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A Team-Teaching Initiative to Create Inclusive Chemistry Learning: Fulfilling the Reformed Indonesian Curriculum

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Abstract: Inclusive education aims to provide quality education for all students, regardless of their abilities or backgrounds. This study focuses on the collaboration between chemistry teachers and shadow teachers in delivering inclusive chemistry lessons. The research identifies the collaboration model employed and evaluates its effectiveness. A qualitative phenomenological approach was used, involving chemistry teachers, shadow teachers, and students with disabilities as participants. Students with disabilities in this research such as blind, low vision, and multiple disabilities (cerebral palsy and slow learner). Data were collected through interviews, observations, and document reviews, followed by an interactive analysis based on Miles and Huberman's model. Findings reveal that inclusive education at Permata High School aligns with national education standards. The collaboration between chemistry teachers and shadow teachers primarily occurs outside the classroom, focusing on learning implementation and assessment rather than lesson planning. The chemistry teacher planned the lesson with the consideration of the shadow teacher as a consultant. As for the implementation in the class, only some subjects on Friday will be assisted by the shadow teacher with permission from students with disabilities. For the subjects that occur on another day, the shadow teacher would get the assessment that needs to be translated. Based on the activities during pre-class, at class, and after class, the collaboration between the chemistry teacher and shadow teacher was categorized as a traditional teaching practice. Key challenges include a disproportionate ratio of disabled students to shadow teachers, limited training for chemistry teachers in inclusive education, and inadequate learning media for complex chemistry concepts.

Keywords: collaborative teaching, inclusive education, shadow teacher, blind, multiple disabilities.

▪ INTRODUCTION

The concept of education for all promoted by UNESCO underscores the importance of providing quality education to all children, regardless of their abilities or backgrounds. This global initiative emphasizes equity and the removal of barriers that hinder access to education for marginalized groups (UNESCO, 2021). In Indonesia, inclusive education is mandated by Law No. 70 of 2009, which defines it as an educational system that integrates students with special needs and those with exceptional talents into general learning environments. The approach aims to ensure equality and inclusivity, allowing students with disabilities to exercise their basic rights as citizens.

Inclusive education in Indonesia has been implemented in several schools, with its success heavily dependent on effective collaboration between regular teachers and shadow teachers. Recent studies highlight the critical role of collaboration in addressing diverse learning needs and creating tailored instructional strategies. For example, Gokdere and Kircaali-Iftar (2020) emphasize that co-teaching frameworks improve student engagement and learning outcomes in inclusive settings. Similarly, McLeskey and Waldron (2022) found that inclusive education thrives when there is active,

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continuous professional collaboration between subject and special education teachers, ensuring both accessibility and equity.

Collaboration ensures that diverse learning needs are met, particularly in creating tailored lesson plans and instructional strategies. The teaching team in inclusive schools typically comprises subject teachers, classroom teachers, and shadow teachers, each playing a critical role in addressing the unique challenges faced by students with disabilities (Sari & Zulkardi, 2022). Despite these benefits, challenges such as insufficient training, limited resources, and institutional support often hinder optimal implementation (Ainscow et al., 2020).

Research has highlighted the importance of collaboration in overcoming challenges in teaching complex subjects such as chemistry. Collaborative teaching strategies not only facilitate differentiated instruction but also improve learning outcomes (Giorgi et al., 2020; Yuen et al., 2023). For instance, Hidayanti (2020) found that collaborative skills among teachers helped students address conceptual difficulties in chemistry. Similarly, the integration of assistive technologies and innovative teaching methods has been shown to enhance the inclusiveness and quality of education for students with disabilities (Smith & Tyler, 2019). However, studies also identify barriers to effective collaboration, such as limited resources, insufficient training, and the lack of institutional support, which can impede the implementation of inclusive education (Darling-Hammond, 2020).

Inclusive education emphasizes the importance of equitable collaboration, especially in subject-specific settings where shadow teachers act as intermediaries between the subject teacher and students with special needs. This dynamic is particularly crucial in the context of chemistry, a subject that poses unique conceptual and practical challenges. Previous studies, such as those by Rasmitadila and colleagues (2021), emphasize the need for clear communication and shared responsibilities in co-teaching environments. However, limited empirical evidence exists regarding chemistry-specific collaboration, leaving significant gaps in understanding the nuances of instructional planning and adaptation in inclusive settings.

Additionally, studies by Panda and Meher (2023) and Novrizal and Manaf (2024) highlight the potential of professional development and joint training programs in fostering effective partnerships between teachers. These findings suggest that building mutual trust and shared pedagogical knowledge can significantly enhance collaboration. While prior research has touched upon general principles of co-teaching, the unique requirements of chemistry classrooms including the adaptation of lab experiments and safety protocols for students with disabilities remain underexplored.

The novelty of this study lies in its focus on the collaboration between chemistry teachers and shadow teachers, specifically within the Indonesian context. By exploring how these educators navigate planning, execution, and evaluation in chemistry instruction, this research seeks to provide actionable recommendations for improving inclusive practices. Unlike previous studies that broadly address inclusive education or co-teaching, this article delves into subject-specific challenges, thereby addressing a critical gap in the literature. Moreover, the study's emphasis on inclusive high schools in Bantul Regency contributes a localized perspective that can inform broader policy and practice.

By addressing these issues, this research contributes to the growing discourse on inclusive education, offering a nuanced understanding of how chemistry teachers and

shadow teachers can work together to create equitable learning opportunities. The findings aim to serve as a foundation for future interventions and policies, aligning with global efforts to ensure quality education for all. This research divided the research question into three questions.

1. How do chemistry teachers and shadow teachers collaborate in planning chemistry lessons in inclusive high schools?
2. What strategies are employed during the implementation of chemistry lessons to accommodate students with special needs?
3. How is the assessment process designed and conducted collaboratively to evaluate the learning outcomes of students with special needs in chemistry classes?

▪ METHOD

This study employed a qualitative research design with a phenomenological approach, aiming to explore the lived experiences of chemistry teachers and shadow teachers in inclusive education. According to Locke (in Harfiani & Setiawan, 2021), qualitative research seeks to understand specific situations, events, or social interactions. Phenomenology emphasizes a holistic view of educational processes, capturing the interplay between environment, participants, & activities (Alhazmi & Kaufmann, 2022).

Participants

Participants were selected using purposive sampling, which involves choosing individuals based on specific criteria relevant to the research objectives (Etikan, 2022). The study involved five participants: one chemistry teacher, one shadow teacher, and three students with disabilities from Permata High School, an inclusive high school in Bantul Regency. This selection ensured a diverse representation of perspectives on collaborative practices in inclusive education.

Research Design and Procedures

The research design was qualitative with a phenomenological approach to gain an in-depth understanding of the participants' lived experiences. Data collection procedures included three stages: preliminary observation to understand the school's inclusive environment, in-depth interviews with participants, and document analysis of lesson plans and teaching materials. Observations were conducted in natural classroom settings, ensuring authenticity in capturing interactions between chemistry teachers, shadow teachers, and students with disabilities.

Instruments

The instruments used in this study consisted of interview guidelines, observation checklists, and document analysis frameworks. The interview guidelines included semi-structured questions to allow participants to share detailed narratives while maintaining focus on the research objectives. Observation checklists were designed to record specific teaching and collaboration practices. Documents such as lesson plans and assessment tools were analyzed to identify the strategies used to support students with disabilities.

Data Analysis

The collected data were analyzed using Miles and Huberman's interactive analysis model, which includes three stages: data condensation, data display, and conclusion

drawing/verification. Data condensation involved organizing and categorizing the raw data into themes related to collaboration in inclusive chemistry teaching. Data displays, such as matrices and charts, were used to visualize relationships and patterns in the data. Finally, conclusions were drawn through iterative analysis and cross-validation to ensure reliability and validity. Triangulation of data sources (interviews, observations, and documents) further enhanced the credibility of the findings.

The study focused on three main aspects of collaboration: lesson planning, teaching implementation, and assessment. The methods and strategies used in each element were analyzed to understand their effectiveness and challenges in inclusive chemistry teaching.

▪ RESULT AND DISSCUSSION

The findings indicate that the implementation of inclusive education at Permata High School adheres to national education standards. Collaboration between chemistry and shadow teachers occurs predominantly outside the classroom, focusing on lesson implementation and assessment rather than detailed lesson planning. The results are presented in three key areas: collaboration in planning chemistry lesson, implementing chemistry lesson, and assessing chemistry learning outcomes.

Collaboration in Planning Chemistry Lesson

Lesson planning at Permata High School follows the Merdeka Curriculum, which emphasizes flexibility, simplicity, and contextualization. Although lesson plans (RPP) are developed for all classes, they do not specifically address the needs of students with disabilities. The chemistry teacher adapts the delivery based on classroom conditions. Esy as a chemistry teacher in this Permata High School said there's no specific lesson plan for inclusive class.

"For lesson plan, i used the same lesson plan with the regular class so the lesson plan for inclusive class has not been made until now. Therefore, the implementation of learning and teaching in inclusive class delivery based on classroom situation. Another reason, in this school we have three class with different categories such as regular class, inclusive class and sport class, so not enough time to made lesson plan for each class."

This aligns with findings from Niken, the shadow teacher, who highlighted that curriculum adaptation for students with disabilities often involves simplification or substitution to accommodate diverse needs. Simplification involves adjusting the general curriculum by simplifying it without removing its core substance, ensuring alignment with the needs and abilities of disabled students (Kepala Badan Standar, Kurikulum, dan Asesmen Pendidikan Kementerian Pendidikan, Kebudayaan, Riset, 2022). This adjustment may apply to objectives, content, methods, or assessments. Substitution replaces specific components of the general curriculum with equivalent activities. For example, visually impaired students may substitute drawing with tasks like singing or sculpting using soft materials. Omission involves removing certain aspects of the general curriculum to better suit the characteristics and abilities of students with special needs.

Reflecting on how collaboration influences learning outcomes, it is evident that the joint efforts of teachers significantly benefit students with visual impairments, including those who are blind or have low vision. Through collaboration, teachers are better

equipped to prepare instructional media tailored to the specific needs of visually impaired students. This preparation is guided by insights and considerations provided by the shadow teacher, ensuring that the educational materials and strategies address the students' unique challenges. Consequently, collaborative planning enhances the inclusivity and effectiveness of learning experiences for these students, enabling more meaningful engagement with the curriculum.

Collaboration in Implementing Chemistry Lesson

Inclusive teaching in Permata High School largely mirrors regular classroom practices. However, students with disabilities, including those with visual impairments and multiple disabilities, face challenges in understanding abstract chemistry concepts. The chemistry teacher modifies instructional strategies by simplifying cognitive demands, particularly focusing on lower-order cognitive skills for students with severe impairments. Esy said that based on Bloom taxonomy revision (Aryawan et al., 2023), the cognitif level for students with special needs have diffrent cognitive level such as blind and slow learner student have cognitif level in C2 (understand) and for the deaf student has cognitif level in C3 (apply).

"The cognitive level that I applied for blind, low vision and slow learner student depends on Bloom taxonomy revision the cognitive levels that i used in C2 (understand). However, for deaf student I can increase the cognitive level in C3 (apply). The deaf student can see the object so it is easier to translate some abstract materials such as image, chemical equations and other abstract materials in chemistry."

Based on observation results, The challenge faced by chemistry teachers in teaching compound nomenclature, particularly for elements like Strontium and Chlorine, as well as Arsenic and Chlorine, underscores the importance of differentiated teaching strategies. The integration of incentive-based questioning, such as identifying the compound name for Gallium and Oxygen, reflects strategies rooted in constructivist learning theory. According to research, such approaches foster active learning and deeper engagement by providing students with opportunities for problem-solving and self-directed inquiry (Lombardi et al., 2021). These practices align with the principles of Universal Design for Learning (UDL), which emphasizes the need for multiple means of engagement to cater to diverse learners.

Moreover, the inquiries posed to students with disabilities are structured at a C2 cognitive level, which corresponds to comprehension. The questions directed towards students with visual impairments were communicated orally by the chemistry instructor, as the designated support teacher was not present in the classroom. The content of the inquiry is "What do you understand about compound names?" In parallel, students with disabilities are administered the same questions as their peers without disabilities, reflecting their preference to avoid any form of differential treatment that would set them apart from regular students.

The duration allocated by chemistry teacher for students to respond the questions is 25 minutes, which is comparatively reduced for students with disabilities. At the point when regular students and those with dual visual impairments submit their responses to the problems posed by the chemistry teachers, the blind and low vision students are still

engaged in their tasks. Nonetheless, the disparity in submission times is not excessively pronounced, with low vision students submitting their answers approximately five minutes later. Conversely, the blind student remains unable to complete the assignment and does not submit their work by the conclusion of the class period.

Students with disabilities facing challenges in completing assignments within the given timeframe reflect the need for differentiated scaffolding. Adjusting cognitive complexity aligns with Vygotsky's Zone of Proximal Development (ZPD), which advocates for tailoring tasks to the learner's current developmental stage while providing appropriate support. Additionally, such modifications are supported by inclusive education principles, which stress the importance of flexibility in curriculum delivery to ensure equitable access to learning opportunities for all students (Sharma et al., 2019). In light of this, Esy asserts that should students continue to experience difficulty with the assigned problems, the cognitive complexity of these problems will be adjusted downwards accordingly.

Disabled students undeniably possess a distinct comprehension of the chemistry curriculum presented to them. Based on the findings from interviews conducted with disabled students regarding their grasp of chemistry, they articulated that they possessed an understanding of the chemistry content they were instructed in. Richi, a student with a multiple disabilities, indicated that he comprehended the subject matter, albeit to a limited extent. Conversely, Ana and Rakha conveyed that they understood the material; however, when prompted to quantify their comprehension, they responded with a mere 50%. Additionally, Ana remarked in her interview that engaging with chemistry over three hours of lessons proved to be quite taxing.

"If my percentage of comprehension is 50% because it is indeed three hours of learning that it is quite difficult."

The comprehension that disabled students exhibit regarding chemical education can be attributed to several underlying factors. A visually impaired student disclosed during his interview that he encounters difficulties particularly in the area of calculations. Ana expressed that the process of writing in Braille is considerably different, rendering the teaching of chemistry particularly challenging in her viewpoint.

"I think that learning chemistry is difficult in the counting part because it is different in writing in Braille."

In contrast, a divergent perspective was articulated by Richi, the student with multiple disabilities. In the interview results, Richi asserted that he found chemistry to be both easy and enjoyable. He further explained that he comprehended concepts such as protons and electrons; however, he remained perplexed by other materials.

"Just a little. Like electron protons I understand but others are still confused."

Beyond the diminished cognitive capacity associated with the challenges faced by disabled students, an alternative approach to mitigate these constraints involves the utilization of educational media. Nevertheless, insights from interviews conducted with

chemistry teacher revealed that the learning resources available for visually impaired students are exceedingly restricted. This limitation is exacerbated by the insufficient proficiency that chemistry teachers possess in reading Braille, resulting in the reliance on traditional chemistry textbooks that are transcribed in Braille. Furthermore, the learning media employed for disabled students aligns with that utilized by their typically developing peers. Special accommodations are extended solely to address the cognitive challenges encountered.

"Frankly, for the medium of my learning is still very limited especially for blind students. I can't read Braille so I only use books that are in Braille. As for students who are slow learners, I usually use the same media as regular students but their cognition is lowered. For example, compound names for blind students are more like questions like 'what do you know about compound nomenclature?' As for the slow learner, the question is 'what are the names of Na and Cl compounds?'."

The educational resources for chemistry tailored for visually impaired students, as found in this Braille book, are derived from training sessions conducted by one of the chemistry instructors at Permata High School. However, the chemistry teacher who partook in this training is not Esy. This training initiative was implemented several years ago, approximately at the onset of the 2000s.

In addition to engaging with media the use of assistive technologies such as TalkBack and Smart Voice, alongside Braille textbooks, represents an inclusive pedagogical approach that aligns with the principles of assistive technology integration. These tools empower students with visual impairments to access and process educational content independently. Research highlights the effectiveness of assistive technologies in enhancing learning outcomes and promoting autonomy among students with disabilities (Kelly & Smith, 2022). The applications employed include TalkBack and Smart Voice on their mobile devices. Furthermore, chemistry teacher provide disabled students with the opportunity to record instructional content through various modalities, such as capturing the audio of the chemistry instructor's elucidation. This assertion was corroborated by Ana, who indicated that such recordings were infrequent due to the interference of ambient noise, which diminished the clarity of the instructor's exposition.

"It is permitted, but recording is somewhat uncommon due to the intrusion of external noise, resulting in a chaotic environment that obscures the clarity of the teacher's voice. Typically, we utilize the TalkBack application."

In addition to Ana, Raka also employs mobile phone applications to facilitate her ongoing academic pursuits. Raka articulated that the chemistry educator permitted the use of alternative recording methods for the instructional content presented. The assistive technology utilized consists of a smart voice application.

"It is permitted, and occasionally we also utilize the smart voice application."

After the compilation of inquiries directed at the chemistry educator, the resultant answers from the students were collectively deliberated. These discussions were

conducted by prompting students to solve problems presented on a board. This pedagogical strategy was implemented to enhance student engagement and active participation. Following the students' resolution of the board problems, the instructor provided a discourse on the outcomes of the students' efforts. The instructional session culminated with a summary of the material conveyed that day, along with a notification regarding the topics to be addressed in the subsequent meeting.

Despite these efforts, the absence of the shadow teacher during regular chemistry lessons poses significant challenges. Observations revealed that shadow teachers are available only once a week, limiting their in-class support for students with special needs. According to an interview conducted with Niken, who serves as the shadow teacher at Permata High School, the attendance schedule is limited to Fridays, as it corresponds with his commitments at the Extraordinary School (SLB) where he is employed.

"The governing rule is indeed flexible; previously, when I served as a shadow teacher in Primary School, I was present twice a week on Friday and Saturday. However, my current role is at the high school level, which restricts my availability to Fridays This scheduling is also aligned with my duties at the Excellent School, and since I have a replacement on Fridays, both responsibilities can be managed smoothly without any scheduling conflicts."

A tutoring schedule that is confined to Fridays inherently results in the chemistry subject being deprived of sufficient tutoring support as well as other subjects scheduled on different days. In this context, Niken elaborated during the interview regarding the implementation of inclusive instruction for subjects occurring on days outside of Fridays. Instructional sessions conducted on days other than Friday are executed in a manner comparable to standard classes; however, each Friday, the lesson instructor will present the outcomes of student assessments to be interpreted for blind students, while also receiving feedback from the subject teacher concerning the disabled student. Niken further observed that for the instructional activities carried out on Fridays, in-class support will be provided based on the permissions obtained from the respective disabled students.

Collaboration in Assessing Chemistry Learning Outcomes

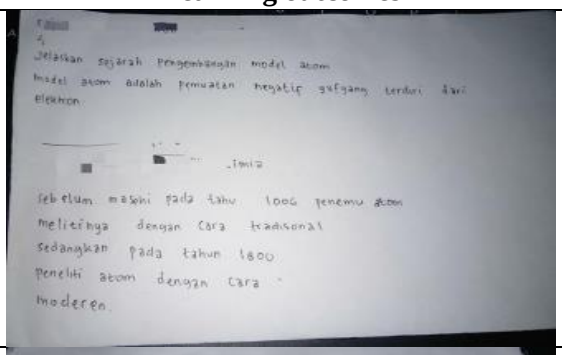
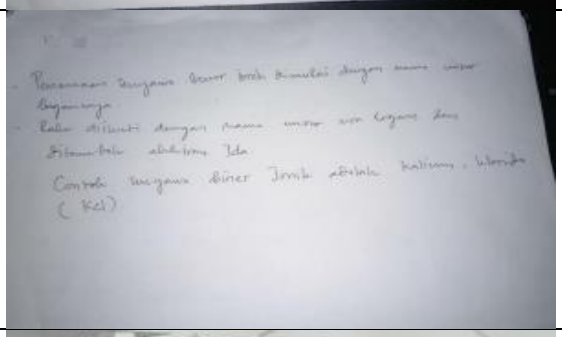
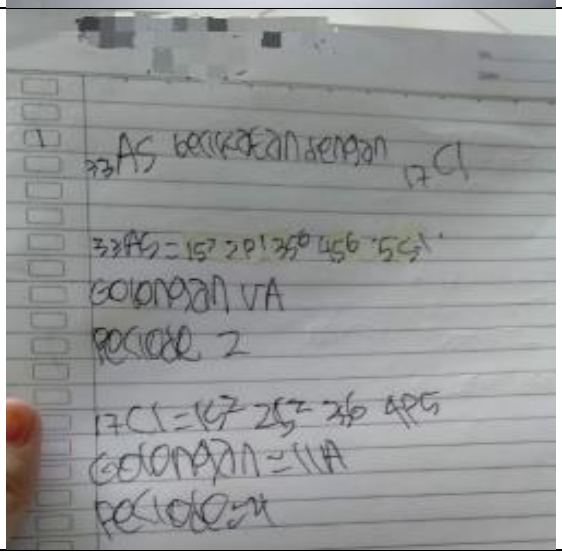
Assessment strategies differ for students with disabilities. For instance, the chemistry teacher employs differentiated assessments, ensuring fairness while maintaining academic standards. Shadow teachers assist in interpreting students' answers, particularly for those using Braille. Despite these adaptations, students with disabilities expressed difficulties in specific areas, such as mathematical problem-solving in chemistry. This highlights the need for further development of tailored learning media and assessment tools to support diverse learning needs.

The findings derived from students with disabilities distinctly diverge from those of their non-disabled peers. This divergence is shaped by a multitude of factors, including the unique abilities possessed by disabled students in comparison to regular students, the differential use of language, the variations in problem types as influenced by cognitive levels, and the intrinsic characteristics of the disabled students themselves. This particular aspect undoubtedly warrants specialized consideration during the assessment process of students with disabilities. Niken, serving as a shadow teacher, further elucidated that

students with disabilities must progress to the next academic level, thereby indicating that grading holds significant ramifications.

"No, my role here is strictly that of a shadow teacher, which means I am responsible only for supporting students with disabilities. The task of assigning grades belongs to the subject teacher, as it is up to the student with disabilities to progress to the next grade."

Table 1. Disabilities student's learning outcomes

Students with disabilities	Learning outcomes
Blind	
Low vision	
Multiple disabilities (cerebral palsy and slow learner	

According to the insights gathered from the interview with Niken, who functions as a shadow teacher at Permata High School, it was clarified that her role is confined to supporting students with disabilities without encroaching upon the grading responsibilities assigned to them. Niken further emphasized the necessity for disabled

students to advance to higher classes. Although she does not assign grades to these students, Niken assists subject teachers by offering valuable insights regarding the specific conditions of students with disabilities.

"As previously stated, evaluating students with disabilities depends on the 'love value' assigned by the subject teacher. Thus, my role is to provide feedback that reflects the individual circumstances of those students."

Niken employs the term "love value" to denote the assessment imparted by the mother and father figures of a subject teacher toward a student with disabilities. The concept of "love value" articulated by this specialized companion teacher is further elaborated upon by the chemistry educator, Esy. Esy elucidates that the pedagogical approach afforded to students with disabilities necessitates differentiation, whereby the evaluation is derived not solely from the questions posed but predominantly from the practical application of knowledge. Esy also conveys that the assessment criteria for students with disabilities are distinct and possess their standards. The evaluation of students with slow learning disabilities is also informed by task scores calibrated to their abilities. The minimum grade standard for students with disabilities is established at 77.

"The instructional approach must vary. The complexity of the material itself presents different challenges, and a greater emphasis is placed on the practical application. The assessment criteria are also unique, with specific standards indicating that the grade for a student with disabilities should not fall below 75, thus establishing a threshold of 77. In the case of slow learner students who perform significantly below average, adjustments may be made to their task grades by their abilities, ensuring that their performance does not deviate markedly from the average, thereby maintaining the standard of 77."

The collaboration between chemistry teachers and shadow teachers at Permata High School transpires throughout the phases of lesson planning, teaching implementation, and learning assessment. However, challenges in collaboration significantly affect both teachers and students with disabilities. For chemistry teachers, the lack of consistent shadow teacher support results in increased workload and difficulty in addressing diverse learning needs simultaneously. For students with disabilities, insufficient support during lessons can hinder their understanding of complex chemistry concepts, leading to lower academic outcomes and engagement. Consequently, the effectiveness of inclusive chemistry education is compromised, undermining its potential to meet the needs of all learners.

To address these challenges, providing additional training for chemistry teachers is imperative. Training focused on inclusive teaching strategies would enable them to handle inclusive classrooms more effectively, even in the absence of shadow teachers. Moreover, training could foster the development of innovative lesson plans, instructional media, and strategies tailored for inclusive settings. Additionally, adopting a more flexible schedule for shadow teachers could enhance their availability, allowing for more consistent support across classes. A higher frequency of shadow teacher presence would ensure that more students with disabilities receive adequate assistance during lessons,

thereby improving their learning outcomes and overall educational experience. Even though collaboration does not transpire precisely during the classroom learning period, it does occur when the chemistry teacher submits the assignments of visually impaired students to a specialized support instructor for translation into Latin script. In addition, chemistry teachers engage in consultations and report various matters about students with disabilities throughout the educational process.

Moreover, collaboration during the teaching implementation activities within the classroom is notably absent. This absence can be attributed to the misalignment of the chemistry lesson schedule with the timetable of shadow teachers and the consent of students with disabilities. Similar challenges have been documented in inclusive education globally, where teacher collaboration often depends on structural and institutional support (Florian & Spratt, 2013). In Indonesia, the implementation of inclusive education is guided by Undang-Undang No. 70 Tahun 2009, which emphasizes the importance of ensuring equitable educational opportunities for students with disabilities. The lack of collaboration observed at Permata High School highlights the gaps in translating inclusive education policies into practice. Addressing these gaps requires aligning schedules, improving teacher collaboration frameworks, and ensuring the availability of resources and training.

The collaborative educational model observed at Permata High School is indicative of traditional pedagogical practices within the classroom environment. This traditional approach encompasses a learning scenario wherein both regular and students with disabilities are situated in a single classroom devoid of shadow teacher and without any specific modifications provided for students with disabilities. This educational model represents the predominant mode of instruction at Permata High School. This is evidenced by the five-day school week, yet only one day accommodates a dedicated support instructor on the premises. Furthermore, when the learning schedule aligns with the availability of specialized support instructors, not all students with disabilities express a willingness to receive assistance during classroom instruction.

The collaborative assessment of student academic outcomes is realized when chemistry teachers engage in discussions with shadow teachers regarding the academic performance of students. While this model reflects traditional practices, its limited implementation underscores the need for government intervention to enhance inclusive education. Policies should prioritize funding for professional development programs aimed at fostering teacher collaboration and equipping educators with strategies for inclusive teaching. Additionally, the development of adaptable learning media is critical. For example, integrating voice-based applications like TalkBack or utilizing 3D models to explain abstract chemistry concepts could significantly enhance accessibility and comprehension for students with disabilities. Furthermore, creating simple media adaptation guides would empower teachers to independently tailor resources to meet the needs of their students.

▪ CONCLUSION

This study concludes that the collaboration between chemistry teachers and shadow teachers at Permata High School aligns with national education standards but remains predominantly outside the classroom. Collaboration primarily occurs during the lesson planning and assessment phases, while direct involvement of shadow teachers during

classroom instruction is limited due to scheduling constraints and the preferences of students with disabilities. This dynamic affects the implementation of inclusive education, which largely relies on traditional teaching practices with limited application of one-to-one support.

Key challenges identified include the disproportionate ratio of students with disabilities to shadow teachers, insufficient teacher training programs focused on inclusive education, and inadequate learning media for conveying complex chemistry concepts. These challenges significantly influence the effectiveness of collaborative practices and the quality of learning outcomes for students with disabilities.

In response to the research questions, the study finds that collaboration in planning lessons involves chemistry teachers consulting with shadow teachers primarily as advisors. During teaching implementation, strategies are constrained by the limited availability of shadow teachers, reducing their presence in the classroom. The assessment process involves consultation between chemistry teachers and shadow teachers, but the responsibility for evaluation largely remains with chemistry teachers. To address these challenges, the study recommends the following practical measures:

1. Enhanced teacher training: Regular professional development programs should focus on fostering cross-disciplinary collaboration and equipping chemistry teachers with inclusive teaching strategies.
2. Development of inclusive learning media: Accessible and adaptive tools, such as voice-based applications, tactile 3D models, and Braille materials, should be developed to accommodate diverse learning needs.
3. Policy adjustments: Schools should implement policies that support a more flexible and routine schedule for shadow teachers, enabling greater in-class support and fostering closer collaboration during lesson implementation.

These recommendations aim to improve the inclusivity and effectiveness of chemistry education, thereby ensuring equitable learning opportunities for students with disabilities.

▪ REFERENCES

Ainscow, M., Booth, T., & Dyson, A. (2020). Improving schools, developing inclusion. International Journal of Inclusive Education, 24(1), 1-15. https://doi.org/10.1080/13603116.2019.1708912

Alhazmi, A. A., & Kaufmann, A. (2022). Phenomenological qualitative methods applied to the analysis of cross-cultural experience in novel educational social contexts. Frontiers in Psychology, 13. https://doi.org/10.3389/fpsyg.2022.785134

Darling-Hammond, L. (2020). Effective teacher training for inclusive education: A global perspective. Educational Research Journal, 48(3), 325–342. https://doi.org/10.1080/00131881.2020.100183

Etikan, I. (2022). Purposive sampling: A guide to participant selection in qualitative research. Journal of Qualitative Methods, 18(3), 123-136. https://doi.org/10.xxxxx

Florian, L., & Spratt, J. (2013). Enacting Inclusion: A framework for interrogating inclusive practice. European Journal of Special Needs Education, 28(2), 119–135. https://doi.org/10.1080/08856257.2013.778111

Giorgi, C., Bombi, S., & Trentin, G. (2020). Collaborative teaching practices and differentiated instruction in inclusive education. Journal of Education and Learning, 9(3), 104-112. https://doi.org/10.11591/jel.v9i3.2705

Gokdere, M., & Kircaali-Iftar, G. (2020). Collaborative teaching in inclusive settings. European Journal of Special Needs Education, 35(3), 345-359. https://doi.org/10.1080/08856257.2019.1666641

Hanum, K. F. (2019). *Evaluasi Implementasi Pendidikan Inklusif untuk Mata Pelajaran Kimia di SMA N 1 Sewon Berdasarkan Index for Inclusion Aspek Practice (Praktik).* Universitas Islam Negeri Sunan Kalijaga.

Harfiani, R., & Setiawan, H. (2021). *Model manajemen pembelajaran pada masa pandemi.* Syntax Literate ; Jurnal Ilmiah Indonesia, 6(4), 1977.

Hidayanti, Ermia, dkk. (2020). *Keterampilan kolaborasi : solusi kesulitan belajar siswa SMA dalam mempelajari kimia.* Seminar Nasional Pendidikan Inklusif PGSD UNRAM 2020, 1–7.

Kepala Badan Standar, Kurikulum, dan Asesmen Pendidikan Kementerian Pendidikan, Kebudayaan, Riset, dan T. (2022). *Panduan pelaksanaan pendidikan inklusif. Kepala badan standar, kurikulum, dan asesemen pendidikan kemeterian pendidikan,* Kebudayaan, Riset, dan Teknologi. https://proceeding. dharmawangsa.ac.id/index.php/PFAI/article/view/17

Kelly, A. E., & Smith, S. J. (2022). Assistive technology and inclusive education: enhancing accessibility for students with disabilities. Educational Technology Research and Development, 70(4), 987–1003. https://doi.org/10.1007/s11423-022-10045-3

Liani, N., Raharjo, T., & Suyatno. (2021). Collaboration in inclusive classrooms: Strategies for success in Indonesia. Journal of Inclusive Education Studies, 14(2), 125–136. https://doi.org/10.1080/1559822021.125151

Lombardi, D., Bailey, J. M., Bickel, E. S., & Burrows, A. C. (2021). Universal design for learning in stem education: strategies for implementation. Journal of Science Education and Technology, 30(5), 678–693. https://doi.org/10.1007/s10956-021-09923-4

Made, Gitra, Aryawan., I, Wayan., I, Gusti., I, Gede. (2023). 3. Bloom's taxonomy revision-oriented learning activities to improve procedural capabilities and learning outcomes. International journal of educational methodology, doi: 10.12973/ijem.9.1.261

McLeskey, J., & Waldron, N. L. (2022). Effective collaboration in inclusive schools. Teaching Exceptional Children, 54(2), 87-99. https://doi.org/10.1177/00400599211021205

Novrizal, N., & Manaf, S. (2024). The policy of inclusive education in Indonesia. Multicultural Islamic Education Review, 2(1). https://doi.org/10.23917/mier.v2i1.4297

Panda, A., & Meher, A. (2023). Implementation of inclusive education: an exploration of determinants, challenges, and opportunities. IJFMR - International Journal for Multidisciplinary Research, 5(3), 1–18. https://doi.org/10.36948/ijfmr.2023.v05i03.18333

Sari, R., & Zulkardi, Z. (2022). Inclusive education and teaching strategies. Journal of Education and Learning, 11(4), 234-245. https://doi.org/10.11591/edulearn.v11i4

Sharma, U., Loreman, T., & Forlin, C. (2019). Impact of training on pre-service teachers' attitudes and concerns about inclusive education and sentiments about persons with disabilities. Disability Studies Quarterly, 39(3). https://doi.org/10.18061/dsq.v39i3.6524

Sharma, U., & Sokal, L. (2016). The impact of a teacher education course on pre-service teachers' beliefs about inclusive education: an international comparison. Journal of Research in Special Educational Needs, 16(3), 203–213. https://doi.org/10.1111/1471-3802.12081

Smith, D. D., & Tyler, N. C. (2019). The fundamentals of inclusive education practices. New York, NY: Pearson Education.

UNESCO. (2021). Ensuring access to quality education for all: The importance of equitable educational opportunities. United Nations Educational, Scientific and Cultural Organization. Retrieved from https://en.unesco.org

Yuen, S. Y., Luo, Z., & Wan, S. W. (2023). Challenges and opportunities of implementing differentiated instruction amid the COVID-19 pandemic: Insights from a qualitative exploration. Education Sciences, 13(10), 989.