

## How to learn science in an environmentally friendly inclusive school?



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**Abstract:** Knowledge of good practices of science learning in inclusive and environmentally friendly schools is currently not well presented. This study aims to find patterns of planning activities, learning activities, and assessment patterns of science learning in environmentally friendly and inclusive schools. The research method used is an explanatory case study using Spradley analysis where the research subjects were determined through purposive sampling and consisted of the principal, class teachers, and special assistant teachers at Giwangan State Elementary School, Yogyakarta. Data collection techniques used interviews, observations, and documentation studies with the instruments used being interview guides, observation sheets, and document study sheets. The conclusions of this study are: (1) Learning planning begins with transformational leadership and comprehensive policies and collaborative planning; (2) Collaborative learning activities that realize physical, social, and teaching integration and train science process skills; and (3) learning assessment is carried out collaboratively and fulfills students' rights. The implications of this study are in the form of affirmation of ecological theory and the concept of deep ecology.

**Keywords:** Science learning; environmentally friendly; inclusive schools

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## INTRODUCTION

The concept of Education for Sustainable Development is based on the human need to have competence in living and acting in a sustainable, tolerant and inclusive manner, which is part of social transformation (UNESCO, 2014). Based on this need, there is an integration between living in an environmentally friendly manner and acting inclusively. One way to instill this behavior is through green schools. Green schools are environmental education programs, environmental management systems, and award schemes that promote and recognize the long-term environmental activities of all school elements. As with the ESD concept, green schools are implemented in a tolerant and inclusive manner. Therefore, social transformation is needed in schools where inclusive education patterns have not yet been implemented.

This inclusive education pattern will guarantee lifelong learning opportunities for everyone, as stated in the fourth target of the SDGs (UNESCO, 2014). Education must be accessible to students with diverse backgrounds and abilities (Ranbir, 2024). Because education cannot be separated from the environment, the aspect of environmental conservation cannot be ignored. This aspect will lead to sustainable education. In other words, inclusive education and environmentally friendly education are concepts that can be integrated (Rončević & Rieckmann, 2025). Based on the concept of

Education for Sustainable Development (ESD), schools at various levels should implement environmentally friendly and inclusive education in an integrated manner (Kioupi & Voulvoulis, 2019).

Schools that adhere to the concept of sustainability are called inclusive-Adiwiyata schools in Indonesia. All schools are supposed to implement this concept. However, according to data from the Indonesian Ministry of Environment in 2018, there was a decline in the number of national Adiwiyata schools. The Ministry of Environment and Forestry, through its minister, stated that in 2021, 4,726 schools had achieved national and independent Adiwiyata school designation since 2006—less than two percent of the total of more than 280,000 schools as listed in the Indonesian Ministry of Education and Culture's basic education data.

Integrating inclusive and environmentally friendly education requires not only schools that have the Adiwiyata designation, but also inclusiveness in their educational processes. Based on data from the Ministry of Education and Culture, the number of students with needs in Inclusive Education Provider Schools (IEPS) at the elementary level is 17,134, while the number of elementary schools in Indonesia is 148,743. The number of students with special needs at the elementary level is 82,326 students, while the total number of children with special needs aged 5–14 years is 42.8 million. Based on these estimates, there will certainly be students with special needs who have not received a proper education, and not all elementary schools have become IEPS.

Data shows that the number of adiwiyata schools implementing inclusive learning is still very small. This gap may stem from schools that do not yet have an inclusive nature or do not meet the criteria for Adiwiyata schools, or even both. Several studies have identified several obstacles to realizing integrated inclusive-Adiwiyata education. These obstacles include: (1) the facilities and human resources available at Indonesian schools to become inclusive schools are very limited, including a lack of paraprofessionals (Wibowo & Muin, 2018; Muazza, 2018; Riyanti & Maryani, 2019; Purwaningsih, 2020; Sari & Hendriani, 2021); (2) lack of cooperation with the community and lack of support from the local government (Alfaaroqi & Khoiruddin, 2020); (3) community resistance to sending their non-specialized children to school with special needs children (Alfaaroqi & Khoiruddin, 2020); and (4) lack of knowledge about environmental education and weak supervision from school principals (Tikho & Gunansyah, 2021). In their study, Sari and Hendriani (2021) found that: (1) some students reject their friends with special needs, which hinders learning activities; (2) teachers' lack of understanding of students with special needs; (3) lack of learning adaptation; and (4) lack of parental involvement in the education of students with special needs.

These obstacles were overcome by one of the public schools in Yogyakarta, namely Giwangan Elementary School. Giwangan Elementary School is able to implement inclusive learning while cultivating environmentally friendly behavior as an independent Adiwiyata school. This combination produces a form of learning activities that are different from schools that do not hold the predicate of both simultaneously. Learning activities at Giwangan Elementary School as an inclusive-Adiwiyata school are implemented through thematic learning, as research by Ikhsan et al., (2019). This is in line with the findings of Prabawani et al., (2017) that the complex challenges of sustainability make the curriculum delivered to students tend to transcend boundaries and within thematic scope, making thematic learning very appropriate for learning environmentally friendly concepts.

Not all subjects contain eco-friendly messages and environmental topics. One subject closely related to the environment is science, both in its content and scientific methods (Kang & Teig, 2025). Science provides a learning program that can be used to teach concepts of inclusion and sustainability.

Giwangan Elementary School has unique characteristics that can serve as a model for other schools, as it holds the designation of an inclusive school and an Adiwiyata school. A development study conducted in 2019 resulted in learning tools that increase the engagement of slow-learning students. Reviewing data on the number of Adiwiyata schools in Indonesia and the adequacy of inclusive schools to accommodate children with special needs, along with the obstacles that create a gap between ideals and reality, a model is needed that can serve as a reference for realizing an integrated inclusive-Adiwiyata school. Therefore, it is necessary to uncover the background behind Giwangan Elementary School's achievements as an inclusive-Adiwiyata school. Based on this need, this case study was conducted. The case selected in this study is science learning given in inclusive classes at Giwangan Elementary School as an inclusive and Adiwiyata school.

Based on the background that has been described, the objectives of this study can be stated, namely (1) to find the pattern of science learning planning activities at Giwangan Elementary School as an inclusive school and an Adiwiyata school, (2) to find the pattern of science learning activities at Giwangan Elementary School as an inclusive school and an Adiwiyata school, and (3) to find the pattern of assessment in science learning at Giwangan Elementary School as an inclusive school and an Adiwiyata school.

## METHODS

The research method used is a case study with research procedures as shown in the Figure 1.



Figure 1. Research procedure (Spradley, 1980)

The location of this research was at the Giwangan adiwiyata-Inclusive elementary School and lasted for one year in 2021. The research subjects were determined through purposive sampling and consisted of school principals, class teachers, parents, and paraprofessional. The selection of research subjects was based on Bronfenbrenner's ecological theory which shows that these professions play an important role in the ecology of inclusive schools.

Data sources in this study consist of primary sources, teachers, principal, special assistant teachers, and documents in the form of learning material, recordings of learning activities in the form of videos and photos. In addition, secondary sources are also used, namely the results of prior research. The data collection techniques used in this study were through observations, interviews, and document studies. The validity of the data collected in this study was carried out through triangulation, checking against data sources (Membercheck) and questions and answers between colleagues (Peer debriefings). The instruments used to collect data consisted of observation sheets, interview guides, and documentation study checklists.

Data analysis techniques used domain analysis, taxonomic analysis, componential analysis, and cultural theme analysis as proposed by Spradley. Spradley's data analysis method is primarily for ethnographic research; however, it can be used for mini-ethnographic case studies. This analysis method was chosen because the study will identify long-standing patterns or culturally ingrained behaviors (Fusch et al., 2017).

## RESULTS AND DISCUSSION

### Science Learning Planning

Initially, the learning process separated regular students from special needs students. After the new principal took office, the learning process integrated regular students with special needs students. This change process was not easy due to resistance from senior teachers who wanted to maintain separate learning for regular students and those with special needs. Despite this, the policy remained in place because the principal adhered to the regulations.

*I have a legal basis, so I will continue (implementing inclusive policies) (principal)*

The inclusivity process begins with education provided by the principal to school staff, especially students. This education is designed to foster positive attitudes among regular students toward children with special needs.

The principal stated,

*Giwangan Elementary School is not great because of its test scores, but because of the attitude it instills.*

This combination of rooms for regular and special needs students was proposed by Dewey (1920); Santrock & Roehrig (2024); and Friend & Bursuck (2019). Special needs students will develop well if they interact with non-special needs students and in a heterogeneous environment. To achieve this change, schools require transformational leaders who have the ability to communicate new ideas. This finding confirms that of (Sholikhah & Purwanta, 2020), who explained that the principal of Giwangan Elementary School is a transformational principal.

The core activity of learning planning is curriculum development, which also involves parents. Interviews indicate that parents provide information about their children to teachers.

*I communicate with parents when creating lesson plans. This is because children with special needs also require greater attention. I communicate everything with the parents. In addition to parents, I also discuss with paraprofessionals beforehand to provide appropriate materials for "U." I monitor this by checking in with parents, for example, asking how their child is progressing and asking about outstanding assignments. (4<sup>th</sup> grade teacher)*

This finding supports the conclusion of Mirna & Chamidah (2025), who stated the importance of collaboration between teachers and parents in inclusive education in schools. The paraprofessional's role is to discuss with class teachers, modify teaching materials, and record the development of children with special needs.



**Figure 2.** Participants in the curriculum development workshop consisted of school principals, teachers, paraprofessionals, parents, school supervisors, and experts from educational staff training institutions.

(Berns, 2015) explain that teachers are leaders in their classes and function as managers who plan, manage, implement, and assess learning. Tyagi (2016) and Berns (2015) also suggest that teachers are tasked with adapting the curriculum so that children with special needs can learn according to their abilities. The result of the paraprofessionals' work is an Individual Learning Program that explains the characteristics of ABK students based on assessments, as stated by Kumari & Kataria (2022)

### Learning Media

Based on observations, the learning media used include natural and manipulative media (Dewanti, Rahmawati & Sumardi, 2025; Yuliza, Haryono & Bendiryanti, 2025). Manipulative media are created by teachers, while natural media are provided by nature. Examples of natural media can come from the school's surroundings, especially green open spaces. The plants used can be whole plants or dried leaves. Green open spaces can also serve as recreational areas for students with special needs who are tired of studying. Figure 3 (a) shows third-grade students, consisting of regular students and a slow learner, in one group doing an activity together using natural

learning media. This is supported by Kumari & Kataria (2022), who argue that students with special needs should be brought into natural environments.



Figure 3. Green open spaces and plants as natural learning media

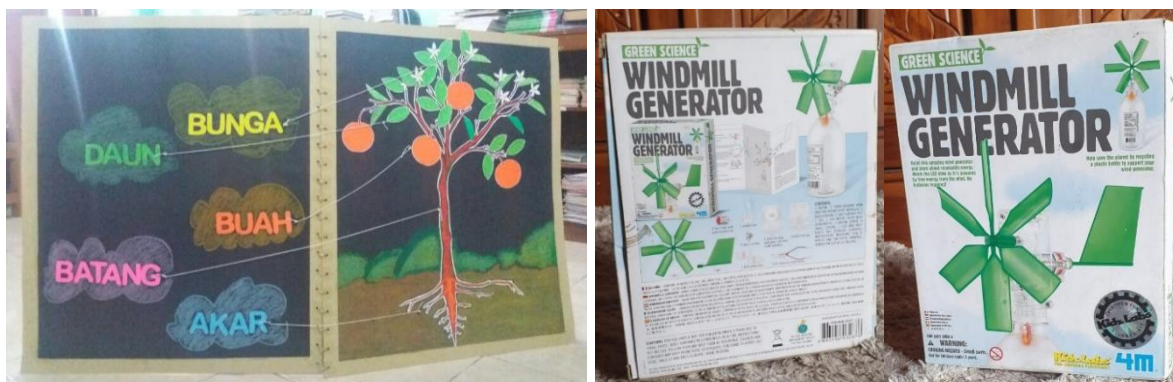


Figure 4. Manipulative learning media in the form of a big book and a windmill model

In addition to green open spaces and plants, Giwangan Elementary School also uses artificial media, such as big books and windmill models. Big books have been shown to increase learning interest in slow-learning students (Nugroho & Prasetyo, 2019). Sedangkan model koncir angin digunakan untuk mengajarkan perubahan energi untuk anak dengan hearing empairing (Figure 5).



Figure 5. A child with hearing impairment learns using a windmill model.

### The Role of the Principal and Teachers

The principal regularly assists teachers during teaching, even when planning learning. This finding strengthens the findings of Badrudin, Ummah & Ropik (2024) who stated that the principal's focus is on developing teacher professionalism, effective communication, and implementation of innovation in the learning process.



**Figure 6.** The principal guides class teachers in preparing lesson plans



**Figure 7.** The principal provides reinforcement and motivation to students and teachers regarding the attitude of living together in differences.

The principal, based on findings at Giwangan Elementary School, consistently acts as a discussion partner for teachers, for example, providing guidance when teachers develop lesson plans (Figure 6). Furthermore, as mentioned in the previous section, Giwangan Elementary School has experienced significant policy changes, making the school's role as a transformational leader highly strategic. The principal demonstrates this role by assertively educating school elements targeted by the policy changes. For example, the principal regularly delivers messages at each morning assembly about the importance of embracing diversity. These messages of inclusivity are repeated not only to maintain awareness but also because new students arrive each year. This education is necessary as a follow-up to the policy of integrating regular and special needs students. This role is strengthened by Syuhada et al., (2025) who stated that a

transformational leader must be able to create a climate of acceptance of differences and collaboration. The same thing was stated by Kefallinou et al., (2020) also Lalak Muslimin & Muqowim (2021) who believes that leaders must be able to provide a conducive climate for change.

Teachers play a role in fostering harmonious interactions between students, as demonstrated by democratic teachers (Berns, 2022). In addition, teachers also play a role in fostering a climate of cooperation with students' parents, as stated by a teacher,

*I communicate with parents when creating lesson plans. This is because students with special needs also require more attention. I communicate everything with parents. In addition to parents, I also discuss with paraprofessionals beforehand to provide appropriate materials for students. I monitor this by checking in with parents, for example, asking how their progress is and inquiring about outstanding assignments.*

Observations also revealed the teachers' attitudes, which were characterized by patience and perseverance. This will undoubtedly impact the success of learning in inclusive schools (Ewing et al., 2018; Moberg et al., 2020; Saloviita, 2020; Unianu, 2012).

### The Role of the paraprofessional

The presence of the paraprofessional is significant (Lequia, 2018). The paraprofessional sometimes needs to adapt learning materials during lessons. The role is the need for individualized teaching methods to meet the needs of children with special needs (Berns, 2015). This is done when the material presented is difficult for the children being assisted with special needs to grasp. For example, paraprofessionals will assist classroom teachers in planning lessons, as one classroom teacher explained,

*The revision of the lesson plan was carried out by Mrs. Ayu. If there was material that was difficult to follow, it was revised by Mrs. Ayu and the lesson plan was returned to me.*



**Figure 8.** A paraprofessional accompanies a student with special needs.

During the classroom learning process, if the material presented is difficult for the child with special needs to understand, for example, the paraprofessional paraphrases the sentence delivered by the class teacher. During learning outside the classroom, the accompanying teacher supervises and guides students in activities, such as feeding fish

and watering plants. Paraprofessionals also play a role in providing meaning to the material learned by students with special needs. The role of paraprofessionals is very important to demonstrate the effectiveness of inclusive learning (Syrinithnia & Whitworth, 2014; Biggs et al., 2019; Massafra et al., 2020).

### The Role of Parents

Interview results indicate that parents play a significant and crucial role. Parents must be willing to cooperate and maintain good communication with the class teacher and paraprofessionals (Paseka & Schwab, 2020). An example of cooperation between parents and schools is helping children prepare tools and materials for science experiments and communicating with teachers, as found by Adam (2013). Observation results also showed good cooperation between parents and paraprofessionals so that students with special needs received good learning services. This confirms the findings of Bariroh (2018) which states that the role of parents has a great influence on the quality of learning in inclusive schools.



Figure 9. Parents always prepare the learning process for their children with special needs.

### Learning Adaptations



Figure 10. Smartphone use for slow learner children

Children with visual impairments are placed at the front, close to the light, and learn using concrete objects or modified media, such as embossed maps. Children with

special needs with intellectual disabilities are continuously accompanied to maintain focus in learning. Teachers use assistive devices such as tablets, smartphones, and computers to present material in non-classical learning (Räty et al., 2016). The use of these devices supports the findings of Panopoulos & drossinou-korea (2020) and Lowrey et al., (2017). Furthermore, students with intellectual disabilities gain better comprehension in well-structured instruction than in unstructured, activity-based instruction (Vavougiou et al., 2016).

Children with special needs with hearing impairments are accompanied by paraprofessional during learning to verbally review the material, as noted by Kafle et al., (2019). Material is presented in written form and includes more illustrations and explanations. Field findings also indicate that teachers use three-dimensional media, namely models of windmills and fans (Zakia, Sunardi & Yamtinah, 2016). During teaching, paraprofessional is directly in front of the students, allowing them to clearly see the teacher's lips (Friend & Bursuck; 2019).



**Figure 11.** Use of concrete objects (fans) as a learning medium for children with hearing impairing

Adaptations for slow learners involve the use of engaging objects, both artificial and natural. The use of concrete objects, big books, and papercraft can be factors that can attract the interest of slow learners with special needs. This method is similar to the findings of Fitriana (2017). Big books also make learning more engaging (Kiromi & Fauziah, 2016).

### Science Practices

During out-of-class learning, students with special needs observed plants in the schoolyard and manipulated experimental equipment while conducting experiments on creating series and parallel electrical circuits. During these activities, students with special needs observed the lighting of a light bulb after the circuit was manipulated. Furthermore, students with special needs also observed and inferred switch functions.

These activities show students observing, communicating, inferring, and predicting (NGSS, 2013). This process improves the quality of learning as stated by (Hadis & Nurhayati, 2018).



**Figure 12.** Students performing science process skills

### Interactions between Special Needs and Non-Special Needs

Based on observations, classroom management at Giwangan Elementary School is integrated, with children with special needs and those without special needs being placed in the same class. This fact aligns with the idea of Friend & Bursuck (2019) that inclusive schools must fulfill three types of integration: physical integration, social integration, and teaching integration. This concept of integration is supported by the idea Aisy & Aprilia (2025) which suggests that interactions in inclusive classes can hone empathy, patience, acceptance, and tolerance.



**Figure 13.** A slow learner child who receives support from peers in group work.

Science learning activities at Giwangan Elementary School demonstrated positive interactions between students with special needs and non-Special Needs, particularly during environmentally friendly activities. This aligns with the findings of Thote & Gowri (2020). Rasmitadila & Goldstein (2017) also found that in inclusive classes, interactions between students can be built well. When students with special needs engaged in

uncontrolled activities, regular students provided supervision, and parents did not intervene to calm them down, as found by Ranbir (2024). These interactions occurred because teachers preferred not to use paraprofessional in their classrooms.

### Science Learning Assessment

Science learning assessment at Giwangan Elementary School does not involve changing core competencies, but rather modifying the questions and minimum completion criteria. However, students with special needs with the same cognitive level will be given the same questions if their specific needs are met, especially physical ones.

Modifications to the minimum completion criteria include setting a lower minimum completion criteria to allow students with special needs to pass the subject. For formative assessment, teachers need to modify the questions given to students. As stated by the school principal,

*We set the math completion criteria to 2 out of 10. This way, both regular and special needs children are very likely to achieve it.*

### CONCLUSION

The science learning plan at Giwangan Elementary School, as an Inclusive-Adiwiyata program, has been implemented in accordance with the essence of inclusive education and Adiwiyata values. The principal has successfully managed school resources effectively, fostering strong collaboration. The learning plan involves various school elements, including the principal, teachers, special assistant teachers, parents, and the school supervisor.

Learning activities integrate students with special needs (ABK) and non-ABK students through positive interactions. Parents place trust in the school. The principal consistently provides guidance, supervision, and teacher capacity building. Inclusiveness is maintained along with the scientific aspects of the learning process, and environmentally friendly values are also effectively instilled.

Learning assessments are also conducted through strong collaboration between the principal, teachers, special assistant teachers, and parents. The acceptance of parents and students regarding the special needs assessment for students with special needs is an exemplary factor.

### Implication

This study found that ecological theory has reinforcement, as demonstrated by the positive relationships between school components. Furthermore, the school's environmentally friendly social life reinforces the concept of deep ecology.

These findings imply that having a leader who is courageous enough to make changes is crucial. This is not only about having the courage to make changes, but also being firm enough to have a basis in rules. Furthermore, obedience to leadership and collaboration is a must for educational institutions. The strong role of parents is crucial, given that the primary foundation of education is not the school, but rather the parents.

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