



STRENGTHENING INCLUSIVE BIOLOGY-ORIENTED IPAS LEARNING THROUGH DIFFERENTIATION, ASSESSMENT, COLLABORATION, AND SUPPORT: A QUALITATIVE STUDY

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Abstract: *Inclusive education in elementary schools requires more than admitting students with special needs into regular classrooms; it must be supported by adaptive learning, fair assessment, collaboration, and sustainable services. In biology-oriented IPAS learning, these needs are crucial because science learning involves observation, simple practical activities, concrete media, communication, and active participation. This study aimed to analyze the need to strengthen inclusive education in biology-oriented IPAS learning, focusing on differentiation, teacher–special assistant teacher–parent collaboration, inclusive assessment, and learning support. A descriptive qualitative approach was used through observation, semi-structured interviews, and documentation at UPT SPF SDN Mongisidi 1 Makassar. The main informant was a teacher/special assistant teacher involved in supporting students with special needs. Data were analyzed through reduction, thematic coding, presentation, and conclusion drawing, with trustworthiness strengthened through technique and source triangulation. The findings show that the school has implemented inclusive practices through regular classroom placement, special assistant teacher support, an inclusion room, modified indicators, simple IPAS activities, differentiated assessment, parent communication, and general learning technologies. However, further strengthening is needed in adaptive IPAS modules, individual rubrics, behavior-management procedures, accessibility, assistive technology, psychologist collaboration, and sustainable financing for special assistant teachers.*

Keywords : *Inclusive education, Biology-oriented IPAS, Differentiated learning, Inclusive assessment, Learning support.*

Abstrak: Pendidikan inklusif di sekolah dasar tidak cukup hanya menerima peserta didik berkebutuhan khusus ke dalam kelas reguler, tetapi harus didukung oleh pembelajaran adaptif, asesmen yang adil, kolaborasi, dan layanan berkelanjutan. Dalam pembelajaran IPAS berorientasi biologi, kebutuhan tersebut menjadi penting karena pembelajaran sains melibatkan observasi, kegiatan praktik sederhana, media konkret, komunikasi, dan partisipasi aktif. Penelitian ini bertujuan untuk menganalisis kebutuhan penguatan pendidikan inklusif dalam pembelajaran IPAS berorientasi biologi, dengan fokus pada diferensiasi, kolaborasi guru-guru pendamping khusus-orang tua, asesmen inklusif, dan dukungan belajar. Penelitian ini menggunakan pendekatan kualitatif deskriptif melalui observasi, wawancara semi-terstruktur, dan dokumentasi di UPT SPF SDN Mongisidi 1 Makassar. Informan utama adalah guru/guru pendamping khusus yang terlibat dalam pendampingan peserta didik berkebutuhan khusus. Data dianalisis melalui reduksi data, pengodean tematik, penyajian data, dan Strengthening Inclusive Biology-Oriented....

(Wahyuni, Ernawati, Atira, Palennari, & Muis, 2026)

penarikan kesimpulan, dengan keabsahan data diperkuat melalui triangulasi teknik dan sumber. Temuan menunjukkan bahwa sekolah telah menerapkan praktik inklusif melalui penempatan peserta didik berkebutuhan khusus di kelas reguler, dukungan guru pendamping khusus, ruang inklusi, modifikasi indikator, kegiatan IPAS sederhana, asesmen berdiferensiasi, komunikasi dengan orang tua, dan penggunaan teknologi pembelajaran umum. Namun, masih diperlukan penguatan pada modul IPAS adaptif, rubrik individual, prosedur pengelolaan perilaku, aksesibilitas, teknologi asistif, kolaborasi dengan psikolog, dan pembiayaan berkelanjutan bagi guru pendamping khusus..

Kata kunci : *Pendidikan inklusif, IPAS Berorientasi biologi, Pembelajaran berdiferensiasi, Asesmen inklusif, Dukungan belajar*

INTRODUCTION

Inclusive education is an educational approach that positions student diversity as the basis for designing learning that is fair, participatory, and responsive. In the context of elementary schools, inclusion does not only mean providing access for students with special needs to learn in regular classrooms, but also ensuring that they receive academic, social, emotional, and learning-environment support that is appropriate to their needs. Therefore, the success of inclusive education should be viewed from the quality of participation, instructional adjustment, assessment, collaboration, and institutional support, not merely from the presence of students with special needs in schools. A national study on inclusive elementary schools shows that the implementation of inclusive education often still faces obstacles such as limited availability of special assistant teachers, the absence of specific funding, inadequate facilities, and teachers' limited understanding of the characteristics and needs of students with special needs (Jannah & Hermanto, 2022).

Based on observations and interviews at UPT SPF SDN Mongisidi 1 Makassar, the school has demonstrated inclusive education practices through the presence of special assistant teachers, an inclusion room, modification of indicators, involvement of students with special needs in group activities, differentiated assessment, communication with parents, and the use of learning technology. The observation report shows that the implementation of inclusion in this school was analyzed through access, participation, instructional adjustment, assessment, classroom climate, supporting factors, obstacles, and recommendations for strengthening inclusive practices. However, field data also indicate the need for further strengthening, particularly regarding mood changes, tantrums, limited psychological services, accessibility, adaptive learning media, assistive technology, and financing for special assistant teachers.

Therefore, this study is important for analyzing the need to strengthen the implementation of inclusive education in biology-oriented IPAS learning in elementary schools. The study focuses on three research questions: how differentiated biology-oriented IPAS learning is implemented in inclusive classrooms; how collaboration among teachers, special assistant teachers, and parents supports the implementation of inclusion; and what forms of support are still needed to strengthen inclusive learning services in elementary schools.

LITERATURE REVIEW

Biology-oriented IPAS learning has distinctive characteristics because it requires students to understand life phenomena through observation, simple practical activities, the use of concrete media, discussion, and

communication of learning outcomes. In inclusive classrooms, these characteristics require teachers to adjust the way materials are presented, the forms of learning activities, the complexity level of tasks, and learning achievement indicators. Studies on inclusive science learning show that science teachers need to provide concrete, multimodal, and participatory learning experiences so that students with diverse needs can meaningfully access science concepts (Mbowe & Iddy, 2026; Teo, 2021; Teo & Pua, 2021). In science education, the need for differentiation has also become increasingly important because science learning models that consider students' readiness levels have become part of current discourse in science education, as reflected in studies on differentiated science inquiry and Teaching at the Right Level published.

One of the main approaches in inclusive education is differentiated learning. Differentiation enables teachers to adjust content, process, product, support, learning pace, and learning environment according to students' readiness and needs. Langelaan et al. (2024) emphasize that differentiated instruction requires teacher readiness, an understanding of student diversity, pedagogical reflection, and continuous professional development. Similar findings were reported by (Hidayat et al., 2024), who found that differentiation can expand learning access and increase participation when designed creatively and contextually. However, differentiation may also increase teachers' workload if it is not supported by collaboration, school leadership, and adequate resources (Agustina et al., 2026; Pozas et al., 2023).

In inclusive education, collaboration is an essential element. Collaboration among classroom teachers, special assistant teachers, school principals, parents, and external parties can help ensure that learning services do not depend on a single actor. Strogilos et al. (2023), show that co-teaching between general teachers and special education teachers can strengthen learning for students with and without disabilities. Schnepel et al. (2025) also emphasize that teachers' attitudes toward inclusion and the quality of collaboration are related to inclusive teaching practices. Other studies indicate that teacher collaboration for instructional improvement needs to be supported by role division, clear tasks, a professional culture, and reflective learning communities (Gotsch et al., 2026; Huijboom et al., 2023; Odabaşı Çimer et al., 2025; Weddle, 2022). In the national context, Taqiyah et al. (2025), show that identification and assessment services for students with special needs in inclusive schools require multidisciplinary collaboration involving teachers, orthopedagogues, psychologists, medical personnel, school principals, and parents.

In addition to differentiation and collaboration, inclusive assessment is an important component of fair learning. Assessment in inclusive classrooms cannot be implemented based on rigid uniformity; rather, it must consider students' actual abilities, individual achievement indicators, response formats, levels of difficulty, and required support. Explain that inclusive classroom assessment requires accommodation and adaptation so that assessment does not become a new source of exclusion. In digital environments, inclusive assessment also requires teachers' assessment literacy, digital competence, and the ability to design adaptive tasks (Ofem et al., 2024). In the Indonesian context, Syamsi & Dharma (2023) developed identification and academic assessment models for students with specific learning difficulties in inclusive elementary schools using observation, tests,

interviews, and surveys. These findings support the importance of initial assessment in determining students' learning needs more accurately.

Technology also has the potential to support inclusive education when used appropriately. Studies on assistive technology, iPads, augmented reality, extended reality, and learning analytics show that technology can improve access, participation, and learning support for students with diverse needs (Chen et al., 2022; Frisch et al., 2025; Kale et al., 2026; Mooij, 2007; Opoku et al., 2023; Somabut et al., 2025). However, technology is not automatically inclusive. It must be aligned with students' needs, teachers' readiness, school infrastructure, and ethical principles of use. In biology-oriented IPAS learning, technology should function not only as presentation media but also as adaptive media that help students understand concepts through images, videos, simple simulations, sound, text, or communication aids.

Other studies also emphasize that inclusive education is closely related to leadership, school culture, and the ways teachers perceive students. Frick & Pazey (2024) position special education leadership as a moral responsibility to promote service equity. Benedict-Chambers et al. (2025), highlight the importance of anti-deficit framing, namely a perspective that does not view students based on their limitations but rather based on their potential and the support they need. Weyers et al. (2023), add that teachers need teacher noticing, namely the ability to recognize learning needs and respond to them professionally. In the family context, Buren (2025) shows that parents play an important role in advocacy, communication, and the continuity of support for children with disabilities. Mumpuniarti et al. (2020), emphasize that regular teachers in inclusive schools need stronger pedagogical competence and continuous training to address the challenges of teaching slow learners.

RESEARCH METHODOLOGY

This study employed a descriptive qualitative approach with a case study design. This approach was selected because the study aimed to understand the implementation of inclusive education in the real context of an elementary school, rather than to test the effectiveness of an intervention or the statistical relationships among variables. The case study design was used because the study focused on one school that had implemented inclusive services and had practices involving special assistant teacher support, an inclusion room, and collaboration with parents.

The study was conducted at UPT SPF SDN Mongisidi 1 Makassar, an elementary school that provides inclusive education and admits students with diverse learning needs. The site was selected because it had already implemented inclusive practices, including the presence of special assistant teachers, an inclusion room, instructional adjustment, and collaboration between the school and parents. In the observation report, the subjects included classroom teachers or subject teachers, special assistant teachers, school leaders, and students in relation to their involvement in learning, while the objects of observation included inclusive learning practices, adjustment of materials and media, assessment, classroom interaction, technology use, and parent collaboration.

The main informant was a teacher/special assistant teacher who had direct experience in supporting students with special needs. The data were also strengthened through observations of learning practices, classroom

interactions, supporting facilities, and observation report documentation.

Data were collected through three techniques. First, observation was conducted to obtain an overview of inclusive learning practices, the involvement of students with special needs, the use of media, and classroom support. Second, semi-structured interviews were conducted to explore the teacher/special assistant teacher's experiences in designing learning, adjusting indicators, managing behavioral challenges, conducting assessment, and building collaboration with parents. Third, documentation was used to strengthen the data through observation reports, synchronized interview findings, and records related to inclusive service practices.

Data analysis was conducted in four stages. First, all data from observations, interviews, and documentation were read thoroughly. Second, data were reduced by selecting information relevant to the research focus. Third, data were coded and grouped into major themes, namely differentiation in IPAS learning, inclusive assessment, the role of special assistant teachers, the inclusion room, parent collaboration, learning technology, behavioral challenges, institutional support, and the need to strengthen services. Fourth, data were interpreted by comparing field findings with the literature review. Data trustworthiness was strengthened through technique and source triangulation..

RESULTS AND DISCUSSION

Differentiation in Biology-Oriented IPAS Learning

The results showed that the implementation of inclusive education in biology-oriented IPAS learning was carried out through adjustments to indicators, material difficulty levels, activity formats, and learning assistance. Teachers continued to use the same learning topics as those taught to regular students, but the achievement targets and indicators were adjusted to the abilities of students with special needs. In the context of learning about growth, development, and puberty, teachers used concrete examples such as voice changes, height, and body weight to make biological concepts easier to understand. This finding was strengthened by the following statement from the informant:

“It must be adjusted, because at the beginning we conduct identification and assessment. There are two types of identification: behavioral identification or behavioral assessment, and academic identification and assessment. From there, we see the extent of the child's ability, whether the child is only able to understand, whether the child is already able to apply, or whether the child is already able to practice. This is seen from the assessment results. The assessment results become our reference in providing learning materials to the child. However, the material remains within the same subtopic, and the basic competency understanding remains the same; only the indicators are changed. So, it is included in a differentiated curriculum.”

The quotation shows that learning differentiation was conducted based on initial assessment, both behavioral and academic. Teachers did not separate students with special needs from the general curriculum but adjusted achievement indicators based on students' actual abilities. Thus, differentiation in biology-oriented IPAS learning was not interpreted as reducing the meaning of the material, but rather as adjusting learning pathways so that core concepts remained accessible to students with diverse needs.

Strengthening Inclusive Biology-Oriented....

(Wahyuni, Ernawati, Atira, Palennari, & Muis, 2026)

In IPAS learning practice, students with special needs were also given opportunities to participate in practical activities. However, these practical activities were simplified according to the students' ability levels. The informant explained:

“Besides being in the classroom, they will still carry out practical activities like other children in general. However, the activities may be simple practical activities, but that is already something extraordinary for them when viewed from their level. In addition to being in the classroom, they also receive additional lessons in the inclusion room. In the inclusion room, special assistant teachers usually provide therapy.”

This quotation indicates that students with special needs were not only physically present in regular classrooms but also had access to science learning experiences. In biology-oriented IPAS learning, simple practical activities are important because they allow students to learn through concrete, visual, and direct experiences. Academically, this practice can be understood as a form of differentiation in content, process, and learning support. This finding is consistent with Langelaan et al. (2024), who emphasize that differentiation requires instructional adjustment based on students' needs. In the national context, this direction is also aligned with studies in *Jurnal Pendidikan IPA Indonesia*, which position differentiated science inquiry as one strategy for strengthening scientific processes and thinking skills in science learning.

Inclusive Assessment and Development Reports

The results showed that the school had implemented the principle of differentiated assessment. Assessment for students with special needs was not rigidly equated with that of regular students, but was adjusted according to indicators, levels of difficulty, types of questions, and the child's actual ability. The informant stated:

“It is certainly different, even though our minimum mastery criterion is equally 80. The score of 80 obtained by a child with special needs is different from the score of 80 obtained by a regular child. As I mentioned earlier, the indicators are different from the beginning, even though the minimum mastery criterion is equally 80. We always explain this because sometimes parents of regular students ask why their child's score is higher than that of a child with special needs. This always happens. So, we always socialize to parents that the score obtained by a child with special needs, whether it is 90 or 95, has a different level. The types of questions are different, the levels of the questions are different, and the way they carry out learning activities is also different.”

This quotation shows that the school understands the principle of assessment fairness in inclusive education. Fairness is not interpreted as giving the same questions and indicators to all students, but as providing every student with the opportunity to demonstrate achievement based on their actual ability. Therefore, the scores of students with special needs cannot be directly compared with those of regular students because both are based on different indicators and achievement demands.

This assessment practice is also strengthened through development reports. Development reports contain the achievements that students have mastered, achievements not yet mastered, and follow-up suggestions for parents. Thus, assessment functions not only as a means of assigning scores but also as a tool for mapping individual development, determining further support, and strengthening communication between the school and families. This finding is consistent with Ofem et al. (2024), who emphasize the importance of accommodation,

adaptation, and teacher assessment literacy in inclusive classrooms. Syamsi & Dharma (2023) also show that academic identification and assessment for students with specific learning difficulties in inclusive elementary schools need to be conducted through various techniques, including observation, tests, interviews, and surveys.

Nevertheless, the findings also indicate that the assessment system still needs to be strengthened through individual achievement rubrics, development portfolios, simple science process skills observation sheets, and authentic assessment instruments based on IPAS activities. With these instruments, teachers can assess students' learning processes, participation, independence, use of media, simple practical skills, and socio-academic development more systematically.

The Role of Special Assistant Teachers as a Link between Individual Support and Regular Learning

Special assistant teachers play a key role in the implementation of inclusive education at the school. The interview results showed that special assistant teachers did not only physically accompany students with special needs but also paid attention to the materials taught by classroom teachers, modified materials, documented children's development, and bridged communication with parents. The informant stated:

“The collaboration is like this: the classroom teacher works together with the special assistant teacher. The special assistant teacher asks and pays attention to what learning material is being taught at the moment. Then, the special assistant teacher modifies the learning material according to the student's needs. As for communication with parents, it is usually the special assistant teacher and the homeroom teacher who convey the information. The special assistant teacher and the homeroom teacher must be synchronized.”

This quotation indicates that special assistant teachers function as pedagogical partners for classroom teachers. They help connect regular learning with the individual needs of students with special needs. In biology-oriented IPAS learning, this role is important because science materials often require adjustments in media, language, practical activities, and achievement indicators.

The role of special assistant teachers is also evident in the preparation and communication of development reports. The informant explained that students with special needs have two types of reports: a general report and a development report. The development report contains the child's achievements during one semester, aspects not yet achieved, and follow-up suggestions for parents. During report distribution, the homeroom teacher, special assistant teacher, and parents sit together to discuss the child's development. In addition, special assistant teachers also conduct daily documentation related to the child's achievements and behavior so that communication with parents is more objective and evidence-based. This practice supports the findings of Taqiyah et al. (2025), who state that services for students with special needs require multidisciplinary collaboration from preparation, implementation, reporting, and follow-up stages.

This finding indicates that inclusive education requires a sustainable support system. Special assistant teachers should not be positioned merely as physical companions but as part of a pedagogical team that helps teachers design learning support. This is in line with Strogilos et al. (2023), (Gotsch et al., 2026; Schnepel et al.,

2025; Weddle, 2022), who emphasize that collaboration between general teachers and special teachers is an important factor in the success of inclusive practices.

Collaboration among Teachers, Special Assistant Teachers, and Parents

Collaboration among teachers, special assistant teachers, and parents emerged as one of the strongest findings in this study. The data showed that special assistant teachers and homeroom teachers jointly communicated children's development to parents. This collaborative pattern was not only carried out at the end of the semester but also through daily communication and documentation. The informant explained:

"It is not only done once in a semester. Every day, the special assistant teacher conveys information and documents what achievements the child has made and what negative or inappropriate behaviors the child has shown. This is so that parents do not only assume that their child is capable. Usually, at home, parents say, 'My child can do it, my child is capable, Ma'am, so why is it like this at school?' That is why we always provide documentation so that parents trust us."

This quotation shows that documenting children's development is an important tool for building communication and trust between the school and parents. In inclusive education contexts, differences may occur between how children's abilities are perceived at home and at school. Therefore, daily documentation helps the school communicate children's development more objectively.

From the perspective of inclusive education, teacher–special assistant teacher–parent collaboration represents a form of family-school partnership. Buren (2025) emphasizes that families play an important role in advocacy and the continuity of educational support for children with disabilities. Jannah & Hermanto (2022) also show that implementing inclusive education in elementary schools requires teachers' understanding, facility support, and adequate funding policies so that services do not stop at student admission. Therefore, schools need to strengthen this collaboration through more systematic communication formats, such as daily communication books, behavior monitoring sheets, periodic meetings, and individual follow-up plans.

Inclusion Room, Learning Technology, and the Need for Adaptive Media

The school has an inclusion room used for learning reinforcement, remedial activities, simple therapy, and support when students require special assistance. The inclusion room functions as a transitional support space that helps students receive individual assistance without being fully separated from regular classrooms. Based on the interview data, the inclusion room is also used to help students who are behind in learning materials or who require additional therapy with special assistant teachers.

In addition, the school has used learning technologies such as LCD projectors, educational games, smartphones, Google Meet, and digital quizzes. The use of technology indicates that the school has begun to utilize digital media to make learning more engaging and interactive. However, the technology used is more appropriately categorized as general learning technology and has not yet fully functioned as assistive technology specifically designed for students who are deaf, autistic, have ADHD, speech delay, or intellectual disabilities.

This finding indicates the need to develop adaptive IPAS media, such as simple visual videos, interactive picture cards, simple simulations, manipulative media, illustrated worksheets, communication boards, adaptive

audiovisual materials, and learning applications aligned with students' characteristics. Studies on iPads, assistive technology, augmented reality, extended reality, and learning analytics show that technology can improve participation when used adaptively and accompanied by teacher readiness (Chen et al., 2022; Frisch et al., 2025; Kale et al., 2026; Lee et al., 2025; Opoku et al., 2023; Somabut et al., 2025). In science learning contexts, the use of media and concrete activities is also aligned with the development of science education that emphasizes process skills, scientific literacy, and learning access appropriate to students' needs.

Behavioral Challenges, Mood, Tantrums, and the Need for Standard Operating Procedures

One of the main challenges in implementing inclusive education is the fluctuating mood and behavior of students with special needs. Students' emotional conditions may change and affect classroom dynamics. The informant explained that when a student experiences a tantrum, other students may feel disturbed. To address this, the school brings the student to the inclusion room until the student calms down and then returns the student to the classroom. The informant stated:

"The impact occurs when, as we know, children can suddenly have tantrums. When a tantrum happens in the classroom, regular children sometimes feel restless. They feel uncomfortable and say, 'Ma'am, he is very noisy, can he be quiet?' That is where we, as teachers, need to find ways to keep the classroom safe and ensure that there is no discrimination against their friends. Usually, children who have tantrums are taken to the inclusion room. When they feel calm, we return them to the classroom."

In addition, if students still greatly require assistance from a special assistant teacher, the special assistant teacher is directly involved in handling the situation. The informant added:

"If a child with special needs really still needs a special assistant teacher, then we will call the special assistant teacher when the child has a tantrum in the classroom. The special assistant teacher will take the child to the inclusion room, while the other students continue learning with the classroom teacher."

These quotations indicate that the school already has a practical mechanism for balancing the needs of students with special needs and the rights of other students to learn in a conducive environment. However, from the perspective of service strengthening, this strategy needs to be formalized into standard operating procedures for behavior management. Such procedures may include identifying tantrum triggers, de-escalation strategies, role division between teachers and special assistant teachers, incident documentation, communication with parents, and follow-up plans.

This finding is consistent with Mumpuniarti et al. (2020), who show that regular teachers in inclusive schools still face challenges in mastering instructional competence for slow learners and require continuous training. Without standard operating procedures and continuous training, behavior management may become overly dependent on the personal experience of teachers or special assistant teachers. Therefore, support from psychologists, resource centers, special schools, higher education institutions, or inclusive service centers is an important need.

Financing of Special Assistant Teachers and Service Equity

Another important finding concerns the financing of special assistant teachers. The interview data showed that the salaries of special assistant teachers are still paid by parents because they are not included in the school operational assistance funding scheme. Although the school attempts to set fees by considering parents' economic conditions to avoid social jealousy, this pattern still indicates that the sustainability of special assistant teacher services depends on families' financial capacity.

This finding needs to be emphasized as an important issue because it is related to the principle of equity in inclusive education. If support from special assistant teachers depends on parents' financial contributions, access to inclusive services may become unequal. Therefore, policy recommendations should be directed toward strengthening financing schemes for special assistant teachers, support from local governments, integration of assistant teacher services into school policy, and collaboration with external institutions.

In this context, inclusive education cannot be understood merely as the responsibility of teachers but must be viewed as a system-level responsibility. (Alkhunini & Alsawalem, 2025; Chinhara & Kuyayama, 2024; Wang et al., 2026), emphasize that educational equity requires structural support, resources, policies, and adequate financing. Jannah & Hermanto (2022) also show that the absence of specific funding and limited facilities are real barriers to implementing inclusive education in elementary schools.

Table 1. Summary of Findings, Interview Evidence, Interpretation, and Strengthening Needs

Theme	Interview Evidence	Interpretation	Strengthening Needs
Learning differentiation	The material remains within the same subtopic, but indicators are modified based on assessment results	Differentiation of content, process, and achievement indicators has been implemented	Adaptive modules
Simple IPAS practical activities	Students with special needs still participate in practical activities, but in a simplified form	Access to science learning experiences is still provided	Concrete media and gradual practical activities
Inclusive assessment	The minimum mastery criterion is the same, but indicators, question types, and question difficulty levels differ	Assessment fairness is understood as adjustment of achievement expectations	Individual rubrics and portfolios
Role of special assistant teachers	Special assistant teachers modify materials according to students' needs	Special assistant teachers act as pedagogical partners for classroom teachers	SOP for teacher-special assistant teacher collaboration
Parent collaboration	Special assistant teachers document children's daily achievements and communicate them to parents	Evidence-based family-school partnership occurs	Communication books and follow-up plans
Inclusion room	Students requiring additional support are taken to the inclusion room	The inclusion room functions as a transitional support system	Strengthening facilities and professional services
Behavioral challenges	Tantrums are handled by bringing the child to the inclusion room until calm	Behavior management still needs to be standardized	De-escalation SOP and psychological support
Financing of special assistant teachers	Salaries of special assistant teachers are still paid by parents	There are issues of service sustainability and equity	More sustainable financing schemes

CONCLUSION AND SUGGESTIONS

Conclusion

This study shows that the implementation of inclusive education in biology-oriented IPAS learning at UPT SPF SDN Mongisidi 1 Makassar has been carried out through several concrete practices, namely support from special assistant teachers, the use of an inclusion room, modification of learning indicators, involvement of students with special needs in group activities, differentiated assessment, communication with parents, and the use of general learning technology. These practices indicate that the school has moved beyond merely admitting students with special needs toward providing more adaptive learning support. However, the needs analysis shows that implementation still requires strengthening in several key aspects, including the development of adaptive IPAS modules, individual assessment rubrics, standard operating procedures for teacher–special assistant teacher–parent collaboration, standard operating procedures for managing tantrums and mood changes, improved facility accessibility, development of assistive technology, formal collaboration with psychologists or resource centers, and more equitable and sustainable financing schemes for special assistant teachers. Thus, inclusive education in biology-oriented IPAS learning should be understood as a support ecosystem that integrates differentiated learning, inclusive assessment, multi-stakeholder collaboration, adaptive technology, and school policies responsive to student diversity. These findings provide practical contributions for inclusive elementary schools in designing IPAS learning services that are more equitable, participatory, and sustainable.

Suggestions

Future studies are suggested to involve more inclusive elementary schools with different institutional characteristics to obtain broader and more comparative findings. Further research may also include multiple informants, such as classroom teachers, special assistant teachers, school principals, parents, psychologists, and students, to provide a more comprehensive understanding of inclusive biology-oriented IPAS learning. In addition, future studies can develop and validate adaptive IPAS learning modules, individual assessment rubrics, and assistive media for students with diverse learning needs. Quantitative or mixed-methods studies are also recommended to examine the effectiveness of differentiated learning, inclusive assessment, collaboration models, and adaptive technology in improving students' participation and learning outcomes in inclusive IPAS classrooms.

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