Realizing Education for All (EFA) through chemistry teaching and learning in a senior high school providing inclusive education

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Abstract. This study aimed to explore the implementation of inclusive education (IE) through chemistry subjects in one of the senior high schools providing IE in the Wonosobo Regency. The research was conducted qualitatively with a case study approach. Participants (principal, chemistry teacher, students with and without disabilities, and parents of students with disabilities) were selected through a purposive sampling technique. Data were collected through interviews and observations, which were then analyzed using the narrative analysis method. Findings demonstrate that all participants did not understand the meaning of IE. In learning chemistry, Deaf and students with physical disabilities were welcomed well in class, but their support was inadequate. For Deaf students, communication was in lip reading, and no sign language interpreter was available. The biggest obstacle to implementing IE in this school is the physical accessibility (viz., access to the buildings and spaces). The laboratory is also not accessible to wheelchair users; therefore, chemistry laboratory activities were conducted in classrooms for students with physical disabilities. Teacher participants stated that they did not receive training on inclusive teaching and learning, so dealing with students with disabilities was challenging. The significance of this study is that full support (e.g., policies, budgets, training for teachers) from the national and local education departments is highly needed in promoting and realizing IE.

Keywords: inclusive science education, students with disabilities, accessibility.

1   Introduction

Persons with disabilities are defined as "any person who experiences physical, intellectual, mental, and/or sensory limitations in the long term who in interacting with the environment can experience obstacles and difficulties to participate fully and effectively with other citizens based on equal rights" [1]. In the Indonesian context, students with disabilities (SWD) have several terms; namely, students with disabilities, students

with impairment (tuna), difable students, exceptional children, and children with spe-cial needs (Anak Berkebutuhan Khusus/ABK) [2], and most primary and secondary education institutions use the term ABK. ABK is classified into several types, i.e., Deaf; hearing, speech or language, vision loss; totally blind; autism; cerebral palsy; intellec-tual disability; communication barriers; hyperactive; sensory impairments; motor disa-bility; down syndrome; attention-deficit/hyperactivity disorder (ADHD/ADD); emo-tional disturbances; dysgraphia; dyslexia; and dyscalculia [3, 4].

SWD are labeled by most of the community as individuals who are different from others [5], so they still receive negative stigmas [6] and are even vulnerable to being excluded and discriminated [7, 8]. According to Permendikbud No. 44 of 2019, SWD can be accepted into regular schools based on a school zone system; however, there are still schools unwilling to receive them and directed to the Special School (Sekolah Luar Biasa/SLB) [9]. Based on a survey, there were only 20.63% of children with special needs had attended school out of a total of 33,472 children with special needs [10]. Data from the official website of the Wonosobo District Social Service, there are as many as 3270 residents with disabilities [13]. Number of school-age SWD, according to data from the Central Java Statistics Agency as of 2016, there are as many as 127 children with physical disabilities, seven children with visual loss, 23 children with hearing and speech disabilities, three children with ex-psychotic mental disabilities, 21 children with intellectual disabilities, and 34 children with multiple disabilities [14]. These data indicate that most children with disabilities in Central Java have not received a proper education.

Wonosobo has four private special schools, namely SLB-B Dena Upakara, SLB-BCDG Aisyiyah Sa'adah, SLB-B Karya Bakti, and SLB-C Budiasih to facilitate SWD. In addition to SLB, Wonosobo Regency also has several regular schools that accept SWD (called School Providing IE or SPIE). At SPIE, all students are placed in the same class so that each child can meet his/her individual needs by joining the class and the community [15, 16]. SPIE has programs that are tailored to the needs and abilities of each student but are still feasible and challenging, supported by the motivation obtained from the students with the aim of student success [17, 18]. The number of SPIE in Wonosobo Regency is still very limited, i.e., four elementary schools, two junior high schools, and one senior high school [19].

In addition to Law No. 8 of 2016, Regulation of the Minister of National Education No. 70 of 2009, Wonosobo Regency also has legal authority to support the implemen-tation of IE, namely Regional Regulation No. 1 of 2015 and Regional Regulation No. 5 of 2016. Unfortunately, these legislations have not yet been appropriately imple-mented [19]. For example, one SPIE in Wonosobo Regency in 2010 received 35 chil-dren [20], but this number decreased to only seven children in the academic year of 2021/2022. This number indicates a decrease in SWD accessing education up to high school or equivalent.

SPIE is one of Indonesia's commitments to realizing Education for All, which was echoed by UNESCO in 1990, where SPIE answers the basic needs of the community regarding education. Education that is accessible to everyone is the key to the basis of an IE system [21, 22], in which all children can learn at the nearest school with their

peers [23, 24]. IE does not only mean the presence of children with disabilities in regular schools, but this educational model seeks to realize education to meet the needs of students with their uniqueness with structures, systems, and educational methodologies that are qualified to meet their needs [28, 32]. Ideally, implementing IE begins with assessment activities, which are collecting information, weighing, and deciding matters relating to students [33, 34]. But in fact, the assessment and identification process for SWD in IE in Central Java has not been carried out; not all SPIE's have SWD identification and assessment sheets [10]. In addition, the selection of learning strategies has not fully considered the students' disabilities. The media used is also less varied, so many SWD cannot access learning materials optimally [25, 28]. This is due *to the lack of knowledge and skills of teachers in managing inclusive classrooms* [25, 29].

At the SPIE Harapan, which is the site of this research, information was obtained that teachers had some difficulties in serving and teaching SWD [30]. This portrait of chemistry learning at SPIE Harapan is fascinating to reveal more deeply, especially on how chemistry teachers prepare, implement and assess chemistry lessons. In addition, the support system provided by this school and the parents of SWD also needs to be explored to get an overview of the implementation of inclusive chemistry education at the SPIE Harapan. Inclusive chemistry learning referred to in this study is learning that seeks to accommodate all the diverse needs and barriers of students [31]. Chemistry teaching means teacher activities in order to provide various experiences to achieve content standards in the field of chemistry so that they can enhance the knowledge, understanding, skills, attitudes, and values towards the chemistry [32].

This research is expected to provide in-depth information on chemistry learning at the SPIE Harapan, best practices that have been carried out by schools and teachers, and obstacles and challenges faced by teachers and SWD. The study results are also intended to provide input to local policymakers, including the Department of Education of Wonosobo Regency and the Principal of the SPIE Harapan, as a basis for future policymaking.

2   Method

2.1   Design

This research was conducted through a descriptive qualitative. This method was selected because it can precisely answer questions by examining the social background and individuals involved in the study [33].

2.2   Participants and their' recruitment

Participants were selected through a purposive sampling technique and selected Sinta as the principal, Yuwana as a chemistry teacher, four SWD majoring in Mathematics and Natural Sciences, namely Hana, Gema, Satria, and Dewa, and three classmates of SWD consisting of Nisa, Andy, and Raka, as well as two parents of SWD consisting of Marni as the mother of Satria and Subagiyo as the father of Dewa. Participants were

informed about the purpose of the study, and their participation was anonymous, voluntarily, and confidential.

2.3 Data collection technique

Data were collected through observation, in-depth interviews, and analysis of lesson plan documents. The interview technique was used to gather preliminary study data and find in-depth information from the participants. Because the results of interviews often lead to bias or deviate from what they should be, it can be said that the data are subjective; it is necessary to observe things that are not disclosed by the participants [44].

2.4 Data analysis

Data from in-depth interviews, observations, and document analysis of the chemistry lesson plan were analyzed using the narrative analysis method. Qualitative data analysis attempts to obtain and compile notes on observations, interviews, and other data systems so that research results are easily understood when presented [45]. This method was chosen because the data in this study were narratives from the results of interviews and observations.

3   Result

3.1   Perceptions of IE and SWD studying chemistry

The definition of IE was asked of all participants, and the data analysis indicated that only the chemistry teacher, the principal, and one parent could answer the general definition of IE. In contrast, other participants said they did not know the meaning of IE. According to teacher and principal participants, IE means education for SWD in public schools by participating in the same activities as other students but with some preferential and/or special treatment such as facilities and infrastructure as well as other special treatments, as quoted from interviews with Yuwana and Sinta:

"IE means education that accepts children with special needs, where children with special needs are specially served by the educational institution. So educational institutions that accommodate children with special needs, where the teachers have also been prepared to serve them. Indeed, we cannot serve the same as normal children, but they need special treatment…" Yuwana

"Inclusive [education] is educational services for children with special needs but … in public schools. So … children participate in the same activities as other children, but they are provided by special treatment, especially maybe the facilities may differ from public schools…." Sinta

According to the understanding of the principal (Sinta), IE in her school can only accommodate students with physical disabilities. She asserted that students with intellectual disabilities should study in a special school because they will be left behind if they go to public schools and are even vulnerable to bullying. In addition, Sinta asserted

that her school does not have a psychologist to support facilities for students with intellectual disabilities.

As a parent with disabilities, Subagiyo said he was lucky because the closest primary school to where he lived was SPIE, so he knew what IE was even though it wasn't deep. IE for Subagiyo is a regular school that accepts children with special needs like his son. When Subagiyo asked about what IE is, he said: "Oh, it's a [school] that handles children with special needs." On the other hand, the interview with Marni, one of the parents of SWD, did not even know that an IE model existed. For her, the main thing is to send her child to a nearby school so that her son is the same as the other children. She asserted: "what is more important is what the children want to do at school rather than at home." Satria (Marni's son) is lucky because his parents support him in attending school rather than hiding him due to his disabilty.

The understanding of IE that is still narrow and limited by the participants in this study is still widespread in the Indonesian context. This is in line with the previous study [38] stated that teachers primarily define IE as a simply welcoming SWD in a general classroom. The school community's acceptance of SWD was generally good, but peers of SWD did not know what IE was. Even one participant (Nisa) admitted that she was surprised when she was in the same class as SWD. This happened because she did not even know that SPIE Harapan accepted SWD. The same thing was explained by Yuwana and other students who initially admitted that they had difficulty mingling with SWD, especially those with severe disabilities. With the guidance of the teachers, the students gradually awakened their empathy toward SWD, helped each other, and accepted the presence of SWD in their class. Although it was difficult to adjust to the presence of SWD at first, their peers remained good friends. This finding echoes Fitria et al. that students who have never been taught about disability awareness increase the possibility of bringing up negative traits and views about SWD [13]. In contrast, students who have been educated about disability and diversity tend to be more positive in dealing with differences [39, 40]. It can be said that teachers in SPIE Harapan have raised disability awareness among students so that from what was previously difficult to blend in to be able to empathize and make friends in the end. It is essential for schools to not only gain students' social skills to accept and include peers from different backgrounds but also be able to provide environmental support to increase the social participation of SWD [41, 42].

High expectations of SWD are provided by the SPIE in this study. Although all participants with disabilities enrolled in the Social Sciences major, the school directed them to Science major, where one of the subjects must be taken is chemistry. This made Yuwana amazed. For her, students who want to study chemistry are extraordinary children; they are willing to take on challenges even within their limitations. Of course, Yuwana fully supported her students by always giving them extraordinary support. Yuwana always encourages them with positive words such as: "You are great! You with all your limitations, but you can do it."

High expectations are demonstrated by teachers in this SPIE benefit for students. Some research literature alleged that when expectations toward SWD increase, teachers' beliefs, attitudes, and practices will change. Teachers with high expectations apply more effective teaching practices; and that these teachers offer guidance in learning,

provide more feedback and more time to assist students, and provide a positive and warm environment to manage student behavior [43]. When SWD are given more advanced learning opportunities, they can make more progress.

A substantial body of literature confirms that teacher expectations can have positive or negative effects on students' performance [44]. This view is substantiated in this present study that found that lowering expectations for SWD resulted in lower student achievement. Some scholars [45, 46] would also agree with this current finding propounding that when science teachers set lower expectations for SWD, they are likely to reduce opportunities for them to learn to their maximum capacity. Teachers with low expectations for students' achievement tend to present experiences that are less cognitively demanding, accept lower work standards and spend more time repeating and reinforcing information.

Finding indicates that the IE model in this SPIE helps children with disabilities to attend regular schools. For chemistry teacher participant, SWD presence helps raise the social spirit of their peers to empathize and accept them. For the school principal, IE helps to accommodate the interests of people with disabilities to learn as long as they are willing to accept school conditions that may not be perfect. The student's peers also agreed that IE helps provide facilities for SWD so that they can attend public schools. According to Raka, a close peer of Satria's, IE supports SWD. Raka mentioned: "... if there is no such thing [IE], those SWD might doesn't want to go to school anymore, mostly like that."

Raka's statement is in line with research conducted by Thompson & Moris quoted from Little et al. that exclusion of SWD can increase the risk of higher academic and adverse social outcomes, such as early dropout, lack of school satisfaction, low academic achievement, crime, to depression [41]. Although the implementation of IE is on its' way, all participants agreed that IE is sufficient to help SWD learn both academically and socially. This finding is in line with many previous studies that state that IE positively impacts academically and socially among SWD and their peers [60, 61]. This is also directly proportional to the theory that SPIE is a school that accepts children to join classes with other peers and organizes programs that are tailored to the needs of their students [15, 16].

3.2   The way chemistry teacher creates lesson plans, implement the plan in the classroom, and assess SWD

The essential part of IE is how teachers design learning. In general, there is no curriculum adaptation applied at the SPIE Harapan. All students (including SWD) learn through the same curriculum, whereas some support for SWD was provided by the teacher. For example, Deaf students were placed in the front row to easily read the teacher's lips when explaining the material and help Deaf students point out which parts the teacher is explaining. If the teacher gives questions in oral form, the teacher will help write the questions in the Deaf student's book. Yuwana explained:

"Usually we put the children [with disabilities] in front of me, then I had their books ready, I brought them to me. I also have a textbook, while I was talking, I opened the page. I explained while I show and direct to the page. I explain while reading to him

too. Because he couldn't possibly see me all the time, he also had to read. For long phrase, I helped him write down in his book. I usually asked him, whether he understood or not with what I mean. If he nods at me, it means he understood, if not, I will repeat my explanation."

For material considered quite complex and conceptual such as Equilibrium, Reaction Rate, and Thermochemistry, the teacher provided additional hours outside of learning hours to re-explain the material to Deaf students. Yuwana said:

"[students with hearing loss] have difficulty, especially when I give the concept that require calculation. For examples in many topics such as Equilibrium, Reaction Rate, Thermo, there are some concepts that really need their thinking skills. If the students doesn't really pay attention, especially this one who is hearing impaired, they do not focus on my explanation, the formula and calculation, they will not get it. Then, I gave them additional hours outside the regular schedule."

This chemistry teacher at SPIE admitted that she had no sign language skills and had never received any training to support Deaf students, as expressed in an interview with Yuwana: "There is no training whatsoever. All by self-taught. We look for the literature and contact the SLB teacher; how do we do it?" The only thing that has been done was technical guidance by inviting teachers from one of the SLB and recommending speechreading as the primary communication means. Yuwana said: "SLB Dena Upakara and Karya Bakti are not allowed to use sign language; therefore, we just continue this [using speechreading]." A single communication pattern with speechreading is not optimal because Deaf students have sign language as their primary language [49, 50]*, and not all of them can read lips well* [65, 66]*. Forcing Deaf students to be willing and able to speak is a bit less wise even though the goal is good so that they can communicate with others. Whereas IE should be able to adapt to all student needs, including the availability of sign language interpreter* [53, 54]*.*

For students with physical disabilities, support was provided when practicum in the laboratory. The practicum originally carried out in the laboratory was transferred to the classroom by bringing all laboratory equipment to class. This was done because access to the laboratory room was difficult. Although sometimes students protested when they could not do a practicum in the laboratory, after being given understanding, the students accepted and understood. As Yuwana said:

"…Well, sometimes it becomes an obstacle; when the students protested like yesterday, that became a problem, because the way from class to the lab is far. … the students said: "Why aren't we in the lab?" … then I explained, "You know that Hana and Gema will be in trouble when you get there." "We will take you there, we will bring it". "Well, I feel sorry for you too." And in the end, all the students understood this condition."

For the assessment process, no modification but accommodations according to the needs of SWD were offered. The type of questions, time, and difficulty level was the same for all students. This was done to avoid SWD being offended because they are considered incapable compared to other friends. Yuwana said:

"It's the same [for assessment]; later, if I differentiate, they will be offended; why am I being distinguished from my friends? Won't I get the same lesson? We can't differentiate, we can't. It's okay to be different in treatment but should be the same in material that give it to all students. It's not allowed to differentiate it".

SPIE must provide for all students' needs [15, 16], and this was demonstrated in this study, in which offered accommodation to the SWD. However, schools should have the courage to be flexible in carrying out learning. Schools need to pay attention to suitable classroom arrangements to the possibility of needing modifications in learning programs and assessment systems that are appropriate for each SWD [55]. Appropriate accommodation is essential to realize IE which fulfills diverse needs [71, 72]. The accommodation is expected to reduce the obstacles that may occur so that students can participate fully in the learning process and to improve learning outcomes [58, 59].

To assess classroom activities, SWD needs to be provoked to be active or be made into a group with active students to increase their confidence. Other accommodations are also provided when taking laboratory skills assessments, and the task and assignment were adjusted. For safety reasons, tasks that involved experimenting with fire or similar hazards were replaced with other tasks. The accommodation was provided to help SWD participate more in the laboratory activities [60].

3.3   Challenges and barriers to implementing IE

All participants in this study admitted that they still found obstacles and challenges in implementing IE, namely physical accessibility (access to buildings and rooms), lack of teacher training, and learning strategies.

As an illustration, the SPIE Harapan has two buildings separated by a road. Most classrooms, administrative offices, a mosque, and fields are in the south building, while the laboratory, library, theatrical, and other classrooms are in the north. The south building has access for wheelchair users even though it has not reached the entire room. The handrail has been installed at the front of the first class in this south building. In the north building, the room is entirely inaccessible for wheelchair users, and there is still a lot of space to be traversed by climbing the stairs. Therefore, students with physical disabilities have difficulty when learning requires students to access laboratories or libraries. For outdoor learning activities, such as acid-base material by looking for natural indicators, it is given homework for SWD, while other students can do it at school. This adjusts to the obstacles of students who cannot reach all spots of the school but still provide the same learning even though it must be done at home.

This physical barrier was also encountered by parents of SWD. Subagiyo as the father of Dewa has to take his son to school every day by motorbike. However, because he uses a motorbike, he finds it difficult when the weather is not supportive, such as hard rain. There is also no public transportation to the school, and one should take a motorcycle taxi as far as one kilometer from the last public transportation. Marni (Satria's mother) said the same problem. There is no public transportation that passes through his village, so Satria is forced to ride his motorbike. Watinah said:

"Even though Satria did not allow to drive a motorcycle, I could not always accompany him to school. No public transport can reach that school. His teachers understood our condition. I don't want to hide my son at home and do nothing, I don't want to hide his condition. Instead, I want just bring it, so everybody can understand."

Lack of accessibility to public facilities such as bathrooms, public transportation, and high-rise buildings are still barriers for people with physical disabilities. The absence of ramps and lifts is also a problem for the accommodation of the quadriplegic [77, 78]. This obstacle also occurs at SPIE Harapan, where not all parts of the school can accommodate students with physical disabilities, including accommodation in the laboratory. The absence of such accommodation hinders the implementation of IE. Therefore, it is necessary to have easy accessibility to reach the laboratory to support the smooth implementation of inclusive chemistry education for students with physical disabilities [63].

For school principals, the biggest challenge is when the school does not have a budget to build a new accessible building. The funding issue becomes serious when the school does not allow to ask for an endowment from parents. All public schools in Indonesia only have funds from School Operational Assistance Program (BOS) and Implementation of Operational Assistance (BOP); which these funds can only be used to mend or renovate buildings. No funds for an IE program were allocated to this school.

For teachers, the disability of students can hinder the learning process in the classroom because teachers have never been trained to handle SWD, and it can be a challenge for teachers to learn to adapt to SWD and find a way of teaching that is right for them. This lack of training for teachers has become a classic problem for the implementation of IE in both developed and developing countries. The training is just a formality without evaluating the effectiveness of the training results [64, 65]. At the same time, this training is essential to broaden the knowledge of teachers and can lead to positive attitudes of teachers toward people with disabilities [77, 82]. The lack of teacher training also causes teachers to be unable to face the challenges of implementing the IE [67, 68]. In addition, teachers also often have difficulty in assessing skills. As explained in Session 3.2, teachers need to adjust in such a way that they can take the value of practical skills.

For SWD, the obstacle is difficult to understand the teacher's explanation, especially regarding material that involves calculations. This was also confirmed by the chemistry teacher, where SWD sometimes has difficulty in the calculation section. Satria mentioned: "I like Chemistry, but cannot use formulas to calculate something. It's difficult. And sometimes maybe [the teacher] explains it too fast." Gema, on the other hand, stated: "Honestly, I don't like chemistry because I find it difficult to count... And sometimes the teacher's explanations are fast, so it's hard for me to understand."

According to students, the difficulties experienced can occur because the teacher's way of explaining is too fast. For Dewa, one of SWD had difficulties understanding the teacher's explanations because there were friends who invited him to chat or joke during class hours. This is undoubtedly quite disturbing because one of the extrinsic factors that increase student interest in learning is a conducive environment [68].

3.4   Hope for future

The main expectation from the teacher, principal, students, and parents of students is support in the form of funding so that SPIE Harapan can build better access for people

with disabilities. According to observations, wheelchair access can only reach the class-rooms in the south building. Meanwhile, access in the form of a handrail only reaches the nearest classroom at the gate. There are no wheelchair facilities to reach facilities such as the mosque, fields, laboratory, hall, and library.

In addition to assistance in the form of development funds, another hope is that the government, through the Social Service will further disseminate more about IE. It aims to make understanding of IE accessible to all levels of society. It is hoped that with this understanding of IE, there will be no more parents who do not send their children with disabilities to school because they do not know about IE services. In addition, it is hoped that other students will also have a better understanding of what IE is so that they can mingle with peers with disabilities at school. Training for teachers is also expected not only for SLB teachers but also for teachers at SPIE so that teachers can properly support SWD. In addition, teachers who are given training are also expected to be evenly dis-tributed not only to one teacher so that regeneration can also be realized for students who are able to properly assist SWD.

4   Conclusion

IE according to the results of this study, is still interpreted in a limited way, namely enrolling SWD into regular classes with their peers. Chemistry teachers do not modify the curriculum but provide accommodation according to the needs of SWD. Physical accessibility is the biggest obstacle in implementing IE at the SPIE Harapan. Other barriers include the absence of training for teachers to support and teach SWD. Partic-ipants at the SPIE Harapan hoped the government would support this school with a sufficient budget to realize a proper and accessible physical building for everyone. In addition, thorough socialization of IE and inclusive learning training for teachers is also needed to implement IE successfully in SPIE Harapan.

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