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Systematic Literature Review: Obstacles to Learning Science and Technology in the Independent Curriculum in Elementary Schools

Atiko Nur Oktaviani[1]; Siti Sarah[1]*; Dian Aswita[2]; Badratun Nafis[2]; Arif Maftukhin[3]

[1]Universitas Islam Negeri Profesor Kiai Haji Saifuddin Zuhri Purwokerto, Indonesia

[2]Universitas Serambi Mekkah, Indonesia

[3]Universitas Muhammadiyah Purworejo, Indonesia

Corresponding author's email: sitisarah@uinsaizu.ac.id

Abstract: IPAS is a combination of Natural Sciences and Social Sciences and is part of the Independent Curriculum at the Elementary Education level in Indonesia. The new Independent Curriculum makes IPAS also a new learning material. This requires educators and educational units to adjust learning patterns to the demands of the independent curriculum. This study aims to explore various obstacles to IPAS learning in the independent curriculum in elementary schools/Islamic elementary schools. The study used the Systematic Literature Review (SLR) method by analyzing 32 articles selected through Google Scholar and SINTA which contain information about IPAS learning in elementary schools and grouping them into several groups. The results of the study showed that the obstacles to IPAS learning were divided into 6 groups starting from the largest to the smallest, namely teacher problems in implementing the independent curriculum (53%), application of media and learning methods (19%), teacher and school readiness (13%), student learning difficulties (6%), obstacles and handling of implementation (3%), assessment in the independent curriculum (3%). The research results provide comprehensive information regarding various obstacles to science learning in the context of the Independent Curriculum in Elementary Schools/Islamic Elementary Schools, as well as providing a strong foundation for practitioners and education policy makers in the future to make the implementation of science learning at the elementary school level a success.

Keywords: *systematic literature review; science and technology learning; independent curriculum; elementary school*

A. INTRODUCTION

In 2022, the Indonesian Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) will begin implementing the Independent Curriculum (Web kemdikbud, 2022). This curriculum is designed to answer the challenges of

education in the era of globalization that emphasizes the development of 21st century skills, such as critical thinking, creativity, collaboration, and communication. Quoting from the book "Geography Learning Planning (Complete with the Independent Curriculum)" by Hadi Soekamto and Budi Handoyo, the independent curriculum is a competency-based curriculum with a new paradigm that integrates differentiated learning and Pancasila character strengthening projects (Handoyo & Soekamto, 2023). Minister of Education Nadiem Makarim stated that the Independent Curriculum is expected to produce graduates who are not only academically superior but also ready to face sustainable global challenges with strong competencies and characters in the Sustainable Development Goals (SDGs) corridor. The implementation of this curriculum is regulated in Permendikbud Number 22 of 2022 concerning Elementary and Secondary Education Process Standards (Mendikbudristek, 2022).

Nadiem Makarim hopes that the Independent Curriculum can accelerate the transformation of Indonesian education to be more relevant to the needs of the times (Web Kemendikbud). In his statement, he emphasized the importance of this curriculum in preparing students to face the industrial revolution 4.0 and society 5.0. The industrial revolution 4.0 refers to a massive transformation in various industries through digital technologies, such as AI and IoT. Meanwhile, society 5.0 is a concept introduced by Japan that focuses on a human-centered society (Astini, 2022), where advanced technology is used to improve the quality of life of the concept of a human-centered society, by utilizing technological advances for social welfare. In addition, the Independent Curriculum also aims to improve PISA (Programme for International Student Assessment) scores (Iskandar et al, 2023, pp. 78-84) which is an international assessment of students' reading, mathematics, and science skills. PISA (Programme for International Student Assessment) is a global study that measures the abilities of 15-year-old students in reading, mathematics, and science (Pakpahan, 2016, pp. 331-348). The aim of PISA is to evaluate education systems in different countries by assessing the skills that are essential for life in the modern world (Zhao, 2020, p. 66), Ozer, 2020, p.28). With the implementation of the Independent Curriculum, it is hoped that there will be a significant increase in Indonesia's PISA scores. This will show that Indonesian students have sufficient competence to compete at the global level. The Minister of Education also hopes that this curriculum will not only improve students' academic competence but also develop non-academic skills that are essential for 21st century life. The main goal is to form students who are creative, critical, independent, and have the ability to collaborate and innovate in various fields. Regulations that support the implementation of the Independent Curriculum are regulated in the Regulation of the Minister of Education, Culture, Research, and Technology of the Republic of Indonesia Number 56/M/2022, which emphasizes the importance of the Pancasila student profile (Rahmadayanti & Hartoto, 2022, p.87).

One of the subjects affected by the changes to the Independent Curriculum is Natural and Social Sciences (IPAS) (Mubarak, 2022, Mulyasa, 2023). The IPA learning approach is designed to make learning more integrated and project-based. The goal of IPA learning is to help students develop critical and creative thinking skills. IPA learning in Elementary Schools also carries several significant pedagogical approaches, such as inquiry-based learning that encourages students to be actively involved in the learning process through observation, experimentation, and concept formation based on existing knowledge (Arief, 2023). The IPAS learning approach also emphasizes the importance of contextual learning, where the material taught is relevant to students' daily lives (Wijayanti & Ekantini, 2023, pp. 2100-2112, Febriyanti et al, n.d.).

Some of the main challenges faced in implementing the Independent Curriculum include the need for teachers to step out of their comfort zone (Syafruddin, 2023). Many teachers are accustomed to conventional teaching methods dominated by direct delivery of material, which makes students tend to be passive. The Merdeka Curriculum requires significant changes in teaching methods, where students are encouraged to be more active in discussing and solving problems together. In addition, other challenges are the lack of experience of teachers in the Merdeka Learning program and the limited references and adequate learning resources. Further criticism of the implementation of the Merdeka Curriculum also came from Doni Koesoema, an education observer and Chairman of the Board of Directors of the Indonesian Education Providers Alliance (APPI) who questioned the implementation of the Merdeka Curriculum which seemed unprepared (Redaksi Swara Pendidikan, 2022). Science as a new subject matter in the Independent Curriculum also poses a new challenge in teaching, both from the teacher and school side. This needs to be analyzed in order to prepare successful science learning in accordance with the demands of the Independent Curriculum.

So far, there has been no comprehensive research that maps the various challenges and obstacles to learning science in elementary schools. This overview is very important to understand the spectrum of research on obstacles to learning science in depth, so that the variety of research that has been done and areas that have not been reached can be clearly identified. This research is expected to reveal various problems in learning science and allow the discovery of important problems that have not been explored to then find solutions. So, the purpose of this study is to analyze the results of research related to various obstacles to learning science in the Merdeka Curriculum in elementary schools/ MI today.

B. MATERIALS AND METHODS

This research uses the Systematic Literature Review (SLR) method or systematic literature review, namely an approach to literature review that identifies, assesses, evaluates and interprets all available research (S. Saha et al, 2022). The study reviewed a number of articles related to the intended topic, namely obstacles to

learning Natural and Social Sciences (IPAS) from various journals that have been published in Google Scholar and SINTA in 2023 to 2024. Google Scholar and SINTA were chosen as databases for several reasons. SINTA is a trusted national journal publication center in Indonesia. Google Scholar provides national and international research results with proven quality. Based on the various articles available, researchers selected 32 articles related to the theme. Data analysis was carried out by dividing the articles into 6 main categories, namely teacher problems in implementing the independent curriculum, student learning difficulties, application of media and learning methods, assessment in the independent curriculum, teacher and school readiness, obstacles and handling of implementation.

C. RESULT AND DISCUSSION

The following are 32 research articles related to the obstacles to learning science in the independent curriculum in elementary schools/Islamic elementary schools published from 2023 to 2024.

Table 1

Article on obstacles to learning science in the independent curriculum in elementary schools/Islamic elementary schools based on research focus

No	Researcher, year	Journal	Research Focus	Research result
1	Sofyan Iskandar et al., 2023	Inovative: Jourrnal of Social Science Research	Problems of implementing the Independent Curriculum in Elementary Schools	Problems: demands for teachers to be more creative, innovative, and technology literate. Demands schools to provide adequate facilities and infrastructure to support learning.
2	Anisya Al Husna & Henry Aditia Rigianti, 2023	Jurnal Basicedu	Teachers' difficulties during the transition from the 2013 Curriculum to the Independent Curriculum in Elementary Schools	Teachers' difficulties in adaptation. Teachers must adjust their teaching methods to meet the requirements of the new curriculum, which focuses on intracurricular and cocurricular materials.
3	Annisa Aulia & Rahmadita Azlia Anugerah Putri, 2023	PGSD: Jurnal Pendidikan Guru Sekolah Dasar	Challenges of Implementing Innovative Learning Media in Science Subjects in Elementary Schools.	The use of innovative learning media plays an important role in increasing students' motivation and interest in learning science.
4	Dino Rohim & Henry Aditia Rigianti, 2023	Jurnal Basicedu	Obstacles in implementing the	Obstacles for grade IV teachers in implementing the

No	Researcher, year	Journal	Research Focus	Research result
			Independent Curriculum in Elementary Schools	independent curriculum. Lack of adequate training, limited facilities, and difficulties in understanding and implementing new learning strategies according to the demands of the independent curriculum.
5	Lia Wanti & Ika Chastanti, 2023	Jurnal Pendas: Jurnal Ilmiah Pendidikan Dasar	Preparation for the implementation of the independent curriculum and science learning at UPTD SD Negeri 09 PanaiTengah Kabupaten Labuhanbatu	Preparation of SD Negeri 09 Panai to implement the Independent Curriculum training for teachers, coordination meetings related to the Pancasila student profile project, and the preparation of syllabus and lesson plans. Most teachers still have difficulty adjusting to the independent curriculum
6	Siti Zulaiha; Tika Meldina; Meisin, 2023	Terampil: Jurnal Pendidikan dan Pembelajaran Dasar	Teachers' problems in implementing the Independent Learning Curriculum in elementary schools.	Teachers faced several problems during the trial implementation of the independent curriculum, such as difficulties in analyzing CP, formulating learning objectives, compiling ATP and teaching modules, determining learning methods and strategies, utilizing technology optimally, obtaining adequate student books, using effective learning methods and media, overcoming the breadth of teaching materials, determining class I and IV projects, allocating project-based learning time, and determining the form of assessment in project-based learning.

No	Researcher, year	Journal	Research Focus	Research result
7	Azi Alam Sudrajat et al., 2023	JPNM: Jurnal Pustaka Nusantara Multidisiplin	Science learning problems at SDN Susukan 06 Pagi, East Jakarta.	Some common problems in science learning at SDN Susukan 06 Pagi, such as changes in the curriculum, lack of teacher training in providing relevant science materials, limited resources and technology, low motivation from students.
8	M. Rio Harits Ikhsandi & Erlisnawati, 2023	Inovative: Journal of Social Science Research	Problems in implementing the Independent Curriculum at SD Negeri 030 Bagan Jaya.	Teachers at SD Negeri 030 Bagan Jaya face several obstacles in implementing the Independent Curriculum, including teachers' lack of understanding and skills in creative learning methods, unsupportive school environment conditions, limited facilities and infrastructure, and limited human resources, difficulties in conducting learning evaluations in accordance with the objectives of the Independent Curriculum.
9	Sumarmi, 2023	Jurnal Social Science Academic	Problems in implementing the Independent Learning Curriculum at MI Negeri 10 Gunungkidul, Yogyakarta	Teachers' difficulties in implementing the independent curriculum, such as lack of understanding of learning outcomes, difficulty in adjusting learning scenarios, and lack of implementation of project-based learning in student worksheets.
10	Setiawan Edi Wibowo, et al., 2023	Jurnal Ilmiah Sekolah Dasar	Challenges of implementing the Independent Curriculum in Indonesian Language learning at Muhammadiyah Kleco 1	The obstacles to implementing the independent curriculum in the upper elementary school classes are: difficulties in designing

No	Researcher, year	Journal	Research Focus	Research result
			Elementary School Yogyakarta	learning tools that require the implementation of project-based learning models that must be adjusted to student characteristics, difficulties in the flow of learning objectives and learning scenarios, and also project-based learning and adjusting it to student characteristics.
12	Dita Arlina; Ikayanti Arsin; Muhammad Sobri, 2023	Pendas : Jurnal Ilmu Pendidikan Dasar	Teachers' problems in learning the Independent Curriculum at SD Negeri 1 Ketangga	Teachers' problems in planning, implementing, and evaluating learning. To overcome this problem, teachers hold regular meetings with the teacher working group (KKG) and participate in Merdeka curriculum implementation training.
13	Eko Bayu Gumilar, 2023	Jurnal Ilmiah Pedagogy	Problems of Science Learning in the Independent Curriculum in Elementary Schools/Islamic Elementary Schools	Challenges such as difficulties in logical, systematic, and critical thinking, as well as low student interest. Influencing factors include teacher teaching methods, culture, assessment systems, and lack of support from parents.
14	Iwan Usma Wardani; Ida Bagus Putu Arnyana; Nyoman Dantes, 2023	*JPPIPA: Jurnal Penelitian Pendidikan IPA*	Science learning problems at SDN Susukan 06 Pagi East Jakarta	Problems of science learning in elementary schools. External factors include family and school environments, where the role of teachers is very important in increasing students' interest and learning achievement. The community environment also influences the formation of students' characters

No	Researcher, year	Journal	Research Focus	Research result
				according to local culture.
15	Nabillatus Solikhah & Aktim Wahyuni, 2023	Jurnal Pendas: Jurnal Ilmiah Pendidikan Dasar	Problems in implementing the Independent Learning Curriculum at SDN Pamotan, Porong District, Sidoarjo	Difficulties in developing Learning Objective Flow (ATP), operating technology, and developing learning models according to the curriculum. At the implementation stage, challenges include difficulties in following the concepts of reading, writing, and arithmetic, as well as time allocation for project-based learning.
16	Nurul Insani Putri, Syania Icha Sabrina, Nanang Budiman, Wulan Tri Puji Utami, 2023	Indonesian Journal of Elementary Education	Barriers for teachers in implementing the Independent Curriculum at SD Negeri 3 Brosot	Barriers to curriculum development.
17	Nur Astri Fifani, Safrizal, Fadriati, 2023	Jurnal Pendas Mahakam	Teachers' difficulties in implementing the Independent Curriculum at Batusangkar City Elementary Schools	Difficulties: technical instructions have not been published and parents' understanding of the curriculum is still lacking
18	Rodiatun Niswah, Rini Apriyani, Winda Agustin, Ines Tasya Jadidah, 2023	Jurnal Edukasi	Teacher readiness in facing the Independent Curriculum, especially in science subjects	Challenges in the science subjects are complicated assessments and limited facilities and infrastructure.
19	Ira Wantiana, Mellisa, 2023	Jurnal Basicedu	Obstacles faced by teachers in implementing the Independent Curriculum	The main obstacle is the limited facilities and technological support which causes the learning process to be less than optimal.
20	Ummi Nur Afinni Dwi Jayanti, Aulia Andin Kinanti, Ade Sekar Anggraini, Adyla Syukhraini	Jurnal Riset Rumpun Matematika dan Ilmu Pengetahuan Alam (JURRIMIPA)	Obstacles and handling in the implementation of the Independent Curriculum	Difficulty in understanding and implementation due to lack of training and resources

No	Researcher, year	Journal	Research Focus	Research result
	Marwi, Putri Agustina Anggreni Arwira, Raini Dahriana Pulungan, 2023			
21	Risa Lailatul Quraniyah, Nur Luthfi Rizqa Herianingtyas, 2023	Jurnal Inovasi dan Teknologi Pendidikan	Readiness of MI/SD teachers in facing the Independent Curriculum	MI/SD teachers need adequate support and capital from the school foundation to integrate independent education plans into learning practices.
22	Khairun Nisa, Muhammad Husin, Aida Fitri, 2023	Cendikia, Jurnal Pendidikan dan Pengajaran	Teachers' problems in implementing the Independent Curriculum in science and science learning	Difficulties in implementing the independent curriculum, especially in planning and implementing science and science learning
23	Mei Nur Rusmiati, Riswati Ashifa, Yusuf Tri Herlambang, 2023	Naturalistic: Jurnal Kajian Penelitian dan Pendidikan dan Pembelajaran	Problems of implementing the Independent Curriculum in Elementary Schools	Implementation constraints such as lack of teacher understanding in preparing lesson plans and lack of innovation in teaching
24	Nia Amelia, Eka Tusyana, Seka Andrean, 2023	Tadris: Jurnal Keguruan dan Ilmu Tarbiyah	Challenges for teachers in implementing the independent learning curriculum	Difficulties in designing and implementing learning that is in accordance with the independent curriculum
25	Indah Nur Aziza Alfatonah, Yonada Viossa Kisda, Aisyah Septarina, Anzela Ravika, Ines Tasya Jadidah, 2023	Jurnal Basicedu	Students' learning difficulties in science subjects	Students' difficulties in understanding science and science material, as well as lack of interest in learning
26	Sintia Merna Sari, Sukarno, Matsuri, 2024	Didaktika Dwija Indria	Implementation of science learning on civilized society material	The implementation of IPAS learning does not comply with the implementation process standards in the

No	Researcher, year	Journal	Research Focus	Research result
				independent curriculum.
27	Syamsudin & Siti Lailatul Fitriani, 2024	At Ta'lim: Jurnal Pendidikan	Science learning problems at SDN Susukan 06 Pagi East Jakarta	Teachers experience difficulties in determining the approach, model, strategy, method, media, assessment and integration of science learning technology to be used.
28	Rahma Alviana, Intan, Aida, 2024	Cendikia, Jurnal Pendidikan dan Pengajaran	Analyzing teacher problems in implementing the Independent Curriculum at Lambheu 1 Public Elementary School	Problems are included in the planning and implementation of learning.
29	Dea Anjelia Rahmah, Risma Delima Harahap, 2024	Jurnal Basicedu	Analyzing students' learning difficulties in science learning in the Independent Learning Curriculum in Elementary Schools	Students experience learning difficulties, especially in science subjects, due to foreign terms and dense material.
30	Heni Purwulan, 2024	Jurnal Jendela Pendidikan	Examining the implementation of the Independent Learning Curriculum and the obstacles faced by teachers at SDN 1 Jiwan	Teachers' difficulties in analyzing CP, formulating TP, compiling ATP and teaching modules, and using technology.
31	Dita Afianti, Rahayu Condro Murti, 2024	Ludi Litterarri	Analyzing the obstacles faced by teachers in implementing the Independent Curriculum at SD Negeri 2 Sanden	Teachers' constraints in curriculum planning and implementation and in adapting learning to students' needs.
32	Ni Putu Eni Astuti, I Gede Margunayasa, Ni Ketut Suarni, I Putu Hendra Wirawan, Putu Sulastra, 2024	Cetta: Jurnal Ilmu Pendidikan	Analyzing assessment problems in the implementation of the Independent Curriculum	Main problem: assessment in intracurricular learning and Pancasila Student Profile Strengthening Project. Teachers have not been able to differentiate between formative and summative assessments properly.

Based on Table 1, it can be concluded that the distribution of problems in implementing the independent curriculum can be grouped into six categories as seen in Figure 1.

Figure 1 shows the percentage of research discussion on teacher problems in implementing the independent curriculum occupying the largest proportion, followed by the application of media and learning methods, teacher and school readiness, student learning difficulties, obstacles and handling of implementation and assessment in the independent curriculum. This indicates that specific issues in science and science learning receive significant attention from many researchers, while aspects of systemic challenges in implementing the curriculum also remain an important focus.

The research group related to teacher problems in implementing the independent curriculum with a percentage of 53% discussed the general challenges faced in implementing the Independent Curriculum in various schools. Several articles found that teachers face various challenges in learning science including demands to be more creative and innovative, lack of adequate training, limited facilities and resources, and difficulties in understanding and implementing new learning strategies required by the independent curriculum. Research in this category provides insight into systemic barriers that affect the success of implementing the new curriculum. (Sofyan Iskandar et al.; Anisya Al Husna & Henry Aditia Rigianti; Dino Rohim & Henry Aditia Rigianti; Siti Zulaiha, Tika Meldina, Meisin; M. Rio Harits Ikhsandi & Erlisnawati; Sumarmi; Setiawan Edi Wibowo et al.; Dita Arlina, Ikayanti Arsin, Muhammad Sobri; Nabillatus Solikhah & Aktim Wahyuni; Nurul Insani Putri, Syania Icha Sabrina, Nanang Budiman, Wulan Tri Puji Utami; Nur Atsri Fifani, Safrizal, Fadriati; Khairun Nisa, Muhammad Husin, Aida Fitri; Mei Nur Rusmiati, Riswati Ashifa, Yusuf Tri Herlambang; Nia Amelia, Eka Tusyana, Seka Andrean; Rahma Alviana et al.; Heni Purwulan; Dita Afianti, Rahayu Condro Murti).

The category of application of learning media and methods, which accounted for

19% of the research, examines how innovative media and learning methods can increase students' motivation and interest in learning. Research by Annisa Aulia & Rahmadita Azlia Anugerah Putri (2023) underlines the effectiveness of innovative learning media in creating a more active and enjoyable learning experience. (Azi Alam Sudrajat et al; Eko Bayu Gumilar; Iwan Usma Wardani et al.; Sintia Merna Sari, et al.; Syamsudin & Siti Lailatul Fitriani).

Research on teacher and school readiness includes 13% discussing the evaluation of readiness in facing and implementing the Independent Curriculum. Research by Lia Wanti & Ika Chastanti (2023) shows that many teachers and schools are not fully prepared, both in terms of curriculum understanding and facility support. Other research that falls into this category is the work (Muhamad Sadli & Baiq Arnika Saadati; Risa Lailatul Quraniyah, Nur Luthfi Rizqa Herianingtyas; Rodiatun Niswah, Rini Apriyani, Winda Agustin, Ines Tasya Jadidah).

Meanwhile, the category of student learning difficulties covers 6% highlighting various difficulties experienced by students in following learning, especially in science subjects under the Merdeka Curriculum. The findings in various articles with the focus of this research are that students have difficulty understanding the material, especially in science subjects, which is often caused by foreign terms and dense material. An example of research in this category is the work (Indah Nur Aziza Alfatonah et al.; Dea Anjelia Rahmah et al)

Research on obstacles and handling of implementation with a percentage of 6% includes the identification of various obstacles in the implementation of the Independent Curriculum and strategies to handle them. Article by Ummi Nur Afinni Dwi Jayanti et al. (2023) highlights the need for effective strategies to overcome obstacles such as lack of training and resources. Other research that falls into this category is the work of Ira Wantiana and Mellisa (Wantiana & Mellisa, 2023, p.65).

Discussion on the focus of assessment in the Independent Curriculum only covers 3% of the total articles collected as research objects. Research by Ni Putu Eni Astuti et al (2024) identifying teacher difficulties in differentiating between formative and summative assessments and the importance of assessments that are in line with curriculum objectives to measure student progress.

Overall, this study shows that the main challenges in implementing the Independent Curriculum lie in teacher readiness, student difficulties, and the need for better learning and assessment methods. To address these issues, it is recommended that teacher training be improved, facilities and resources be improved, and collaboration between teachers, schools, and parents be encouraged to support the success of the Independent Curriculum.

D. CONCLUSION

The results of the study conducted using the Systematic Literature Review (SLR) method on 32 articles related to the obstacles to learning Natural and Social Sciences (IPAS) in the Independent

Curriculum in Elementary Schools showed that there were many obstacles to learning IPAS at the elementary education level. These obstacles are divided into 6 groups starting from the largest to the smallest: teacher problems in implementing the independent curriculum (53%), application of media and learning methods (19%), teacher and school readiness (13%), student learning difficulties (6%), obstacles and handling of implementation (3%), assessment in the independent curriculum (3%).

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