Exploring The Implementation of the Merdeka Curriculum: A Case Study of Integrated Science Teaching Materials with ESD and Ethnoscience

Gita Nurul Puspita[1], Ari Widodo[2], Siti Sriyati[3]

[1, 2, 3] Science Education Study Program, Universitas Pendidikan Indonesia, Dr. Setiabudi Street, Sukasari Bandung 40154, Indonesia

Coressponding Author. E-mail:

[1]gitapuspita@upi.edu

[2]widodo@upi.edu

[3]sriyati@upi.edu

Abstract

This study analyzes the science teaching materials integrated with ESD and Ethnoscience based on teachers' teaching experiences and educational qualifications. This case study research involved six junior high school science teachers in Cimahi City who participated voluntarily in a teacher training program. Data collection techniques in this research used observation, in-depth interviews, and documentation. The data analysis employed a descriptive narrative approach by reducing data, presenting data, and drawing conclusions. Then, triangulation is also performed for data validation. Based on the research findings, teaching materials prepared by novice teachers with less than five years of teaching experience tend to be textbook-oriented, and the language used still needs to be suitable for the cognitive level of junior high school students. However, the materials they prepared have an attractive appearance. Meanwhile, experienced teachers elaborate and provide contextual examples, using easily understandable language and incorporating tables or graphs to enhance students' literacy and numeracy skills. Out of the six teachers, four have a Biology/ Biology Education background, and two have qualifications in Physics Education at the bachelor's level. Teachers choose teaching materials that align with their educational background because they feel more confident in delivering scientific concepts. Through this research, it is described that teachers still tend to develop teaching materials based on the 2013 curriculum, whereas, at present, the preparation of teaching materials should be aligned with the principles of the Merdeka curriculum.

Keywords: Science Teaching Materials; ESD; Ethnoscience; Diagnostic Assessment; Merdeka Curriculum.

How to cite this article:

Puspita, G.N., Widodo, A., Sriyati, S. (2024). Exploring The Implementation of the Merdeka Curriculum: A Case Study of Integrated Science Teaching Materials with ESD and Ethnoscience. IJIS Edu: Indonesian Journal of Integrated Science Education, 5(2), 99-111. doi:http://dx.doi.org/10.29300/ijisedu.v5i1.10481

INTRODUCTION

Based on preliminary study data in one of the junior high schools in Cimahi City, the teaching materials used in science lessons are textbooks provided by the Ministry of Education and Culture (Kemendikbud). These materials are developed based on the 2013 curriculum. Moreover, teachers used student worksheets made by the Cimahi City Science Teacher Community (Musyawarah Guru Mata Pelajaran IPA). Teachers have conducted diagnostic assessments, but the results have never been utilized in developing teaching materials. In other words, the teaching materials utilized in the learning activities still need to incorporate the principles of the independent curriculum. Another finding is that, thus far, the learning experiences have not been designed according to the student's culture and have yet to be directed toward achieving sustainable development goals.

Furthermore, the actual situation in Indonesia shows that junior high school science teachers generally come from diverse educational backgrounds, including biology, physics, and chemistry. Despite this, these teachers are required to teach integrated science. Teachers are expected to understand scientific content and the methods of teaching it (Septiana et al., 2018).

The Merdeka Curriculum has been gradually implemented since the academic year 2021/2022, spanning from kindergarten to high school/vocational school levels. This curriculum is based on the understanding and ideas of Ki Hajar Dewantara, encapsulated in the principles of ing ngarso sung tulodo, ing madyo mangunkarso, and tut wuri handayani. Tut wuri handayani implies that a teacher continuously provides supervision while encouraging and motivating students to learn according to their inherent abilities (Agus et al., 2020; Ferary, 2023; Nugroho, 2021).

The ideas and ideals of Ki Hajar Dewantara serve as the foundation for the Merdeka Curriculum. The principles of Merdeka Curriculum learning include: learning is designed taking into account the developmental stages and current levels of student achievement; learning is designed according to the context, environment, and culture of the students; learning is oriented toward a sustainable future (Kemendikbud Ristek, 2022).

To realize these principles, the role of the teacher is crucial, serving as an exemplar for their students (ing ngarso sung tulodo) and also as a companion for intellectual exchange (ing madyo mangunkarso). Teachers are required to enhance their professionalism according to knowledge and technology (Sancar et al., 2021). A set of competencies that teachers must possess includes pedagogical competence, personality competence, social competence, and professional competence. Pedagogical competence refers to a teacher's ability to manage student learning, encompassing (König et al., 2011; Voss et al., 2011): (1) knowledge of classroom management, (2) knowledge of teaching methods; (3) knowledge of assessment, (3) structuring learning objectives and learning processes, (5) planning and evaluating learning, (6) the ability to adapt to heterogeneous groups in the classroom, (7) assessing learning outcomes, and (8) developing students to actualize various potentials they possess.

Lee Shulman first introduced Pedagogical Content Knowledge (PCK) at the American Educational Research Association. PCK is a form of specialized knowledge for teaching that transforms subject matter knowledge to make it easily understandable for students (Shulman, 1987). Teacher competence significantly influences their performance (Hanaysha et al., 2023). Efforts to enhance teachers' pedagogical competence, particularly in terms of PCK, involve training in instructional material development. This training aims to improve teachers' knowledge, attitudes, and skills for personal development to assist in their professional tasks (Zhi & Wang, 2023), particularly in developing instructional materials. Teachers must present instructional materials in a way that is easily comprehensible for students. Teachers must be more frequent in developing their instructional materials (De Medio et al., 2020). Teaching materials necessarily align with students' prior knowledge based on diagnostic assessment results. The diagnostic assessments are essential for teachers to understand and use to identify students' misconceptions (Soeharto et al., 2019). Furthermore, it is essential to support quality learning with innovation in teaching material (Suzuki et al., 2020).

Several studies related to instructional materials have been conducted. Instructional materials must be crafted as engaging, easily understandable, and meaningful to ensure enjoyable learning experiences (Cloonan & Fingeret, 2020). Teaching materials developed by integrating local cultural contexts can

significantly enhance students' problem-solving abilities (Kwangmuang et al., 2021). Teachers must develop instructional media, strategies, or models more suitable and aligned with the instructional content or the context students face (Kamil et al., 2020). The instructional materials developed for learning may include student textbooks and workbooks (Angrist et al., 2021; van Alten et al., 2020)

Learning that integrates culture and indigenous tribes or incorporates local wisdom is called ethnoscience (Zidny & Eilks, 2022). Ethnoscience can be utilized as a learning resource that encourages students to align with the norms or culture present in their communities (Khusniati et al., 2023). This indigenous knowledge is relevant to be applied in education to achieve sustainable development goals (Nurcahyani et al., 2021; Sandoval-Rivera, 2020).

Based on real-life situations and previously presented theories, a gap has been identified, indicating that the science teaching materials used by teachers are sourced from 2013 curriculum textbooks (Patika & Surmilasari, 2023; Qiftiyah, 2023). Consequently, these teaching materials need to be aligned with the learning needs, environment, and culture of the students, and they need to be oriented towards a sustainable future (education for sustainable development). Therefore, the novelty of this research lies in developing integrated science teaching materials that incorporate both education for sustainable development (ESD) and ethnoscience, guided by the results of students' diagnostic assessments.

The research questions in this case study are: (1) What are the characteristics of science teaching materials integrated ESD and ethnoscience developed by novice and experienced science teachers? (2) What are the characteristics of science teaching materials integrated with ESD and ethnoscience developed by science teachers with different educational backgrounds? Thus, the objectives of this research are: (1) To identify the characteristics of integrated science teaching materials integrated ESD-ethnoscience developed by novice and experienced science teachers; (2) To identify the characteristics of science teaching materials integrated ESD-ethnoscience developed by science teachers with different educational backgrounds.

METHOD

This study employs a case study method for the teaching materials of integrated ESD-Ethnoscience developed by six science teachers in Cimahi City who underwent training in May 2023 (32 hours in four weeks), each with varying years of experience and different educational backgrounds. Case study research is a qualitative approach in which the investigator explores a bounded system (a case) or multiple bounded systems (cases) over time through detailed, in-depth data collection involving multiple sources of information and reports a case description and case-based themes (Creswell, 2007). The "case" may be a single individual, several individuals separately or in a group, a program, events, or activities (e.g., a teacher, several teachers, or the implementation of a new program) (Creswell & Guetterman, 2019). The case study involved observation, in-depth interviews, and documentation during the teacher training. Interview questions can be seen in following table.

Table 1. Interview Questions

No.	Indicator	Questions
1	Family background	• Where were you born? • What is your ethnic background? • What is your husband's ethnic background? • Do you still communicate using your native language?
2	Educational background	What is your educational background?
3	Teaching experience	• How long have you been teaching? • Where did you first serve as a teacher? • Has the cultural background of your mother's ethnic group influenced your teaching style? • Do you use the native language in your teaching?

Those questions can be developed to obtain more in-depth information.

The teacher training comprises the following stages.

Recall

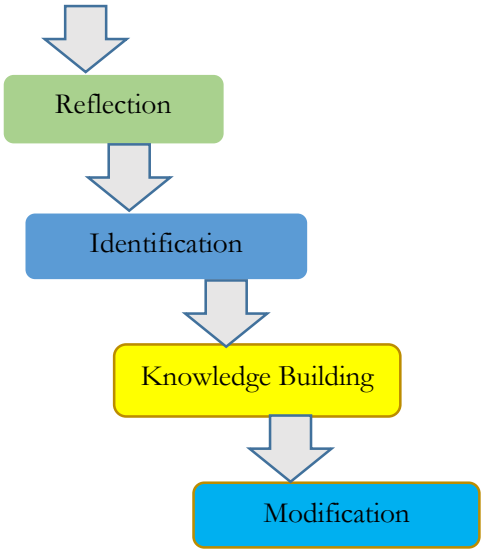

Figure 1. Stages of training experienced by teachers

In the first stage, the Recall stage, teachers reminisce about their experiences related to presenting science content in teaching materials. They prepare diagnostic assessments and instructional materials and then engage in discussions to share their experiences.

The second stage is Reflection. Teachers fill out a checklist for self-assessment regarding the teaching materials they have previously developed. Subsequently, teachers take turns presenting their reflection results.

The third stage is Identification. In this stage, teachers listen to the instructor's presentation on Principles of the Merdeka Curriculum Learning, Science Learning Achievements in the Merdeka Curriculum for Phase D, Essential Materials in the Merdeka Curriculum Phase D, Diagnostic Assessment, and Development of Teaching Materials integrated with ESD and Ethnoscience.

Based on the reflection results and listening to the material presentation, teachers then identify areas that need modification in their instructional material development. These modification areas are aspects that teachers need to improve in developing teaching materials to align with students' prior knowledge and the prevailing curriculum (Merdeka Curriculum). Teachers complete an identification sheet of modification areas and take turns presenting the areas they intend to modify.

The fourth stage is Knowledge Building. In this stage, teachers acquire new knowledge to modify teaching materials more precisely. Teachers conduct a literature review from reputable journals over the last five years. Additionally, they examine best practices related to instructional material development. This analysis enables participants to determine appropriate strategies for modifying their teaching materials.

The final stage is Modification. Teachers modify instructional materials based on the new knowledge built in the fourth stage. In this stage, teachers design modifications to teaching materials and present them in turn. Subsequently, teachers independently develop the modified teaching materials at home. In the next meeting, teachers will present the results.

The data analysis technique is descriptive narrative, involving data reduction, data presentation, and concluding. Then, triangulation is also performed for data validation.

RESULT AND DISCUSSION

The demographic of participants can be seen in the following table.

Table 2. The Demographic of Respondent

Teacher	Age (Years)	Teaching Experience (Years)	Ethnic
A	54	28	Sundanese
B	54	28	Sundanese
C	49	25	Javanese
D	53	18	Javanese
E	28	4.8	Sundanese
F	23	0.4	Sundanese

Here is a description of the demographic of the six science teachers (training participant). All science teachers are female. Teachers A and B are 54 years old with 28 years of teaching experience. Teacher A was born in Bandung, West Java, while Teacher B was born in Semarang, Central Java, and later moved to Bandung. Teacher C is 49 years old, born in Ponorogo, East Java, and has been a science teacher for 25 years. Teacher D is 53 years old, born in Magelang, Central Java, and has been a science teacher for 18 years. Teacher E is 28 years old, born in Bandung, and has been teaching for 4 years 10 months (4.8 years). Furthermore, Teacher F is 23 years old, born in Karawang, and has just become a teacher for the past 5 months (0.4 years).

Except for Teachers D and F, the other four teachers were initially assigned to be science teachers outside of Cimahi. These teachers

requested a transfer to Cimahi following their husbands, who were previously transferred to Cimahi. Teacher A's first assignment was at a junior high school in Kuningan District, Teacher B in Tasikmalaya District, Teacher C in Pasuruan District, East Java, and Teacher E first taught at a junior high school in Bandung District. Teacher F has taught at Junior High School X since graduating from university.

Teachers recall their experiences using diagnostic assessments and science instructional materials in the initial training stage. Subsequently, teachers engaged in reflection by completing a checklist regarding the diagnostic assessments and instructional materials they had previously created, followed by discussing the results of their reflections. Through self-reflection, teachers received valuable feedback to improve their Pedagogical Content Knowledge (PCK) (West, 2023). Moreover, adequate reflection enhances teachers' competence in integrating cultural knowledge and experiences into relevant student learning (Romijn et al., 2021).

From the reflection activities, it was found that all teachers had already developed instructional materials based on the core competencies and basic competencies in the curriculum. Teachers A, B, C, D, and E conducted diagnostic assessments to determine students' prior knowledge. Teachers A, B, D, and E learned about diagnostic assessments in in-house training (IHT) organized by the school and online training on the Merdeka Curriculum on the Merdeka Mengajar platform from the Ministry of Education and Culture Research and Technology. Teacher C did not attend IHT and online training because she was on leave for the Hajj pilgrimage. However, Teacher C conducted diagnostic assessments based on information from her colleagues at school. Teacher F, who had just graduated from university, had yet to conduct a diagnostic assessment because she still needed to understand the purpose and benefits of diagnostic assessments. During her university studies, there was minimal material related to diagnostic assessments.

Although Teachers A, B, C, D, and E had conducted diagnostic assessments, they did not use the results as the basis for developing instructional materials. The interviews found that the diagnostic assessment questions given to students tended to go unanswered because they needed to know the answers. In other words, students do not have prior knowledge regarding the learning material. Lack of prior knowledge may be because students have been learning online during the COVID-19 pandemic for the past two years, making it difficult to understand the lessons teachers deliver. In contrast to what other teachers reported, Teacher C provided diagnostic assessment questions to students, but all the answers given by students were correct. Teacher C had yet to inform the students that the diagnostic assessment questions were beneficial for the teacher to assess the student's understanding of essential concepts. As a result, students answered the questions correctly without knowing they were supposed to demonstrate their understanding without referring to the textbook.

The reasons given by Teachers A, B, D, and E for not using the results of the diagnostic assessment as a basis for developing instructional materials were the lack of time to prepare differentiated instructional materials. Teachers need to classify the results of diagnostic assessments into high, medium, and low groups and then develop instructional materials for each group. While other science teachers are assigned 30 instructional hours, Teacher D has an even heavier workload, teaching 35 instructional hours. Teacher C is also a curriculum staff, and Teacher D is a student affairs staff. The considerable workload makes it difficult for teachers to develop differentiated instructional materials.

Furthermore, in the training stage of identification, all teachers successfully concluded that areas needing improvement in developing instructional materials include using diagnostic assessment results as the basis for developing instructional materials to align with students' prior knowledge, integrating cultural values to make learning more contextual, and connecting learning with sustainable development, which is a principle of the Merdeka Curriculum.

In the knowledge-building stage, teachers conduct a literature review on instructional material development by seeking information from reputable journal articles or best practices conducted over the last five years. The following is a list of articles reviewed by the participants.

Table 3. Articles Reviewed by Participants

No.	Title
1	Application of Flipped Classroom in ESD Context to Improve Cognitive Ability and

	Build Sustainability Awareness of Students
2	Development of E-Module STEM integrated Ethnoscience to Increase 21st Century Skills
3	Classroom Assessment Management to Utilise Diagnostics in Biology Learning at SMP Muhammadiyah 1 Kartasura
4	Implementation of Diagnostic Assessment in Science Learning during the Covid-19 Pandemic
5	Literature Review: Using Four-Tier Diagnostic Assessments to Identify Concept Understanding and Misconceptions

Science Teaching Materials by Novice and Experienced Teachers

The insights and knowledge gained from the literature review in the knowledge building stage are then used by teachers to develop teaching materials. The description of teaching materials that science teachers have prepared will be presented starting from teachers with more than five years of experience, namely teachers A-D, then novice teachers whose teaching experience is less than five years (teachers E and F).

Teacher A chose to modify the teaching materials on the human reproductive system in class IX. The learning objective is to analyze the interrelationship of organ systems and abnormalities or disorders that arise in these organs. After conducting a diagnostic assessment, it is known that all students need to gain knowledge about the functions of reproductive organs and diseases in human reproductive organs. The cultural aspects integrated into the teaching materials are *pamali ulah kuramas pami nuju kareseban* (it is taboo for a woman to wash her hair during menstruation). Menstrual events occur due to drastic changes in reproductive hormone levels. In the first days of menstruation, body temperature will rise by an average of 0.3-0.7 degrees Celsius (Baker et al., 2020). Menstruating women have decreased stamina, so it is advisable not to wash their hair using cold water. The sustainable development goal to be achieved through this learning material is good health and well-being.

Unlike teacher A, teacher B modified teaching materials for the Interaction of Living Things and their Environment for students in grade VII. The learning objectives to be achieved are that students can analyze the forms of interdependence of living things. The diagnostic assessment found that all students needed help understanding the forms of interdependence of living things. Teacher B integrated the culture in Cimahi City, namely bamboo planting in leuweung tutupan (reforestation forest) of Cireundeu Traditional Village, Cimahi City. Bamboo can trap high quantities of carbon dioxide (Yadav & Mathur, 2021). The sustainable development goal to be achieved through this learning material is climate action by reforestation to reduce carbon dioxide as a gas that triggers global warming.

Teacher C modified the teaching materials on physics, namely Newton's Force and Law, for 8th-grade students. The learning objectives to be achieved in the material are to analyze the relationship between motion and force and its application in everyday life. Teacher C conducted a diagnostic assessment, and the results showed that all students needed help understanding the concept of force and Newton's Law. In modifying the teaching materials, Teacher C raised the performing arts from Ponorogo, East Java Province, namely Reog. Ponorogo reog players can lift the Dhadak Merak, which weighs more than 50 kg, using only their teeth. The traditional dance movement applies Newton's Law (Putra et al., 2020). When Dhadak Merak stands, Newton's Law I applies; when it moves, Newton's Law II applies; when it dances and maintains a balanced position, Newton's Law III applies. Quality education is the sustainable development goal for this learning material. Through contextual learning, learning becomes more meaningful.

Teachers D and E modified the teaching materials, the Human Digestive System. The learning objectives formulated are to analyze the interrelationship of the digestive organ system and abnormalities or disorders that arise in the organ system. From the student diagnostic assessment results, it is known that all students from teachers D and E have yet to understand the concept of organs, functions, and disorders in the human digestive system correctly. Teacher D included elements of Sundanese culture in her teaching materials, namely *pamali ulah dahar bari sare, bisi gede hulu* (do not eat while lying down, you will become arrogant). From a scientific perspective, eating while lying down is not

suitable for health because it can increase the risk of stomach acid (hydrochloric acid) rising the esophagus and causing heartburn. Furthermore, lying down after eating contributes to GERD symptoms (Yuan et al., 2019).

In contrast to teacher D, teacher E brought up the Sundanese culture of *pamali ulah nuang tunggir, bisi dicandung* (do not eat the buttocks/back of the chicken, you will be polygamous). Unfortunately, Teacher E did not thoroughly explain the scientific concepts underlying that prohibition. Uropygial glands produce fat in the chicken's tail area (dorsally over the last caudal vertebrae) (Chiale et al., 2021). Consumption of saturated fat from animal foods increases the risk of cancer (Bojková et al., 2020). In their modified teaching materials, teachers D and E align with sustainable development goals. Teacher D delves deeper into material about diseases affecting the human digestive organs, aiming for students to avoid such illnesses and achieve a healthy and prosperous life (SDG Good Health and Well-being). Meanwhile, teacher E addresses the issue of improper disposal of feces to improve sanitation in the community (SDG Clean Water and Sanitation).

Teacher F modified the teaching materials, Mixed and Single Substance materials, for 7th-grade students; the learning objectives determined by Teacher F are that students can describe chemical and physical change. Teacher F provided examples of traditional salt making and told students to be wise in consuming salty food for health. The salt content in food can trigger the occurrence of hypertension. (Filippou et al., 2023) . The sustainable development goal to be achieved is good health and well-being.

From the diagnostic assessment conducted by the six teachers, it is known that not all students need the correct prior knowledge of the concepts to be learned. Based on the results of interviews with teachers, this is because, for approximately two years, students have experienced online learning during the pandemic. Most students need help learning about device specifications and data package availability online. Only a handful of students can actively interact with teachers synchronously through video conferencing applications, so teachers have decided to use asynchronous online learning through the learning management system (LMS). Although there is room for discussion in the LMS, students must maximize this facility. As a result, learning is expected not to occur optimally, and students have to interpret science concepts appropriately.

Teaching materials prepared by teachers who have more than five years of teaching experience use language that is easy for junior high school students to understand. Scientific terms are simplified without reducing their meaning. For example, the teacher uses the word absorption to explain absorption. Experienced teachers explain and provide many examples in the teaching materials they prepare. It cannot be denied that with decades of teaching experience and life experience, teachers can incorporate many contextual things into the material to enrich students' knowledge. With elaboration, the organization of teaching materials becomes systematically arranged from broad material to specific material, from simple material to complex material, and interrelated parts. Furthermore, teachers can also elaborate on traditional community artifacts that have the potential to connect cultural and scientific concepts (Utami et al., 2021). This elaboration also leads to more meaningful learning (Sharma & Orey, 2017).

For example, the teaching materials prepared by teacher A for grade IX students incorporate the local wisdom of the *pamali* (taboo) for a Sundanese woman who is menstruating to wash her hair. The teaching materials explain the scientific reasons that the prohibition is logical. Menstruation occurs due to a drastic decrease in the levels of the reproductive hormones estrogen and progesterone, followed by the production of other hormones (prostaglandins) that trigger the uterine muscles to push the menstrual blood out. Another hormone (serotonin) is also released which affects mood. These hormones are what cause both physical and psychological discomfort in women who are menstruating (Agarwal et al., 2023). Menstruating women have decreased stamina (Uchibori et al., 2023), so it is recommended not to wash their hair at the beginning of menstruation.

Experienced teachers also include illustrations in the form of graphs or tables. Teacher A displayed a graph of the menstrual cycle and the relationship between a woman's age and her reproductive ability. Teacher C displayed a table of the relationship between mass and acceleration of objects in Newton's Law II. Inserting graphs and tables into teaching materials aims to develop student's literacy and

numeracy skills. Higher ability to read texts such as graphs and tables would benefit students more in terms of their performance in numeracy (Ding & Homer, 2020; Kazmi et al., 2017; Kohen et al., 2022). She displayed pictures and included a video link to the Dhadak Merak Ponorogo attraction to provide examples of Newton's Law I, II, and III events. Although the users of the teaching materials were Cimahi City students, teacher C used the culture of her home region, Ponorogo, to explain the concept of Newton's Law. The attraction was considered appropriate and relevant to the teaching materials developed. In addition, teacher C felt that the Reog Ponorogo attraction would be exciting for students because it features thick traditional dances with magical elements where the dancers can wear masks that weigh more than 50 kg and lift them using only their teeth. This position and movement of the Dhadak Merak dancer is associated with the events of Newton's Law. Compared to teacher C, teachers B and D, born in Central Java Province, did not incorporate Javanese culture into their teaching materials. Neither teacher has yet linked learning with Javanese culture. This condition is because both teachers only lived in Central Java for a short time, following the transfer of their parent's assignments, so they were raised in the Sundanese culture in West Java.

Meanwhile, teaching materials prepared by novice teachers or those with less than five years of teaching experience tend to be more textbook. The language used is still relatively high for junior high school students, for example, using the word decomposition without including the term's meaning. The material described by teachers E and F is narrower and more in-depth. Teacher E tried to bring the material closer to student's lives by revealing the taboo in Sundanese society (according to the teacher's family background) that women are prohibited from eating chicken buttocks—however, the scientific concept underlying the prohibition needed to be explained. Teacher F tried to give an example of crystallization in traditional salt making. Unfortunately, the saltmaking process was not described. However, the novice teachers seemed to make the teaching materials enjoyable; teacher E used color pictures to display the human digestive organs, and Teacher F displayed pictures of distillation and chromatography to explain the process of separating mixtures.

Science teaching materials based on teacher's educational backgrounds

Modifications of teaching materials made by science teachers with their educational backgrounds can be seen in Table 2.

Table 4. Teacher's Educational Background and Modification of Teaching Materials

Teacher	Educational Background	Modified Teaching Materials
A	Bachelor of Biology Education	Human Reproductive System
B	Bachelor of Biology Education	Interaction of Living Things and Their Environment
C	Bachelor of Physics Education	Force and Newton's Laws
D	Bachelor of Biology Education	Human Digestive System
E	Bachelor of Biology	Human Digestive System
F	Bachelor of Physics Education	Single and Mixed Substances

Table 4 shows that training participants have diverse educational backgrounds. Teachers A, B, D, and E graduate from the Biology/Biology Education department, while C and F have Physics Education qualifications. The teachers determine the teaching materials they modify according to their educational background. Teacher A chose the Human Reproductive System material in class IX. Teacher B chose the material on the Interaction of Living Things and their Environment in grade VII. Meanwhile, teachers D and E chose the Human Digestive System material in class VIII. Teacher C chose Force and Newton's Law in class VIII, and Teacher F chose Single and Mixed Substances in class VII.

The teachers revealed they felt more confident developing teaching materials according to their scientific fields. They have more freedom to explore and be creative and do not have to worry about misrepresenting concepts. Teachers A, B, C and D, although they have been teaching for more than 18 years, when teaching science content that is less relevant to their educational background, only rely on the teacher's handbook, knowledge in lectures during the TPB (joint preparation stage) and learning

experience during high school. So far, teachers often discuss teaching material outside their expertise with their colleagues. Teacher D, who graduated from Biology Education before teaching physics content, will consult with teacher who has a Physics Education background, to help her understand physics concepts appropriately and how to convey them correctly so that students easily understand them. A study shows that educational background is the main problem (60%) in teaching integrated science (Indrawati & Nurpatri, 2022). In reality, many teachers who teach at the junior high level are graduates of Physics Education and Biology Education. This educational background impacts the mastery of teacher material on integrated science (Septiana et al., 2018). Such educational background hinders quality science learning (Kalkan et al., 2020). Often, because teachers do not master the material, they deliver it using the expository method (Insani, 2016). However, from research on science teacher's classroom management skills, it is known that what contributes to the classroom management of junior high school science teachers is their teaching experience and professional development activities, while the educational background has no influence (Waluyo et al., 2021).

CONCLUSION

The following conclusions can be drawn based on the earlier research findings and discussions. First, teaching materials created by novice teachers tend to be more textbook-oriented, and the language used still needs to align with the level of thinking of junior high school students. However, the teaching materials have an attractive appearance because they use a variety of colorful pictures. Meanwhile, experienced teacher's teaching materials provide much elaboration and contextual examples. The language of delivery is appropriate for junior high school students and is enriched with graphs and tables to facilitate the development of student's literacy and numeracy. The background of the teacher's upbringing also influences the teaching materials developed by experienced teachers. Teachers born and raised in Ponorogo Regency, East Java Province, incorporated the culture of their home region, Reog Ponorogo, in developing Newton's Force and Law teaching materials. However, another teacher born in Central Java Province but spent her childhood to adulthood in West Java never incorporated Central Javanese culture into science learning and mostly related science materials to Sundanese culture. Second, training participants have educational qualifications in biology/biology education and physics education. The teaching materials modified by teachers follow their educational background. Biology/Biology Education graduate teachers choose biology content, and Physics Education graduate teachers choose physics content. This preference is because teachers feel more confident to explore and be creative in developing their teaching materials and do not need to worry about errors in concept delivery. Through this research, it is described that teachers still tend to develop teaching materials based on the 2013 curriculum, whereas, at present, the preparation of teaching materials should be aligned with the principles of the Merdeka curriculum. This study recommends that future researchers examine the preparation of teaching materials based on the teacher's gender and ethnicity/beliefs.

REFERENCES

Agarwal, K., Franks, A. T., Zhang, X., Schisterman, E., Mumfordd, S. L., & Joseph, P. V. (2023). Association of inflammation biomarkers with food cravings and appetite changes across the menstrual cycle. Clinical Nutrition ESPEN, 56(2023), 193–199. https://doi.org/10.1016/j.clnesp.2023.06.004

Agus, C., Cahyanti, P. A. B., Widodo, B., Yulia, Y., & Rochmiyati, S. (2020). Cultural-Based Education of Tamansiswa as a Locomotive of Indonesian Education System. In World Sustainability Series. https://doi.org/10.1007/978-3-030-15604-6_29

Angrist, N., de Barros, A., Bhula, R., Chakera, S., Cummiskey, C., DeStefano, J., Floretta, J., Kaffenberger, M., Piper, B., & Stern, J. (2021). Building back better to avert a learning catastrophe: Estimating learning loss from COVID-19 school shutdowns in Africa and facilitating short-term and long-term learning recovery. International Journal of Educational Development, 84. https://doi.org/10.1016/j.ijedudev.2021.102397

Baker, F. C., Siboza, F., & Fuller, A. (2020). Temperature Regulation in Women:

Effects of The Menstrual Cycle. Temperature, 7(3), 226–262. https://doi.org/10.1080/23328940.2020.1735927

Bojková, B., Winklewski, P. J., & Wszedybyl-Winklewska, M. (2020). Dietary fat and cancer—which is good, which is bad, and the body of evidence. International Journal of Molecular Sciences, 21(11), 1–56. https://doi.org/10.3390/ijms21114114

Chiale, M. C., Cadierno, M. P., Fernández, P., Mijailovsky, S., Heras, H., Barbeito, C., & Montalti, D. (2021). Biochemical and Morphological Features of The Uropygial Gland of The Chilean Flamingo and Their Functional Implications. Zoology, 147(2021), 1–11. https://doi.org/10.1016/j.zool.2021.125941

Cloonan, M., & Fingeret, A. L. (2020). Developing teaching materials for learners in surgery. Surgery (United States), 167(4). https://doi.org/10.1016/j.surg.2019.05.056

Creswell, J. W. (2007). A Qualitative Inquiry and Research Design Choosing Among Five Approaches (Second edi). Sage Publications, Inc.

Creswell, J. W., & Guetterman, T. C. (2019). Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research (Sixth). Pearson.

De Medio, C., Limongelli, C., Sciarrone, F., & Temperini, M. (2020). MoodleREC: A recommendation system for creating courses using the moodle e-learning platform. Computers in Human Behavior, 104. https://doi.org/10.1016/j.chb.2019.106168

Ding, H., & Homer, M. (2020). Interpreting mathematics performance in PISA: Taking account of reading performance. International Journal of Educational Research, 102. https://doi.org/10.1016/j.ijer.2020.101566

Ferary, D. (2023). A Philosophical Perspective on the Purpose of Education in Indonesia. In Comparative and Decolonial Studies in Philosophy of Education. https://doi.org/10.1007/978-981-99-0139-5_4

Filippou, C., Thomopoulos, C., Konstantinidis, D., Siafi, E., Tatakis, F., Manta, E., Drogkaris, S., Polyzos, D., Kyriazopoulos, K., Grigoriou, K., Tousoulis, D., & Tsioufis, K. (2023). DASH vs. Mediterranean diet on a salt restriction background in adults with high normal blood pressure or grade 1 hypertension: A randomized controlled trial. Clinical Nutrition, 42(10), 1807–1816. https://doi.org/10.1016/j.clnu.2023.08.011

Hanaysha, J. R., Shriedeh, F. B., & In'airat, M. (2023). Impact of classroom environment, teacher competency, information and communication technology resources, and university facilities on student engagement and academic performance. International Journal of Information Management Data Insights, 3(2). https://doi.org/10.1016/j.jjimei.2023.100188

Indrawati, E. S., & Nurpatri, Y. (2022). Problematika Pembelajaran IPA Terpadu (Kendala Guru Dalam Pengajaran IPA Terpadu). Educativo: Jurnal Pendidikan, 1(1), 226–234. https://doi.org/10.56248/educativo.v1i1.31

Insani, M. D. (2016). Studi Pendahuluan Identifikasi Kesulitan Dalam Pembelajaran pada Guru IPA SMP Se-Kota Malang. Jurnal Pendidikan Biologi, 7(2), 81–93. http://journal2.um.ac.id/index.php/jpb/article/view/723/454

Kalkan, Ö. K., Altun, A., & Atar, B. (2020). Role of Teacher-Related Factors and Educational Resources in Science Literacy: An international perspective. Studies in Educational Evaluation, 67(October), 1–9. https://doi.org/10.1016/j.stueduc.2020.100935

Kamil, P. A., Utaya, S., Sumarmi, & Utomo, D. H. (2020). Improving disaster knowledge within high school students through geographic literacy. International Journal of Disaster Risk Reduction, 43.

https://doi.org/10.1016/j.ijdrr.2019.101411

Kazmi, Z., Fatima, I., Perveen, S., & Malik, S. S. (2017). Monosodium Glutamate: Review on Clinical Reports. International Journal of Food Properties, 20(2), 1807–1815. https://doi.org/10.1080/10942912.2017.1295260

Kemendikbud Ristek. (2022). Perubahan atas Keputusan Menteri Pendidikan, Kebudayaan, Riset, dan Teknologi Nomor 56/M/2022 tentang Pedoman Penerapan Kurikulum Dalam Rangka Pemulihan Pembelajaran. JDIH Kemendikbud Ristek. https://jdih.kemdikbud.go.id/detail_peraturan?main=3156

Khusniati, M., Heriyanti, A. P., Aryani, N. P., & Ridho, T. (2023). Indigenous Science Constructs Based on Troso Woven Fabric Local Wisdom : A Study in Ethnoscience and Ethnoecology. Journal of Turkish Science Education …, 20(3), 549–566.

Kohen, Z., Amram, M., Dagan, M., & Miranda, T. (2022). Self-efficacy and problem-solving skills in mathematics: the effect of instruction-based dynamic versus static visualization. Interactive Learning Environments, 30(4). https://doi.org/10.1080/10494820.2019.1683588

König, J., Blömeke, S., Paine, L., Schmidt, W. H., & Hsieh, F. J. (2011). General Pedagogical Knowledge of Future Middle School Teachers: on The Complex Ecology of Teacher Education in The United States, Germany, and Taiwan. Journal of Teacher Education, 62(2), 188–201. https://doi.org/10.1177/0022487110388664

Kwangmuang, P., Jarutkamolpong, S., Sangboonraung, W., & Daungtod, S. (2021). The development of learning innovation to enhance higher order thinking skills for students in Thailand junior high schools. Heliyon, 7(6). https://doi.org/10.1016/j.heliyon.2021.e07309

Nugroho, S. (2021). Ki Hadjar Dewantara leadership development and its effect on sustainable shareholder value moderated by it and business strategy alignment. Journal of Data, Information and Management, 3(2). https://doi.org/10.1007/s42488-020-00038-8

Nurcahyani, D., Yuberti, Irwandani, Rahmayanti, H., Ichsan, I. Z., & Rahman, M. M. (2021). Ethnoscience Learning on Science Literacy of Physics Material to Support Environment: A Meta-analysis Research. Journal of Physics: Conference Series, 1796(1), 1–8. https://doi.org/10.1088/1742-6596/1796/1/012094

Patika, S., & Surmilasari, N. (2023). Pengembangan Bahan Ajar IPA Berbasis Pendekatan STEM pada Materi Rangkaian Listrik Kelas VI SD. Jurnal Edukasi Matematika Dan Sains), 11(2).

Putra, S. A., Sahbana, M. A., & Finahari, N. (2020). Dinamika Perubahan Beban Tumpuan Pijakan Kaki pada Penari Bapang Malangan. JUSTE (Journal of Science and Technology), 1(1), 61–74. https://doi.org/10.51135/justevol1issue1page61-74

Qiftiyah, M. (2023). Muatan HOTS pada Pembelajaran Tematik Materi IPA Kelas 5 Sekolah Dasar. Scholaria: Jurnal Pendidikan Dan Kebudayaan, 13(1). https://doi.org/10.24246/j.js.2023.v13.i1.p28-38

Romijn, B. R., Slot, P. L., & Leseman, P. P. M. (2021). Increasing Teachers' Intercultural Competences in Teacher Preparation Programs and through Professional Development: A Review. Teaching and Teacher Education, 98(2021), 1–15. https://doi.org/10.1016/j.tate.2020.103236

Sancar, R., Atal, D., & Deryakulu, D. (2021). A new framework for teachers' professional development. In Teaching and Teacher Education (Vol. 101). https://doi.org/10.1016/j.tate.2021.103305

Sandoval-Rivera, J. C. A. (2020). Environmental Education and Indigenous Knowledge: Towards The Connection of Local Wisdom with International Agendas in The Framework of the Sustainable

Development Goals (SDGs). Diaspora, Indigenous, and Minority Education, 14(1), 14–24. https://doi.org/10.1080/15595692.2019.1652588

Septiana, N., Rohmadi, M., Nasir, M., Nastiti, L. R., Usmiyatun, U., & Riswanto, R. (2018). Kesulitan Guru IPA SMP/MTs Mengajarkan IPA Terpadu di Kalimantan Tengah. Edusains, 6(1), 1–11. https://e-journal.iain-palangkaraya.ac.id/index.php/edusains/article/view/716

Sharma, T., & Orey, D. C. (2017). Meaningful Mathematics Through the Use of Cultural Artifacts. https://doi.org/10.1007/978-3-319-59220-6_7

Shulman, L. S. (1987). Those Who Understand: Knowledge Growth in Teaching. Educational Researcher, 57(1), 1–22. https://people.ucsc.edu/~ktellez/shulman.pdf

Soeharto, Csapó, B., Sarimanah, E., Dewi, F. I., & Sabri, T. (2019). A Review of Students' Common Misconceptions in Science and Their Diagnostic Assessment Tools. Jurnal Pendidikan IPA Indonesia, 8(2), 247–266. https://doi.org/10.15294/jpii.v8i2.18649

Suzuki, S. N., Akimoto, Y., Suzuki, K., Okada, A., Hirata, K., Kato, T., Yajima, K., Kanematsu, H., Fukumoto, T., & Yoshikawa, F. (2020). Development of A-txt system compatible introductory teaching materials for Electric Power Engineering using gaming simulation. Procedia Computer Science, 176. https://doi.org/10.1016/j.procs.2020.09.167

Uchibori, M., Eguchi, A., Ghaznavi, C., Tanoue, Y., Ueta, M., Sassa, M., Suzuki, S., Honda, S., Kawata, Y., Iida, M., Sakamoto, H., & Nomura, S. (2023). Understanding factors related to healthcare avoidance for menstrual disorders and menopausal symptoms: A cross-sectional study among women in Japan. Preventive Medicine Reports, 36(July), 102467. https://doi.org/10.1016/j.pmedr.2023.102467

Utami, N. W., Sayuti, S. A., & Jailani, J. (2021). Indigenous artifacts from remote areas, used to design a lesson plan for preservice math teachers regarding sustainable education. Heliyon, 7(3). https://doi.org/10.1016/j.heliyon.2021.e06417

van Alten, D. C. D., Phielix, C., Janssen, J., & Kester, L. (2020). Self-regulated learning support in flipped learning videos enhances learning outcomes. Computers and Education, 158. https://doi.org/10.1016/j.compedu.2020.104000

Voss, T., Kunter, M., & Baumert, J. (2011). Assessing Teacher Candidates' General Pedagogical/Psychological Knowledge: Test Construction and Validation. Journal of Educational Psychology, 103(4), 952–969. https://doi.org/10.1037/a0025125

Waluyo, E., Naparin, A., & Arsyad, S. W. (2021). Hubungan Latar Belakang Pendidikan Guru IPA SMPN Dengan Kemampuan Mengelola Kelas Di Kabupaten Hulu Sungai Selatan. Prosiding Seminar Nasional Pendidikan IPA, 113–120. http://jbse.ulm.ac.id/index.php/PMPIPA/article/view/31%0Ahttp://jbse.ulm.ac.id/index.php/PMPIPA/article/viewFile/31/45

West, J. (2023). Utilizing Bloom's taxonomy and authentic learning principles to promote preservice teachers' pedagogical content knowledge. Social Sciences and Humanities Open, 8(1). https://doi.org/10.1016/j.ssaho.2023.100620

Yadav, M., & Mathur, A. (2021). Bamboo as A Sustainable Material in The Construction Industry: An Overview. Materials Today: Proceedings, 43(2021), 2872–2876. https://doi.org/10.1016/j.matpr.2021.01.125

Yuan, L. Z., Yi, P., Wang, G. S., Tan, S. Y., Huang, G. M., Qi, L. Z., Jia, Y., & Wang, F. (2019). Lifestyle Intervention for Gastroesophageal Reflux Disease: A National Multicenter Survey of Lifestyle Factor Effects on Gastroesophageal Reflux Disease in China. Therapeutic Advances in Gastroenterology, 12, 1–12. https://doi.org/10.1177/1756284819877788

Zhi, R., & Wang, Y. (2023). English as a foreign language teachers' professional success, loving pedagogy and creativity: A structural equation modeling approach. Thinking Skills and Creativity, 49. https://doi.org/10.1016/j.tsc.2023.101370

Zidny, R., & Eilks, I. (2022). Learning about Pesticide Use Adapted from Ethnoscience as a Contribution to Green and Sustainable Chemistry Education. Education Sciences, 12(4), 1–16. https://doi.org/10.3390/educsci12040227