engagement," *Studying Teacher Education*, vol. 20, no. 2, pp. 129–132, 2024, doi: 10.1080/17425964.2024.2341488.
- [27] P. M. Senge, N. Cambren-McCabe, T. Lucas, B. Smith, and J. Dutton, *Schools that Learn: A fifth discipline fieldbook for educators, parents, and everyone who cares about education.*, Currency. 2012.
- [28] L. Darling-Hammond, M. E. Hyler, and M. Gardner, *Effective Teacher Professional Development (research brief)*, no. June. 2017.
- [29] M. Fullan, *The New Meaning of Educational Change*, Fifth. Canada: Teachers College Press, 2016.
- [30] S. L. Doyle Fosco, M. A. Brown, and D. L. Schussler, "Factors affecting educational leader wellbeing: Sources of stress and self-care," *Educational Management Administration and Leadership*, vol. 53, no. 3, pp. 582–601, 2025, doi: 10.1177/17411432231184601.
- [31] K. F. Latif, I. Latif, U. Farooq Sahibzada, and M. Ullah, "In search of quality: Measuring Higher Education Service Quality (HiEduQual)," *Total Quality Management and Business Excellence*, vol. 30, no. 7–8, pp. 768–791, 2019. doi: 10.1080/14783363.2017.1338133.
- [32] R. J. Marzano, T. Frontier, and D. Livingston, *Effective Supervision: Supporting the Art and Science of Teaching*. 2011.
- [33] C. Danielson, *THE FRAMEWORK FOR TEACHING EVALUATION INSTRUMENT*. 2018. doi: 10.4135/9781506326139.n179.
- [34] R. DuFour and M. Fullan, *Cultures Built to Last: Systemic PLCs at Work TM*. United States of America: Solution Tree Press, 2013.
- [35] S. K. Mand *et al.*, "The coaching approach in graduate medical education: Practical considerations for program creation and implementation," *AEM Education and Training*, vol. 9, no. S1, pp. S12–S23, 2025, doi: 10.1002/aet2.70019.

- [36] J. H. Stronge, "Qualities of effective teachers," *Journal of Engineering Education Research*, vol. 13, no. 6, p. 348 pages, 2018.

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