Al-Bidayah : jurnal pendidikan dasar Islam
Volume 13, Number 2, December 2021
ISSN: 2549-3388 (online)
Available online at https://jurnal.albidayah.id
Submitted: November 11, 2021, Accepted: December 27, 2021

MEETING THE CHALLENGES OF ACCESSIBILITY FOR SCIENCE INCLUSIVE CLASSROOMS IN INDONESIAN BASIC EDUCATION SYSTEM

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DOI: 10.14421/al-bidayah.v13i2.710

ABSTRACT

There is no one-size-fits-all answer to support the uniqueness of a student's learning needs. Providing accessibility to enable every student to achieve the same learning goals is a critical issue to create an inclusive environment. This study investigated ways of science teachers met the challenges in providing accessibility for students in learning science. Ten participants from three Schools Providing Inclusive Education (SPIE): Schools Cerdas, Pintar, and Pandai in basic education level in the Province of Daerah Istimewa Yogyakarta Indonesia were selected purposively. The participants were interviewed individually and in group to share their thought and experiences in meeting the challenges of learning accessibility for students with disabilities (SWD) in the science classrooms. As part of a qualitative case study, data were analyzed systematically and three themes were generated to discuss the findings, i.e., inclusive pedagogy, inclusive content, and inclusive technology. All participants considered how learning is achieved and provided the means to help students succeed. A syllabus was made available in all schools, although expectations were set low and learning objectives were not clearly defined and measurable. Collaborative teaching only existed in School Pandai with limited co-planning time. All teachers revisited science content and ensured it was set up for all students to meet their expectations. Science teachers in School Pandai created different worksheets based on the student's needs as the main learning source, while other teachers in Schools Cerdas and Pintar claimed they had no time to vary science modalities. Although all teachers understood how SWD needs to interact with different tools, only teachers in School Pintar and Pandai utilized assistive technologies to help SWD in learning science.

Keywords: accessibility; assistive technology; inclusive classroom; inclusive content; inclusive pedagogy

INTRODUCTION

Education for all (EFA) has been guaranteed by Law No. 20 of 2003 on the National Education System, however, there are still many children in Indonesia who do not attend school.[1] Indonesia is one of the ten countries that have 45% of the gap between youth aged 15 to 29 with and without disabilities (53% versus 98%) who ever attended school.[2] Although the Indonesian government through the Ministry of Education and Culture has enacted some regulations on inclusive education, Handayani and Rahadian[3]

[1] IDCT, "Indonesia Shadow Report: Implementation of the United Nations Convention on the Rights of Persons with Disabilities" (United Nations Committee on The Rights of Persons with Disabilities, 2017).

[2] UN, *Realization of the Sustainable Development Goals by, for and with Person with Disabilities: UN Flagship Report on Disability and Development*, A/RES/69/142 (The Division for Inclusive Social Development (DISD), Department for Economic and Social Affairs, 2018).

[3] Titik Handayani and Angga Sisca Rahadian, "Peraturan Perundangan Dan Implementasi Pendidikan Inklusif. Translation: Legislation and Implementation of Inclusive Education," *Masyarakat Indonesia* 39, no. 1 (2013): 27–48.

stated that those regulations have not fully addressed the inclusive education concept. In several departments and agencies, the special education term has been replaced with inclusive education without any actual change in policy and practice. Consequently, these adopted policies brought a different perspective, assumptions, and beliefs about inclusive education to teachers in Indonesia. Their understanding of the real inclusion in education are not accurate which effect the irregularities and broad range of variety in practices of inclusive education concept among the Indonesian teachers.[4]

Circular of the Director-General of Primary and Secondary Education Management of the Ministry of National Education No. 380/C.C6/MN/2003 mentioned: that every district is mandatory to develop and implement inclusive education system by accepting students with disabilities (SWD) in all school levels. These schools are appointed as school providing inclusive education (SPIE) or *Sekolah Penyelenggara Pendidikan Inklusif* (SPPI). Mostly, SPIE in Indonesia are driving mainstreaming and pull-out models[5] rather than a 'genuine' inclusive model. In those SPIE, SWD work to get to a stage where they are integrated into the regular classroom.

Documents that mentioned the rights of SWD to be educated in science general classroom can be found in the US regulations, such as Science for All published by the American Association for the Advancement of Science (AAAS) in 1990; the National Science Education Standards (NSES)[6] published by the National Research Council in 1996 and The Next Generation Science Standards (NGSS)[7]—specifically Appendix D, All Standards, All Students—embarked by the National Academy of Sciences, Achieve, the American Association for the Advancement of Science, and the National Science Teachers Association in 2010. Indonesia has no legal documents stating that SWD has the right to be included in science learning yet in the general classroom (viz. Law No. 23 of 2002, Law No. 20 of 2003, The Regulation of Minister of Education No. 70 of 2009,

[4] Pradhikna Yunik Nurhayati, "Mewujudkan Pendidikan Inklusif: Tinjauan Atas Praktik Sekolah Inklusi Tingkat Menengah Di Kota Yogyakarta (Translation: Realizing Inclusive Education: An Overview of the Practice of Inclusive Secondary Schools in the Yogyakarta Municipality)," *WELFARE, Jurnal Ilmu Kesejahteraan Sosial* 1, no. 1 (2012): 103–18.

[5] Anggun Dyah Anjarsari, Mohammad Efendy, and Sulthoni, "Penyelenggaraan Pendidikan Inklusi Pada Jenjang SD, SMP, Dan SMA Di Kabupaten Sidoarjo (Translation: The Implementation of Inclusion Education Assistance for Elementary, Junior High, and Senior High School in Sidoarjo Regency)," *Jurnal Pendidikan Inklusi* 1, no. 2 (2018): 91–104.

[6] Mehmet Aydeniz et al., "Using Inquiry-Based Instruction for Teaching Science to Students with Learning Disabilities," *International Journal of Special Education* 27, no. 2 (2012): 1–17.

[7] The Next Generation Science Standards, "The Next Generation Science Standards for States, by States," 2013.

Government Regulation No. 17 of 2010, The Regulation of Minister of Education and Culture on Special Education No. 46 of 2014). However, those Indonesian regulations on SWD and inclusive education have not been translated into guidelines to be operationalized and practiced in schools, particularly in science learning.

The document Curriculum 2013 for science mentioned that learning science at the basic education level (elementary school or *SD/MI* and middle school or *SMP/MTs*) is carried out on an integrated basis.[8] All students are expected to learn the science principles by doing hands-on and mind-on activities. However, the guideline for a science teacher to implement this curriculum is not provided, particularly in which mentioning how to include SWD in science classroom. Consequently, the science achievement of Indonesian students including those with disabilities is not adequate.[9]

The number of SWD who learn science is rocketed as SWD are acknowledged by legislation to be welcomed in a general education system.[10] Therefore, science teachers are expected to build "a caring, positive learning environment by modeling sensitivity to differences and using a variety of instructional approaches and interaction styles" to teach SWD in the science classrooms.[11] Many scholars[12] said that learning science including in laboratory activities for SWD is possible and they can be successful;[13] when they are

[8] Ministry of Education and Culture, *Kurikulum 2013 (Curriculum 2013)* (Jakarta: Department of Education and Culture, Indonesia, 2013).

[9] Alberthus Fenanlampir, John Rafafy Batlolona, and Imelda Imelda, "The Struggle of Indonesian Students in the Context of TIMSS and PISA Has Not Ended," *International Journal of Civil Engineering and Technology (IJCIET)* 10, no. 02 (2019): 393–406.

[10] Mary Ellen Bargerhuff, Heidi Cowan, and Susan A. Kirch, "Working toward Equitable Opportunities for Science Students with Disabilities: Using Professional Development and Technology," *Disabil Rehabil Assist Technol* 5, no. 2 (January 2010): 125–35, https://doi.org/10.3109/17483100903387531; Karen Mutch-Jones, Gillian Puttick, and Daphne Minner, "Lesson Study for Accessible Science: Building Expertise to Improve Practice in Inclusive Science Classrooms," *Journal of Research in Science Teaching* 49, no. 8 (2012): 1012–34, https://doi.org/10.1002/tea.21034.

[11] Greg Stefanich, Pat Holthaus, and Louise Bell, "The Cascade Model for Managing Students with Disabilities in Science Classrooms," in *Science Teaching in Inclusive Classrooms: Theory & Foundation*, ed. Greg Stefanich (The National Science Foundation, 2001), 115–26.

[12] Sami Kahn et al., "Let's Get Physical," *Science and Children* 51, no. 5 (2014); Margo A. Mastropieri and Thomas Ë Scruggs, "Science for Students with Disabilities," *Review of Educational Research* 62, no. 4 (1992): 377–411, https://doi.org/10.3102/00346543062004377; Margo A. Mastropieri et al., "Differentiated Curriculum Enhancement in Inclusive Middle School Science: Effects on Classroom and High-Stakes Tests," *The Journal of Special Education* 40, no. 3 (2006): 130–37, https://doi.org/10.1177/00224669060400030101; T. Scruggs, M. Mastropieri, and R. Boon, "Science Education for Students with Disabilities: A Review of Recent Research," *Studies in Science Education* 32 (1998): 21–44.

[13] Mahadeo A. Sukhai and Chelsea E. Mohler, "Accommodating Students with Disabilities in Science Laboratories and in Fieldwork," in *Creating a Culture of Accessibility in the Sciences*, ed. Mahadeo A. Sukhai and Chelsea E. Mohler, 2017, 199–205.

provided with the learning activities that enhance their participation. "Creativity and an open mind" are the way to minimize the barrier to participation for SWD in laboratory activities, while "preparation and planning" are essential aspects to give the SWD fully access to laboratory activities.[14]

Each SWD respond to the science curriculum in many ways according to their disabilities. SWD may need adaptations, i.e., modification or accommodation. Some SWD might need modified learning objectives, alternative learning media, instructional scaffolding, and additional time to practice and complete tasks and assignments. These kinds of modifications can help SWD to access science general curricula because they are too often blocked from accessing essential aspects of science.[15]

Successful inclusive science education can be succeeded with fully support and collaboration among the school members: the principal, science teachers, support teachers, SWD and their peers, parents, staff, and local government. Flexibility and accessibility are two main aspects that science teachers should be pondered when designing inclusive instruction. To create inclusive instruction, a framework namely Universal Design for Learning (UDL) offers guidelines mentioning curriculum should be flexible and accessible.

Flexibility means when students' abilities and choices can be accommodated[16] in the ways the information is presented; in the ways students demonstrate their understanding; and in the ways students are engaged.[17] In terms of a flexible curriculum, UDL "helps teachers maintain educational integrity and maximize consistency of instructional goals and methods, while still individualizing learning".[18] "Greater

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[14] Sukhai and Mohler., 205

[15] Cory A. Buxton and Eugene F. Provenzo, *Teaching Science in Elementary and Middle School: A Cognitive and Cultural Approach (Second Ed.)* (Thousand Oaks, CA: Sage Publications, 2010).

[16] Margaret King-Sears, "Universal Design for Learning: Technology and Pedagogy," *Learning Disability Quarterly* 32, no. 4 (2009): 199–201, https://doi.org/10.2307/27740372.

[17] Charles Bernacchio and Michelle Mullen "Universal Design for Learning," *Psychiatric Rehabilitation Journal* 31, no. 2 (Fall 2007): 167–69, https://doi.org/10.2975/31.2.2007.167.169; Margareth E. King-Sears et al., "An Exploratory Study of Universal Design for Teaching Chemistry to Students with and without Disabilities," *Learning Disability Quarterly* 38, no. 2 (2015): 84–96, https://doi.org/10.1177/0731948714564575.

[18] Chuck Hitchcock et al., "Providing New Access to the General Curriculum: Universal Design for Learning," *TEACHING Exceptional Children* 35, no. 2 (2002): 8–17, https://doi.org/10.1177/004005990203500201., 9

flexibility in curriculum and instruction also can increase supportive exchange and interaction between student peers, as well as between students and instructors".[19]

UDL contains the proactive guidelines to plan the learning, pedagogical content knowledge (PCK), and improvement to build learning experiences that are accessible and to engage learners with diverse needs.[20] UDL creates an accessible and student-centered learning environment;[21] reduces barriers to learning and increases meaningful access;[22] and helps the teacher in providing "equal access, quality programs, and appropriate services"[23] for SWD.

Measuring accessibility, challenges, and barriers to meet the accessibility of science teaching and learning in SPIE in the Indonesian context is remarkably limited. Therefore, by revealing science teachers and supporting teachers' voices and experiences in providing inclusive science learning for SWD would gain a greater understanding of how science teaching and learning are accessible for SWD.

A significant gap and little research still exist in the literature relating to access for SWD towards inclusive science classrooms in Indonesia, particularly in Daerah Istimewa Yogyakarta. Investigating the accessibility of science classrooms has the potential to impact education policies and practices, increase participation of SWD and minimize exclusion. In addition this investigation can identify challenges, barriers, strengths and weaknesses of what teachers need to be implemented to gain the access and participation for SWD in science learning. Moreover, research evidence science classrooms accessibility for SWD in Indonesia will increase the awareness of the government, including local department of education that lead them to support schools and teachers in promoting and implementing inclusive science education.

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[19] Bernacchio and Mullen, "Universal Design for Learning.", 168

[20] James D. Basham et al., "A Comprehensive Approach to RTI: Embedding Universal Design for Learning and Technology," *Learning Disability Quarterly* 33, no. 4 (2010): 243–55, https://doi.org/10.1177/073194871003300403; King-Sears, "Universal Design for Learning: Technology and Pedagogy."

[21] Margaretha Vreeburg Izzo and William M. Bauer, "Universal Design for Learning: Enhancing Achievement and Employment of STEM Students with Disabilities," *Universal Access in the Information Society* 14, no. 1 (2013), https://doi.org/10.1007/s10209-013-0332-1.

[22] Maya Israel, Cecelia Ribuffo, and Sean Smith, *Universal Design for Learning: Recommendations for Teacher Preparation and Professional Development* (Florida: the University of Florida, Collaboration for Effective Educator, Development, Accountability, and Reform Center, 2014).

[23] Susan Trostle Brand, Antoinette E. Favazza, and Elizabeth M. Dalton, "Universal Design for Learning: A Blueprint for Success for All Learners," *Kappa Delta Pi Record* 48, no. 3 (2012): 134–39, https://doi.org/10.1080/00228958.2012.707506., 139

RESEARCH METHODS

General Background

The main rationale behind this paper was to explore science teachers' experience in meeting the accessibility of inclusive science classrooms in Indonesian contexts through a qualitative lens. A case study was employed in three SPIE (Schools Bintang, Bulan and Matahari) in the Province of Daerah Istimewa Yogyakarta, Indonesia.

Participants

According to Article 1 Paragraph 8 Law No. 20/2003 of the National Education System (Sisdiknas), three SPIE in this study are classified as a basic education level or called the nine-year compulsory education system, which includes an elementary school and middle school. School Bintang is a public school, that has welcomed SWD since 1982 as an integrated school and has changed its status as an SPIE pointed out by the Department of Education in 2011. School Bulan is an Islamic private school that welcomed students with visual impairment since 1968 as a special school. In 2008, this school transformed to SPIE through Yogyakarta Mayor Regulation No. 47/2008. School Matahari is a private school that welcomes SWD and claims to implement the spirit of the Education for All. Ten participants (see Table 1) of three SPIE were selected purposively.

Table 1
Demography of participants

Name of participants	Type of participants	School	Teaching experience for SWD (years)
Melia	Science teacher	Bintang	> 15
Siwi	Science teacher	Bintang	> 5
Jihan	Support teacher	Bintang	> 30
Lusi	Head of the inclusion program	Bintang	> 20
Lani	Science teacher	Bulan	> 5
Tifa	Science teacher	Bulan	> 5
Indah	Support teacher	Bulan	> 5
Puji	Science teacher	Matahari	> 5
Rida	Science teacher	Matahari	> 5
Anita	Support teacher	Matahari	> 10

Data Collection

To gain deeper analysis, interviews (both individually and in a group) were selected as the main data collection method of this study. Ten participants were interviewed individually for about 90 – 120 minutes to give their information of the challenges and barriers in providing access to learn science for SWD. A group interview then was conducted to clarify the data provided from the previous interviews and to compare and contrast the findings among three SPIE.

Data Analysis

Transcripts from all participants were collected, indexed, coded, and categorized to generate emerging themes. Data then were analyzed inductively (coding the data patterns and discovering its potential relationships and themes) and deductively (operating a theoretical framework to guide the analysis), followed by generating themes and cross-case analysis.[24] Three themes (i.e., inclusive pedagogy, inclusive content, and inclusive technology) were captured to shape the main finding.

RESULT AND DISCUSSION

Teachers still have an essential yet challenging roles in organizing their teaching by offering appropriate methods effectively for all students to enable them to demonstrate their abilities and desires.[25] To create inclusive teaching, teachers should equip all students with access and chances to take an interest in learning.[26] The way science teachers in Schools Bintang, Bulan, and Matahari offered access to SWD to learn science is described within three themes, i.e. inclusive pedagogy, inclusive content, and inclusive technology.

Inclusive pedagogy

All science teacher participants in Schools Bintang, Bulan, and Matahari considered how learning is achieved and provided several teaching approaches to help students succeed, although were not fully inclusive. In different degrees and intentions, science teachers in School Bintang and Matahari claimed they applied students centered learning, e.g., an inquiry-based learning approach to increase SWD participation. Melia in School Bintang stated that the student-centered learning approach is useful to "*rock up the class atmosphere and keep students stay awake and not sleepy*". Melia mentioned that

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[24] Robert K. Yin, *Case Study Research: Design and Methods (5th Ed.)* (Thousand Oaks, CA: Sage Publications, 2014).

[25] Norrisa Newton, Janelle Carbridg, and Yvonne Hunter-Johnson, "Teachers' Perceptions of Inclusive Education and Its Implication for Adult Education in the Bahamas," 2014, 331–36.

[26] Jean-Pascal Beaudoin, *Introduction to Inclusive Teaching Practices* (Ottawa: Centre for University Teaching & Learning Support Service, University of Ottawa, 2013).

the teaching strategies she applied were aimed to: "*get the student involved and they were more active, give student opportunities to find the concept [not given by the teacher], increase their independence, get the materials inherent in their memory*". The implementation of an inquiry-based learning approach for SWD in those two SPIE is in line with a study by Melber[27] who confirmed that an inquiry-based learning approach requires students to engage cognitively, in which this activity enables the science classrooms more inclusive for SWD. In addition, inquiry-based learning allows SWD to learn more widely than through writing and reading.[28]

In-School Bulan, science teachers admitted that students with visual impairment tended to less participate in a science lesson. They believed that a lecturing method was the best way to deliver knowledge and understanding. Puji said: "*We use the lecturing method a lot, although there are also other methods, the majority are still, lecturing is dominant*." In addition, Tifa asserted in the interview that she tended to use repetition method when she delivered the material to ensure that the SWD understood, and Puji mentioned:

> to handle students who are slow learners, we are not too demanding, so it's up to him [the student], … should not be the same as his friends, … should not have to write down the material or listen to me. … We don't have a high demand and requirement.

Indah, the support teacher at School Bulan conversely argued she tried to gain students with visual impairment participation using various methods and media. Indah asserted she encouraged students with visual impairment to actively participate in outside observation for particular science topic. Indah stated students with visual impairment are possible to do science activities such as observation, in which an inquiry-based instruction is feasible to be implemented for inclusive classroom. Similarly, a study by Rooks-Ellis[29] found that for students with visual impairment, inquiry-based instruction is possible as they can use the senses to obtain data, to explore real objects for further understanding, to question findings and to test the findings becomes a natural occurrence.

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[27] Leah Melber, "Inquiry for Everyone: Authentic Science Experiences for Students with Special Needs," *Teaching Exceptional Children Plus* 1, no. 2 (2004): n.a.

[28] Kathy Cabe Trundle, "Inquiry-Based Science Instruction for Students with Disabilities," in *Science as Inquiry in the Secondary Setting*, ed. Julie Luft, Randy L. Bell, and Julie Gess-Newsome (Arlington, Va.: NSTA Press, 2008), 79–85.

[29] Deborah L. Rooks-Ellis, "Inquiry-Based Education for Students with Visual Impairment," ed. K. Capps et al. (Hindawi, 2014), 1–7.

In-School Matahari, the student-centered approach was applied in the form of excursions/fieldtrips. This approach was supported by the DeFina[30] the study mentions that during a field trip, student is offered valuable learning experiences. DeFina also mentioned that a field trip can be played as an effective teaching strategy when the teacher plans, organized, and supervised well. In addition, the implementation of outdoor learning could be effective in developing Science Process Skills (SPS) and problem-solving abilities.[31]

Science teachers in three SPIE investigated also provided a variety of learning activities to build students' skills. For instance, the teachers started a lesson with an advanced organizer, asked SWD to work in pairs, provided a worksheet for practical activities, and offered additional time for doing assignments and tasks. In the interview session, Rida claimed that various activities such as discussion, presentation, simulation, games, watching the video and practical in the laboratory were offered to assist SWD in actively participating in science lesson. When conducting a practical laboratory, Melia, Rida, and Lani claimed in the interview, that a worksheet for laboratory practical work was offered to help students do the activities. For students with hearing impairment, Melia usually showed the procedures that those students should follow in doing the practical work. Melia mentioned in the interview:

> Sometimes I applied a practical for a particular topic. And sometimes I prepared a worksheet for them to make the practical more coherent and gave them instructions on what should they do. For that student with hearing impairment, I usually gave him a question, then a direction, I showed number one like this, two like that, and so on, then I continued to demonstrate like this. I would see if he can copy what I did or not.

Rida also claimed beside using a modified worksheet and individual task, she tried to vary the activities (e.g., reading, writing, and basic arithmetic) that were suitable for their cognitive levels. Lani stated that an individual worksheet, presentations and projects were applied to increase individual choice and autonomy of SWD, as she mentioned in the interview: "*I used individual worksheets and sometimes I ordered children to do a*

[30] Anthony V. DeFina, "Building Science Process Skills," *Science Teacher* 73, no. 1 (2006): 36–41.

[31] S. Wahyuni et al., "Developing Science Process Skills and Problem Solving Abilities Based on Outdoor Learning in Junior High School," *Jurnal Pendidikan IPA Indonesia* 6, no. 1 (2017): 165–69, https://doi.org/10.15294/jpii.v6i1.6849.

project. When it's finished, they submitted their project and presented it one-on-one to me."

Various teaching strategies offered by science teachers in three SPIE support some previous studies. A review study by Vavougios et al.[32] on teaching science to SWD demonstrates some effective strategies applied by researchers including exploratory learning, hands-on activities, discovery learning, inquiry learning, problem-based learning. Steele and Westwood[33] recommended some strategies, which are: peer tutoring, collaborative and cooperative working group, project, explicit instruction, thematic lesson, interactive teaching, laboratory works, graphic organizer, computer-assisted learning, computer simulations, preview key concept or vocabularies, video, and visual representation. To select these strategies, however, the teacher should ponder the learning objectives, the students' cognitive level, and their characteristics;[34] in which did not consider by almost science teacher participants in this study. Therefore, it can be concluded that the variety of teaching strategies offered are not fully inclusive, yet good teaching strategies.

Inclusive content

Findings confirm Schools Bintang, Bulan and Matahari offered limited media and tools in the way science teachers make individualization work for SWD. Nevertheless, the research literature highlight that individual learns information using different techniques[35] and each student has different techniques and abilities to process sensory (aural, visual, or tactile patterns) information.[36] Therefore, a single method of presentation will not work for all students. Each SWD has a specific disability that it might affect how teacher select the media that are suitable for those students. However, the science teachers in this study lacked awareness of how the disability of SWD have were considered when the teacher designed and selected instructional media for SWD.

[32] Dionisios Vavougios et al., "Teaching Science to Students with Learning and Other Disabilities: A Review of Topics and Subtopics Appearing in Experimental Research 1991-2015," *International Journal of Higher Education* 5, no. 4 (2016), https://doi.org/10.5430/ijhe.v5n4p268.

[33] Marcee M. Steele, "Science Success for Students with Special Needs," *Science and Children* 45, no. 2 (2007): 48–51; Peter Westwood, *Teaching and Learning Difficulties: Cross-Curricular Perspectives* (Victoria, Australia: ACER Press, 2006).

[34] Westwood, *Teaching and Learning Difficulties: Cross-Curricular Perspectives*.

[35] Westwood.

[36] David H. Rose et al., *Teaching Every Student in the Digital Age: Universal Design for Learning* (USA: Association for Supervision and Curriculum Development (ASCD), 2002).

Science teachers in School Bintang asserted they accommodated students with hearing impairment by providing science content in visual forms such as textbooks, worksheets, and videos; and simplified science content, which does not vary enough to make science content can be fully accessed by students with hearing impairment. Those science teachers admitted that they did not provide students with hearing impairment with specific science learning media. Since vision was the main means for receiving information by students with hearing impairment, science teachers in School Bintang asserted they focused on learning media that could be accessed through visual modalities, e.g., printed materials, images, captioned videos, models, and social media (WhatsApp chat application). Two teacher participants from this school said that visual cues help students with hearing impairment to advance their understanding. This echoes the work of Shah and Freedman who explained the advantages of using visualizations for learning, i.e.: to process the information deeper, to provide an external representation of the information, and to maintain students attention by providing more attractive information; thus, complex information is understood easier.[37]

However, previous studies[38] show that multiple (visual) representations are not always effective and applicable to promote learning. A new representation makes students face complex learning task and this force the students to understand what the meaning of the information.[39] Other scholars underlined that representations should be used in the "right" way, to improve students' learning,[40] to avoid students get confused and produce problems in translating between representations.[41]

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[37] Priti Shah and Eric G. Freedman, "Visuospatial Cognition in Electronic Learning," *Journal of Educational Computing Research* 29, no. 3 (2003): 315–24, https://doi.org/10.2190/QYVJ-Q59L-VE7C-EHUV.

[38] Shaaron E. Ainsworth, "DeFT: A Conceptual Framework for Considering Learning with Multiple Representations," *Learning and Instruction* 16 (2006): 183–98, https://doi.org/10.1016/j.learninstruc.2006.03.001; Martina A. Rau and Percival G. Matthews, "How to Make 'More' Better? Principles for Effective Use of Multiple Representations to Enhance Students' Learning about Fractions," *Zentralblatt Für Didaktik Der Mathematik* 49, no. 4 (2017): 531–44, https://doi.org/10.1007/s11858-017-0846-8; Wolfgang Schnotz and Richard Lowe, "External and Internal Representations in Multimedia Learning," *Learning and Instruction* 13, no. 2 (2003): 117–23, https://doi.org/10.1016/s0959-4752(02)00015-4; Jan van der Meij and Ton de Jong, "Supporting Students' Learning with Multiple Representations in a Dynamic Simulation-Based Learning Environment," *Learning and Instruction* 16, no. 3 (2006): 199–212, https://doi.org/10.1016/j.learninstruc.2006.03.007.

[39] Ainsworth, "DeFT: A Conceptual Framework for Considering Learning with Multiple Representations"; Schnotz and Lowe, "External and Internal Representations in Multimedia Learning."

[40] Rau and Matthews, "How to Make 'More' Better? Principles for Effective Use of Multiple Representations to Enhance Students' Learning about Fractions."

[41] van der Meij and de Jong, "Supporting Students' Learning with Multiple Representations in a Dynamic Simulation-Based Learning Environment."

In-School Bulan, science contents for students with visual impairment was greatly offered in electronic forms, such as *Buku Sekolah Elektronik* (e-book), while touchable media and audio forms were not available. According to Ediyanto and Kawai[42] the accessibility of science learning can be provided with applicable support such as auditory learning, tactile and kinesthetic learning, orientation and mobility (OM), and assistive technology. Similarly, Kumar et al.[43] Pointed out some suggestions for teaching science for SWD, i.e., Braille, tactile images, adaptive electronic media, real objects, large print, and assistive technology enabled students with visual impairment access to learning science.

In-School Matahari, science teachers made an individual worksheet to accommodate the different levels of cognitive of students with learning difficulties in accessing science content. Other media such as real daily examples, videos, computer simulations, and web-based games were also provided in School Matahari.

Even though science content was not offered within various sensory and modality in the three SPIE, the literature proposes that offerin more than one sensory mode was critical for allowing SWD to build their knowledge. Mayer[44] concluded the multimodal learning environment offers more chances to present teaching and learning elements. Presenting information in a variety modes may help lower-achieving students to learn in easier ways, increase attention and lead to improve learning achievement.[45] In addition, Fadel[46] stated "students engaged in learning that incorporates multimodal designs, on average, outperform students who learn using traditional approaches with single modes". The key advantage of having a multimodal design is that it: "allows students to experience learning in ways in which they are most comfortable while challenging them to

[42] Ediyanto and N. Kawai, "Science Learning for Students with Visually Impaired: A Literature Review," *Journal of Physics: Conference Series* 1227 (2019): 1–9, https://doi.org/10.1088/1742-6596/1227/1/012035.

[43] David D. Kumar, Ramasamy Rangasamy, and Greg P. Stefanich, "Science Instruction for Students with Visual Impairments," *ERIC Digest* SE 065 394 (2001).

[44] Richard E. Mayer, "Elements of a Science of E-Learning," *Journal of Educational Computing Research* 29, no. 3 (2003): 297–313.

[45] Gongxiang Chen and Xiaolan Fu, "Effects of Multimodal Information on Learning Performance and Judgment of Learning," *Journal of Educational Computing Research* 29, no. 3 (2003): 349–62, https://doi.org/10.2190/J54F-B24D-THN7-H9PH; Roxana Moreno and Richard Mayer, "Interactive Multimodal Learning Environments," *Educational Psychology Review* 19, no. 3 (2007): 309–26, https://doi.org/10.1007/s10648-007-9047-2.

[46] Charles Fadel, *Multimodal Learning through Media: What the Research Says* (San Jose, CA: Cisco Systems, 2008)., 13

experience and learn in other ways as well";[47] allows them to select the learning material that best suits their choices;[48] and increases students' ability to control their learning progress through the materials.[49] When students are allowed to choose their learning material, they will better engage in learning and make learning experiences more inclusive.[50]

Inclusive technology

Although all teachers realized and understood how SWD needs to interact with different tools, only teachers in-School Matahari utilized more assistive technologies to help SWD in learning science than in Schools Bintang and Bulan. In School Matahari, science teachers provided some tools to help students with learning difficulties in science classrooms, e.g., calculators; Science Practical Kits; computers, and daily sample goods for simulation; apps that are installed in iPads, Android, or other devices. Science teachers in-School Matahari claimed that they were leading digital learning and distance learning to all students (offered for SWD). To promote digital and distance learning, this school has join cooperation with Apple, and science teachers utilized many apps to encourage students in learning science. This school provided a multimedia room, which was a room equipped with an iPad that help students to learn science easier and with more fun. For example, one teacher said she used a KAHOOT quiz to get students' attention and facilitate them with more fun quizzes and assignments. Another science teacher in this school claimed she simulated some topics by computer and showed them to increase students understanding about of topics.

To master science concepts, students with visual impairment require "appropriate adaptations and individual instructional design"; [51] and "more tactual and audio experiences than visual instruction".[52] Whereas to cope with print (e.g. many science concepts are presented graphically) and problems with vision (e.g. many concepts are put

[47] Anthony G. Picciano, "Blending with Purpose: The Multimodal Model," *Journal of the Research Centre for Educational Technology* 5, no. 1 (2009): 4–14, https://doi.org/10.24059/olj.v13i1.1673., 13

[48] Peter E. Doolittle et al., "Multimedia, Cognitive Load, and Pedagogy," in *Interactive Multimedia in Education and Training*, ed. S. Mishra and R. C. Sharma (London: Idea Group, Inc., 2005), 289–310.

[49] Yiasemina Karagiorgi and Loizos Symeou, "Translating Constructivism into Instructional Design: Potential and Limitations," *Educational Technology & Society* 8, no. 1 (2005): 17–27.

[50] Picciano, "Blending with Purpose: The Multimodal Model."

[51] Aydın Kızılaslan, "Linking Theory to Practice: Science for Students with Visual Impairment," *Science Education International* 30, no. 1 (2019): 56–64, https://doi.org/10.33828/sei.v30.i1.7., 56

[52] Mehmet Sahin and Nurettin Yorek, "Teaching Science to Visually Impaired Students: A Small-Scale Qualitative Study," *US-China Education Review* 6, no. 4 (2009): 19–26.

across through visual observations and hard to be explored by touch) to access material, students can be aided with assistive technologies,[53] such as tactile materials, audio-recording, and 3D model; in which these modalities were available in limit in-School Bulan. In addition, to increase students with visual impairment engagement in a laboratory, assistive technologies (low and high-tech laboratory devices) were not provided in this school. Some scholars suggested low-cost modified laboratory equipment such as a talking thermometer, a talking balance,[54] a braille periodic table, a braille metric ruler, a talking scientific calculator, a color identifier[55] to be used to help students with visual impairment in working in the laboratory. Other high-tech laboratory devices for science laboratories have also been developed, i.e., Logger Pro, Pasco, LabView,[56] Vernier Software & Technology LabQuest,[57] and Sci-Voice Talking LabQuest;[58] in which demonstrate improving the participation of students with visual impairment in science learning activities.

CONCLUSION

Each participant faced various challenges and barriers in providing accessibility for SWD in science learning, however all participants considered how learning is achieved and provided various teaching strategies to help SWD succeed. Even though one school provided a lecturing method as the main strategy to teach students with visual impairment, the other two schools investigated offered various teaching strategies and applied inquiry-based instruction. All teachers attempted to create science content that is

[53] Peter Westwood, *A Parent's Guide to Learning Difficulties: How to Help Your Child* (Camberwell, Vic.: ACER Press, 2008).

[54] Cary A. Supalo et al., "Low-Cost Laboratory Adaptations for Precollege Students Who Are Blind or Visually Impaired," *Journal of Chemical Education* 85, no. 2 (2008): 243–47, https://doi.org/10.1021/ed085p243.

[55] Karen E. Koehler and Tiffany A. Wild, "Students with Visual Impairments' Access and Participation in the Science Curriculum: Views of Teachers of Students with Visual Impairments," *Journal of Science Education for Students with Disabilities* 22, no. 1 (2019): 1–17.

[56] Cary A. Supalo and Thomas E. Mallouk, "Talking Tools to Assist Students Who Are Blind in Laboratory Courses," *Journal of Science Education for Students with Disabilities* 12, no. 1 (2007): 27–32, https://doi.org/10.14448/jsesd.01.0003.

[57] Cary A. Supalo, "The Next Generation Laboratory Interface for Students with Blindness or Low Vision in the Science Laboratory," *Journal of Science Education for Students with Disabilities* 16, no. 1 (2012), https://doi.org/10.14448/jsesd.05.0004.

[58] KC. Kroes et al., "Development of Accessible Laboratory Experiments for Students with Visual Impairments," *Journal of Science Education for Students with Disabilities* 19, no. 1 (2016): 61–67, https://doi.org/10.14448/jsesd.09.0006; Cary A. Supalo, Mick D. Isaacson, and Michael V. Lombardi, "Making Hands-on Science Learning Accessible for Students Who Are Blind or Have Low Vision," *Journal of Chemical Education* 91, no. 2 (2014): 195–99, https://doi.org/10.1021/ed3000765.

accessible and relevant to SWD and to meet their expectations, however, media were limited to SWD interacting with science materials. Science teachers in School Matahari created different worksheets based on the student's needs as the main learning source, while other teachers in Schools Bintang and Bulan claimed they had no time to vary science modalities. Although all teachers understood how SWD needs to interact with different tools, only teachers in School Matahari utilized assistive technologies to help SWD in learning science.

ACKNOWLEDGMENTS

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DECLARATION OF CONFLICTING INTERESTS

The author declares that there is no conflict of interest.

FUNDING

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REFERENCES

Ainsworth, Shaaron. "Deft: A Conceptual Framework for Considering Learning with Multiple Representations." *Learning and Instruction* 16 (2006): 183-98. https://doi.org/10.1016/j.learninstruc.2006.03.001.

Anjarsari, Anggun Dyah, Mohammad Efendy, and Sulthoni. "Penyelenggaraan Pendidikan Inklusi Pada Jenjang Sd, Smp, Dan Sma Di Kabupaten Sidoarjo (Translation: The Implementation of Inclusion Education Assistance for Elementary, Junior High, and Senior High School in Sidoarjo Regency)." *Jurnal Pendidikan Inklusi* 1, no. 2 (2018): 91-104.

Aydeniz, Mehmet, David F. Cihak, Shannon C. Graham, and Larryn Retinger. "Using Inquiry-Based Instruction for Teaching Science to Students with Learning Disabilities." *International Journal of Special Education* 27, no. 2 (2012): 1-17.

Bargerhuff, Mary Ellen, Heidi Cowan, and Susan A. Kirch. "Working toward Equitable Opportunities for Science Students with Disabilities: Using Professional Development and Technology." *Disability and Rehabilitation: Assistive Technology* 5, no. 2 (Jan 2010): 125-35.

https://doi.org/10.3109/17483100903387531. https://www.ncbi.nlm.nih.gov/pubmed/20184529.

Basham, James D., Maya Israel, Janet Graden, Rita Poth, and Markay Winston. "A Comprehensive Approach to Rti: Embedding Universal Design for Learning and Technology." *Learning Disability Quarterly* 33, no. 4 (2010): 243-55. https://doi.org/10.1177/073194871003300403.

Beaudoin, Jean-Pascal. *Introduction to Inclusive Teaching Practices.* Ottawa: Centre for University Teaching & Learning Support Service, University of Ottawa, 2013.

Bernacchio, Charles, and Michelle Mullen. "Universal Design for Learning." *Psychiatric Rehabilitation Journal* 31, no. 2 (Fall 2007): 167-9. https://doi.org/10.2975/31.2.2007.167.169. https://www.ncbi.nlm.nih.gov/pubmed/18018964.

Brand, Susan Trostle, Antoinette E. Favazza, and Elizabeth M. Dalton. "Universal Design for Learning: A Blueprint for Success for All Learners." *Kappa Delta Pi Record* 48, no. 3 (2012): 134-39. https://doi.org/10.1080/00228958.2012.707506. http://dx.doi.org/10.1080/00228958.2012.707506.

Buxton, Cory A., and Eugene F. Provenzo. *Teaching Science in Elementary and Middle School: A Cognitive and Cultural Approach (Second Ed.).* Thousand Oaks, CA: Sage Publications, 2010.

Chen, Gongxiang, and Xiaolan Fu. "Effects of Multimodal Information on Learning Performance and Judgment of Learning." *Journal of Educational Computing Research* 29, no. 3 (2003): 349-62. https://doi.org/10.2190/J54F-B24D-THN7-H9PH.

DeFina, Anthony V. "Building Science Process Skills." *Science Teacher* 73, no. 1 (2006): 36-41.

Doolittle, Peter E., Andrea L. McNeill, Krista P. Terry, and Stephanie B. Scheer. "Multimedia, Cognitive Load, and Pedagogy." Chap. X In *Interactive Multimedia in Education and Training*, edited by S. Mishra and R. C. Sharma, 289-310. London: Idea Group, Inc., 2005.

Ediyanto, and N. Kawai. "Science Learning for Students with Visually Impaired: A Literature Review." *Journal of Physics: Conference Series* 1227 (2019): 1-9. https://doi.org/10.1088/1742-6596/1227/1/012035.

Fadel, Charles. *Multimodal Learning through Media: What the Research Says.* San Jose, CA: Cisco Systems, 2008.

Fenanlampir, Alberthus, John Rafafy Batlolona, and Imelda Imelda. "The Struggle of Indonesian Students in the Context of Timss and Pisa Has Not Ended." *International Journal of Civil Engineering and Technology (IJCIET)* 10, no. 02 (2019): 393-406.

Graybill, Cameala M., Cary A. Supalo, Thomas E. Mallouk, Christeallia Amorosi, and Lillian Rankel. "Low-Cost Laboratory Adaptations for Precollege Students Who Are Blind or Visually Impaired." *Journal of Chemical Education* 85, no. 2 (2008): 243-47. https://doi.org/10.1021/ed085p243.

Handayani, Titik, and Angga Sisca Rahadian. "Peraturan Perundangan Dan Implementasi Pendidikan Inklusif. Translation: Legislation and Implementation of Inclusive Education." *Masyarakat Indonesia* 39, no. 1 (2013): 27-48.

Hitchcock, Chuck, Anne Meyer, David Rose, and Richard Jackson. "Providing New Access to the General Curriculum: Universal Design for Learning." *TEACHING Exceptional Children* 35, no. 2 (2002): 8-17. https://doi.org/10.1177/004005990203500201.

IDCT. *Indonesia Shadow Report: Implementation of the United Nations Convention on the Rights of Persons with Disabilities.* United Nations Committe on The Rights of Persons with Disabilities (2017).

Israel, Maya, Cecelia Ribuffo, and Sean Smith. *Universal Design for Learning: Recommendations for Teacher Preparation and Professional Development.* Florida: University of Florida, Collaboration for Effective Educator, Development, Accountability, and Reform Center, 2014.

Izzo, Margaretha Vreeburg, and William M. Bauer. "Universal Design for Learning: Enhancing Achievement and Employment of Stem Students with Disabilities." *Universal Access in the Information Society* 14, no. 1 (2013). https://doi.org/10.1007/s10209-013-0332-1.

Kahn, Sami , Tiffany Wild, M. Lynn Woolsey, and Justin A. Haegele. "Let’s Get Physical." *Science and Children* 51, no. 5 (2014).

Karagiorgi, Yiasemina, and Loizos Symeou. "Translating Constructivism into Instructional Design: Potential and Limitations." *Educational Technology & Society* 8, no. 1 (2005): 17-27.

King-Sears, Margaret. "Universal Design for Learning: Technology and Pedagogy." *Learning Disability Quarterly* 32, no. 4 (2009): 199-201. https://doi.org/10.2307/27740372.

King-Sears, Margaret E., Todd M. Johnson, Sheri Berkeley, Margaret P. Weiss, Erin E. Peters-Burton, Anya S. Evmenova, Anna Menditto, and Jennifer C. Hursh. "An Exploratory Study of Universal Design for Teaching Chemistry to Students with and without Disabilities." *Learning Disability Quarterly* 38, no. 2 (2015): 84–96. https://doi.org/10.1177/0731948714564575. sagepub.com/journalsPermissions.nav DOI: 10.1177/0731948714564575 ldq.sagepub.com

Kızılaslan, Aydın. "Linking Theory to Practice: Science for Students with Visual Impairment." *Science Education International* 30, no. 1 (2019): 56-64. https://doi.org/10.33828/sei.v30.i1.7.

Koehler, Karen E., and Tiffany A. Wild. "Students with Visual Impairments’ Access and Participation in the Science Curriculum: Views of Teachers of Students with Visual Impairments." *Journal of Science Education for Students with Disabilities* 22, no. 1 (2019): 1-17.

Kroes, KC., Daniel Lefler, Aaron Schmitt, and Cary A. Supalo. "Development of Accessible Laboratory Experiments for Students with Visual Impairments."

Journal of Science Education for Students with Disabilities 19, no. 1 (2016): 61-67. https://doi.org/10.14448/jsesd.09.0006

Kumar, David D. , Ramasamy Rangasamy, and Greg P. Stefanich. "Science Instruction for Students with Visual Impairments." *ERIC Digest* SE 065 394 (2001).

Mastropieri, Margo A., and Thomas Ë. Scruggs. "Science for Students with Disabilities." *Review of Educational Research* 62, no. 4 (1992): 377-411. https://doi.org/10.3102/00346543062004377.

Mayer, Richard E. "Elements of a Science of E-Learning." *Journal of Educational Computing Research* 29, no. 3 (2003): 297-313.

Melber, Leah. "Inquiry for Everyone: Authentic Science Experiences for Students with Special Needs." *TEACHING Exceptional Children Plus* 1, no. 2 (2004): n.a.

Ministry of Education and Culture. *Kurikulum 2013 (Curriculum 2013).* Jakarta: Department of Education and Culture, Indonesia, 2013.

Newton, Norrisa, Janelle Carbridg, and Yvonne Hunter-Johnson. "Teachers' Perceptions of Inclusive Education and Its Implication for Adult Education in the Bahamas." Adult Education Research Conference, Harrisburg, PA, 2014.

Nurhayati, Pradhikna Yunik. "Mewujudkan Pendidikan Inklusif: Tinjauan Atas Praktik Sekolah Inklusi Tingkat Menengah Di Kota Yogyakarta (Translation: Realizing Inclusive Education: An Overview of the Practice of Inclusive Secondary Schools in the Yogyakarta Municipality)." *Welfare, Jurnal Ilmu Kesejahteraan Sosial* 1, no. 1 (2012): 103-18.

Picciano, Anthony G. "Blending with Purpose: The Multimodal Model." *Journal of the Research Centre for Educational Technology* 5, no. 1 (2009): 4-14. https://doi.org/10.24059/olj.v13i1.1673.

Rau, Martina A., and Percival G. Matthews. "How to Make 'More' Better? Principles for Effective Use of Multiple Representations to Enhance Students' Learning About Fractions." *Zentralblatt für Didaktik der Mathematik* 49, no. 4 (2017): 531-44. https://doi.org/10.1007/s11858-017-0846-8.

Rooks-Ellis, Deborah L. "Inquiry-Based Education for Students with Visual Impairment." edited by K. Capps, K. Kingsley, K. Y. Kuo and L. Roecker, 1-7: Hindawi, 2014.

Rose, David H., and Anne Meyer. *Teaching Every Student in the Digital Age: Universal Design for Learning.* USA: Association for Supervision and Curriculum Development (ASCD), 2002.

Sahin, Mehmet, and Nurettin Yorek. "Teaching Science to Visually Impaired Students: A Small-Scale Qualitative Study." *US-China Education Review* 6, no. 4 (2009): 19-26.

Schnotz, Wolfgang, and Richard Lowe. "External and Internal Representations in Multimedia Learning." *Learning and Instruction* 13, no. 2 (2003): 117-23. https://doi.org/10.1016/s0959-4752(02)00015-4.

Scruggs, Thomas E., Margo A. Mastropieri, and Richard Boon. "Science Education for Students with Disabilities: A Review of Recent Research." *Studies in Science Education* 32 (1998): 21-44.

Shah, Priti, and Eric G. Freedman. "Visuospatial Cognition in Electronic Learning." *Journal of Educational Computing Research* 29, no. 3 (2003): 315-24. https://doi.org/10.2190/QYVJ-Q59L-VE7C-EHUV.

Steele, Marcee M. "Science Success for Students with Special Needs." *Science and Children* 45, no. 2 (2007): 48-51.

Stefanich, Greg, Pat Holthaus, and Louise Bell. "The Cascade Model for Managing Students with Disabilities in Science Classrooms." Chap. 8 In *Science Teaching in Inclusive Classrooms: Theory & Foundation*, edited by Greg Stefanich, 115-26: The National Science Foundation, 2001.

Sukhai, Mahadeo A., and Chelsea E. Mohler. "Accommodating Students with Disabilities in Science Laboratories and in Fieldwork." In *Creating a Culture of Accessibility in the Sciences*, edited by Mahadeo A. Sukhai and Chelsea E. Mohler, 199-205, 2017.

Supalo, Cary A. . "The Next Generation Laboratory Interface for Students with Blindness or Low Vision in the Science Laboratory." *Journal of Science Education for Students with Disabilities* 16, no. 1 (2012). https://doi.org/10.14448/jsesd.05.0004.

Supalo, Cary A., Mick D. Isaacson, and Michael V. Lombardi. "Making Hands-on Science Learning Accessible for Students Who Are Blind or Have Low Vision." *Journal of Chemical Education* 91, no. 2 (2014): 195-99. https://doi.org/10.1021/ed3000765.

Supalo, Cary A., and Thomas E. Mallouk. "Talking Tools to Assist Students Who Are Blind in Laboratory Courses." *Journal of Science Education for Students with Disabilities* 12, no. 1 (2007): 27-32. https://doi.org/10.14448/jsesd.01.0003.

The Next Generation Science Standards. "The Next Generation Science Standards for States, by States." news release, 2013, https://www.nextgenscience.org/.

Trundle, Kathy Cabe. "Inquiry-Based Science Instruction for Students with Disabilities." Chap. 7 In *Science as Inquiry in the Secondary Setting*, edited by Julie Luft, Randy L. Bell and Julie Gess-Newsome, 79-85. Arlington, Va.: NSTA Press, 2008.

UN. *Realization of the Sustainable Development Goals by, for and with Person with Disabilities: Un Flagship Report on Disability and Development.* The Division for Inclusive Social Development (DISD), Department for Economic and Social Affairs, 2018.

van der Meij, Jan, and Ton de Jong. "Supporting Students' Learning with Multiple Representations in a Dynamic Simulation-Based Learning Environment." *Learning and Instruction* 16, no. 3 (2006): 199-212. https://doi.org/10.1016/j.learninstruc.2006.03.007.

Vavougios, Dionisios, Alkistis Verevi, Panagiotis Papalexopoulos, Crystallia-Ioanna Verevi, and Athanasia Panagopoulou. "Teaching Science to Students with Learning and Other Disabilities: A Review of Topics and Subtopics Appearing in

Experimental Research 1991-2015." *International Journal of Higher Education* 5, no. 4 (2016). https://doi.org/10.5430/ijhe.v5n4p268.

Wahyuni, S., I. Indrawati, S. Sudarti, and W. Suana. "Developing Science Process Skills and Problem Solving Abilities Based on Outdoor Learning in Junior High School." *Jurnal Pendidikan IPA Indonesia* 6, no. 1 (2017): 165-69. https://doi.org/10.15294/jpii.v6i1.6849.

Westwood, Peter. *A Parent's Guide to Learning Difficulties: How to Help Your Child.* Camberwell, Vic.: ACER Press, 2008.

———. *Teaching and Learning Difficulties: Cross-Curricular Perspectives.* Victoria, Australia: ACER Press, 2006.

Yin, Robert K. *Case Study Research: Design and Methods, 5th Ed.* Thousand Oaks, CA: Sage Publications, 2014.