Al-Ishlah: Jurnal Pendidikan
Vol.17, 4 (December, 2025), pp. 8662-8675
ISSN: 2087-9490 EISSN: 2597-940X, DOI: 10.35445/alishlah.v17i4.8043

Understanding Differentiated Learning Among Geography Teachers: Impact of Curriculum Training in Indonesian High Schools

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ARTICLE INFO

Keywords:

differentiated instruction;
geography education;
teacher training;
merdeka curriculum;
high schools

Article history:

Received 2025-06-16
Revised 2025-07-15
Accepted 2025-12-29

ABSTRACT

Differentiated instruction is a key component of the *Merdeka Belajar Curriculum* (Freedom to Learn), aiming to meet diverse student needs in the classroom. However, the extent to which geography teachers understand and implement this approach remains underexplored in the Indonesian context. This quantitative descriptive study used a structured online questionnaire based on Tomlinson & Imbeau's four differentiation dimensions: content, process, product, and learning environment. A total of 59 geography teachers from senior high schools across Indonesia participated, all of whom met eligibility criteria including prior curriculum training. Data were analyzed using descriptive statistics and hierarchical regression via SPSS. Findings show that 66.1% of teachers demonstrated a high level of understanding, and 33.9% a moderate level; none were in the low category. Regression analysis revealed that participation in *Merdeka Curriculum* training significantly predicted understanding of differentiated learning ($p < 0.01$), while being a geography teacher alone had no significant effect. Although conceptual understanding is high, implementation remains limited due to a lack of practical training and systemic support. The findings highlight the critical role of subject-specific, practice-based professional development. Geography, as a context-rich subject, offers strong potential for differentiation, yet requires targeted strategies and ongoing support to bridge the gap between theory and classroom practice.

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1. INTRODUCTION

The implementation of the Merdeka Belajar Curriculum is a significant milestone in the effort to transform Indonesia's education system (Ariga, 2023). This curriculum is designed to promote more flexible, relevant, and learner-centered learning, emphasizing the development of individual potential through greater autonomy for educational institutions (Wahyudin et al., 2024). The goal is to create a learning environment that is adaptive to the diverse needs of students, thereby producing a generation

with holistic competencies and the ability to face the challenges of the times (Susilawati & Juanda, 2023). In this context, the subject of Geography plays a crucial role. Geography not only equips students with an understanding of physical and social phenomena on the Earth's surface but also cultivates spatial awareness, critical thinking skills, and the ability to analysis geographical data (Béneker et al., 2024). This understanding is essential for shaping adaptive, responsible citizens who can contribute to sustainable development (Simm & and Marvell, 2017).

This is certainly true, as geography education in high schools generally still uses a "one-size-fits-all" approach, which is no longer adequate in an era of student diversity (based on ability, interests, and learning styles) (Purwowidodo & Zaini, 2023). Therefore, optimizing geography education through differentiated instruction aligns with the spirit of the *Merdeka Belajar* Curriculum. The implementation of differentiated instruction has been proven to enhance student motivation and learning outcomes; however, many geography teachers have not yet implemented it optimally, despite understanding the concept of differentiated instruction (Ismajli & Imami-Morina, 2018). Challenges such as mindset, time constraints, teaching materials, and school management support remain major obstacles. In the context of geography learning, which is a subject based on spatial, environmental, and socio-cultural aspects, the application of differentiated learning should be an opportunity to ground teaching materials that are relevant, contextual, and meaningful to students (Silviariza et al., 2020).

However, various studies show that teachers' understanding of the concepts and practices of differentiated learning still varies, and the results of its implementation in the field have not been optimal. The findings of Widanti et al (2023), conclude that the implementation of differentiated instruction in the classroom, specifically in teaching essential anthroposphere geography content at SMAN 4 Sidoarjo, has significantly improved the application of differentiated instruction in terms of content, process, and outcomes, thereby enhancing student learning activities and academic achievements. Additionally, based on the research data Akhiruddin et al (2024), it was shown that differentiated instruction significantly improved students' motivation and learning outcomes in geography. Meanwhile, the research findings indicate that the development of character-based student worksheets (LKS) in online geography learning is highly valid and practical. This illustrates that innovation in teaching materials can strengthen differentiated learning. The success of differentiated learning in geography education is only a small part of the various challenges in its implementation. These challenges become increasingly critical because geography education is often perceived as a theoretical subject and less appealing to students if not connected to real-life contexts (Nufus et al., 2019). The application of differentiated learning is one of the keys to increasing students' interest, understanding, and participation in geography lessons.

Teachers' pedagogical competencies are crucial and pose a unique challenge in this situation, as teachers are required to design educational learning activities and develop students' potential so that they can actualize their potential as optimally as possible through the learning process (Lubis, 2018). However, if teachers, as the primary actors in the learning process, lack adequate understanding and the ability to apply this approach, the objectives of implementing the *Merdeka Belajar* Curriculum will not be achieved optimally (Lestari et al., 2023). This research is important because of the urgent need to know the extent to which high school geography teachers understand and are able to implement differentiated learning in schools. Additionally, there have not been many studies that specifically explore the context of differentiated learning in geography, even though the complex characteristics of geography material and the spatial thinking skills needed for life require careful and flexible differentiation strategies. This research is also important because it can provide recommendations for teacher professional development, strengthening practice-based training programs, and designing educational policies that systematically support differentiated learning practices.

Furthermore, a bibliometric study by Nugroho et al (2025), highlights that although there is a growing body of research on curriculum implementation and geography learning methods, differentiated instruction in secondary geography education remains underexplored and requires deeper empirical attention. Based on the above description, this study aims to describe the level of understanding of geography teachers in senior high schools regarding the implementation of differentiated learning, with an emphasis on the dimensions of content, process, product, and learning environment. This study

employs a quantitative approach through a survey method using a questionnaire systematically designed based on indicators of differentiated instruction (Tomlinson & Imbeau, 2023). This study aims to describe the extent of geography teachers' understanding of differentiated instruction within the Merdeka Belajar Curriculum. The novelty of this research lies in its empirical focus on geography teachers, a group rarely examined in existing differentiated learning studies, especially in the Indonesian context. Findings from this research may inform policy development, teacher training programs, and classroom practices to ensure that differentiated instruction is effectively integrated into geography education.

2. METHODS

2.1. Research Design

This study uses a quantitative approach with a descriptive survey method to determine geography teachers' understanding of differentiated learning in senior high schools. The quantitative approach was chosen to systematically collect numerical data that can be analysing statistically to provide a measurable picture of teachers' level of understanding in various dimensions of differentiated learning (Pilcher & Cortazzi, 2024). A descriptive survey design was used in this study to help researchers collect comprehensive information from a broad sample of geography teachers regarding their understanding of the implementation of differentiated learning in the context of the *Merdeka Belajar* Curriculum in Indonesia (Kumar & Praveenakumar, 2025). The focus of this study is to examine geography teachers' understanding of the four key dimensions of differentiated learning as conceptualized by Tomlinson & Imbeau (2023), namely content differentiation, process differentiation, product differentiation, and learning environment differentiation. This study aims to describe the extent of geography teachers' understanding of differentiated instruction within the Merdeka Belajar Curriculum. The descriptive survey design is highly relevant for mapping the current state of teachers' comprehension across key dimensions and for identifying areas that require further professional development support.

2.2. Research Population and Sample

The target population in this study included all high school geography teachers in Indonesia who implemented the *Merdeka Belajar* Curriculum. A total of 59 teachers who were willing to fill out the questionnaire in accordance with the established criteria and completed the questionnaire during the data collection period were included in the final sample. This number is considered adequate for descriptive and regression analysis, providing sufficient statistical power to analysis the relationships between variables in the study (Hazari, 2023). This method was selected to maximize participation and ensure geographical representation, allowing for broader generalization across different school contexts (Hossan et al., 2023). The criteria for selecting the research sample include: (1) geography teachers with a minimum of three years of teaching experience, (2) teaching geography in Phase E and Phase F or Senior High School level, (3) having participated in Merdeka Curriculum training, (4) being graduates of a Bachelor of Education program in Geography Education, and (5) willing to voluntarily participate in an online survey. To ensure representation across the diverse educational landscape in Indonesia, a time-based voluntary response sampling strategy was employed, allowing teachers from various regions, both urban and rural areas to participate. Although probability sampling was initially intended, the final approach relied on an open online survey distributed over one month, ensuring inclusivity and encouraging broader participation across provinces. This approach was chosen to maximize the participation of geography teachers from various provinces in Indonesia and to obtain a comprehensive picture of their understanding of differentiated learning (Wang et al., 2022).

2.3. Questionnaire Development

The main data collection instrument was a structured online questionnaire specifically designed to measure geography teachers' understanding of differentiated learning. The questionnaire was developed based on an established theoretical framework of differentiated learning, specifically referring to a comprehensive model of differentiated learning practices (Tomlinson & Imbeau, 2023). Each dimension was measured using several indicative items. For example, content differentiation included items such as *"I adjust learning materials based on students' readiness levels"* and *"I provide alternative content formats to match*

students' learning interests." Process differentiation was assessed with statements like *"I use varied instructional strategies to match students' learning preferences"* and *"I modify classroom activities based on students' prior knowledge."* Product differentiation involved items such as *"I allow students to demonstrate their understanding through different types of assignments"* and *"I provide choices in how students complete final tasks."* Meanwhile, learning environment differentiation was measured through items like *"I adapt classroom arrangements to support student engagement"* and *"I use digital tools to facilitate flexible learning spaces."*. Each section uses a 4-point Likert scale ranging from "strongly disagree" (1), "disagree" (2), 'agree' (3), to "strongly agree" (4) to measure teachers' level of understanding and agreement wit (South et al., 2022). The 4-point Likert scale was chosen to avoid neutral responses and encourage more decisive answers, which is particularly appropriate in attitude and perception research (South et al., 2022)

2.4. Validity and Reliability of Instruments

The research questionnaire underwent external validation to ensure its content validity and practical relevance to real classroom conditions (Creswell, 2017). External validity was established through assessments by education practitioners consisting of school principals, vice principals, and geography teachers who have direct experience in implementing differentiated learning in schools. Validation was conducted by a panel of education practitioners consisting of school principals, vice principals, and geography teachers with practical experience in implementing differentiated instruction. These validators were selected for their deep contextual understanding, enabling them to assess the instrument from both managerial and pedagogical perspectives. **Table 1**, presents a summary of the external validation results that have been conducted so that the instrument can be disseminated in accordance with the input and suggestions from the external validation review.

Table 1. Summary of External Validation Focus Areas

Validation Aspect	Description	Action Taken
Relevance to Geography Learning	Items reflect real-world geography teaching practices and differentiated learning implementation	Minor revisions to contextualize examples
Clarity of Language	Items use clear, concise, and unambiguous wording	Language refined for clarity and teacher readability
Suitability to Merdeka Curriculum	Items align with curriculum goals, competencies, and differentiated learning mandates	Terms updated to reflect curriculum terminology
Ease of Understanding for Teachers	Items are understandable by a broad range of teachers regardless of school location or background	Simplified sentence structure and clarified instructions

Source: Researcher, 2025

Although no inter-rater reliability statistics were calculated, item revisions were made based on a consensus approach. Validators discussed each item and reached agreement on its appropriateness, ensuring consistency in judgment across perspectives. After revisions, a pilot test was conducted with 30 geography teachers who were not included in the main sample. This phase aimed to assess the clarity, usability, and technical performance of the online instrument.

2.5. Data collection procedure

Data collection was conducted entirely through an online survey platform (Google Forms) during the period from March 28, 2025, to April 28, 2025. The online approach was chosen for its efficiency in reaching geographically dispersed participants, cost-effectiveness, and ability to maintain social distancing protocols when necessary. The survey link was distributed through various channels to maximize participation: (1) collaboration with the provincial education office to reach teachers through official networks; (2) dissemination through geography teacher associations and professional

organizations; (3) sharing through social media platforms commonly used by geography educators; and (4) snowball sampling techniques, in which participating teachers were encouraged to share the survey with their colleagues. Prior to data collection, participants received a consent form explaining the research objectives, confidentiality measures, the voluntary nature of participation, and contact information for questions. The online questionnaire was accompanied by clear instructions and designed to be completed in 15–20 minutes to minimize participant burden while ensuring comprehensive data collection. This research has been reviewed and approved by members of the Green Earth research group, Geography Education, Universitas Sebelas Maret to ensure compliance with ethical guidelines in educational research. Response rate monitoring was conducted periodically during the data collection period, with reminder messages sent to increase participation. Data quality checks were applied to identify and exclude incomplete responses or those showing response patterns indicating a lack of serious engagement. Anonymity was ensured by not collecting any personally identifiable information such as email addresses, or school identities. All responses were stored in a secured, password-protected Google Drive accessible only to the research team.

2.6. Data Analysis Techniques

The collected data were analysis using descriptive and inferential statistical techniques appropriate to the research objectives. Data processing began with a thorough cleaning procedure to identify missing values, outliers, and inconsistent responses. Descriptive statistics, including mean, standard deviation, frequency, and percentage, were calculated to summarize teachers' level of understanding of each dimension of differentiated learning (Adnan & Latief, 2020).

Table 2. Likert Scale Responses

Categorization	Interval	Range
Low	$X < M - 1.5SD$	$X < 35$
Medium	$M - 1.5SD < X \leq M + 1.5SD$	$35 < X \leq 65$
High	$X > M + 1.5SD$	$X > 65$

Source: Researcher, 2025

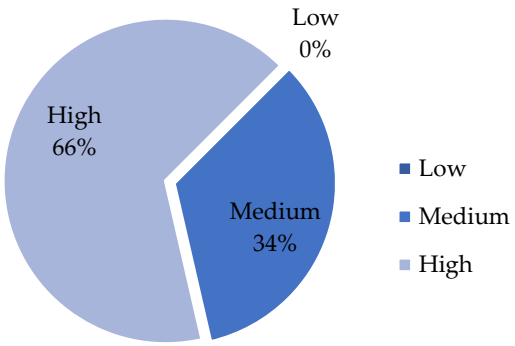
Cross-tabulation analysis was conducted to explore relationships between demographic characteristics (e.g., teaching experience, participation in Merdeka Curriculum training) and understanding scores. Hierarchical regression analysis was employed to examine the unique contribution of specific predictors, particularly training participation, after accounting for demographic variables. This model was appropriate because it enabled assessment of the incremental explanatory power of professional development over baseline characteristics. All quantitative analyses were conducted using SPSS. Additionally, qualitative responses from open-ended questions were analysis using thematic analysis to identify common patterns, implementation challenges, and teacher suggestions (Hermawan, 2019). The findings from both quantitative and qualitative analyses were integrated to provide a comprehensive understanding of teachers' perspectives on differentiated learning in geography education.

3. FINDINGS AND DISCUSSION

3.1. Geography Teachers' General Level of Understanding of Differentiated Instruction

The level of understanding of differentiated learning among geography teachers was determined by first categorizing the teachers' level of understanding of differentiated learning. The categorization score used was a hypothetical score, as categorization based on hypothetical scores is more appropriate for interpreting groups, while empirical scores are more suitable for the individual level (Ijaq et al., 2019). Based on Figure 1, the results of the hypothetical score categorization analysis, it was found that out of 120 respondents who met the selected sample criteria, a total of 59 respondents, 39 teachers

(66.1%) were in the high category, 20 teachers (33.9%) were in the medium category, and no teachers were in the low category.



Source: Researcher, 2025

Figure 1. Geography Teachers' General Level of Understanding of Differentiated Instruction

Based on the data in Figure 1, it can be seen that teachers' level of understanding of differentiated learning is predominantly high. This means that many teachers already understand differentiated learning. This finding shows that geography teachers have a fairly strong conceptual understanding of the main principles of differentiated learning, including the aspects of content, process, product, and learning environment differentiation. This is in line with the opinion of Tomlinson & Imbeau (2023), who state that the success of differentiated learning is largely determined by teachers' comprehensive understanding of these dimensions. In the research findings of Jayanti et al (2023), the implementation of differentiated learning in the *Merdeka Belajar* Curriculum for history lessons at SMA Negeri 22 Surabaya shows that the application of this approach requires teachers to have a deep understanding of the principles of differentiated learning. This finding is relevant to the context of geography learning, as both subjects share similar characteristics as part of the social sciences, which require a learning approach that can accommodate student diversity in understanding spatial, temporal, and socio-cultural phenomena. Therefore, examining teachers' understanding of differentiated learning is important to ensure the effective implementation of the Merdeka Belajar Curriculum, particularly in developing students' competencies in understanding the dynamics of the geosphere and human interactions with their environment.

Although data shows that 66% of geography teachers in Indonesia have a high level of understanding of differentiated learning in the Merdeka Curriculum, with the remainder at a moderate level and none lacking understanding, the reality is that implementation in the classroom is not yet optimal. This situation highlights a disparity between conceptual understanding and practical application. One of the main causes is the lack of concrete support in the form of ongoing and contextual applied training. Pitaloka & Arsanti (2022), revealed that teachers' understanding of the philosophy of differentiated learning is not always accompanied by pedagogical skills in effectively identifying students' learning needs. Teachers often struggle to translate differentiation principles into learning strategies that are appropriate for their classroom realities. Additionally, Jasiah et al (2023), highlight that high administrative burdens and other curriculum demands lead teachers to prefer conventional teaching approaches, which are perceived as more time-efficient. In many cases, teachers recognize the importance of differentiation but encounter obstacles at the planning and execution stages, such as in mapping student learning profiles, developing differentiated materials, and conducting fair and adaptive evaluations. Baro'ah et al (2023), emphasize that implementing differentiation requires high reflective skills and pedagogical flexibility, which do not automatically arise merely from theoretical understanding. Putra et al (2024), also identify that most of the training provided is still theoretical and does not address technical aspects such as the development of microlearning or microcontent to support differentiated learning. As a result, teachers do not yet have concrete models that can be used

as practical references, especially in the context of geography learning, which requires contextual, spatial, and visual approaches. On the other hand, Mulyani (2024), emphasizes that content-based differentiated learning in geography subjects has a positive impact on student learning outcomes, but requires well-designed learning and adequate resource support.

This implementation challenge is reinforced by Syafruddin et al (2024), who highlight the need for innovation and adaptation in social studies learning, including geography, that is not only responsive to the curriculum but also to student characteristics and school conditions. Without a supportive ecosystem such as teacher collaboration, progressive academic supervision, and flexible learning resources, differentiation risks remaining merely a concept in the curriculum document. Thus, despite teachers' relatively high level of understanding of differentiated learning, limitations in practical training, classroom management, resource readiness, and systemic support remain the primary factors hindering optimal implementation. A systematic and sustainable approach is needed to bridge the gap between understanding and practice, ensuring that the essence of the Merdeka Curriculum is truly realized in geography classrooms.

3.2. The Effect of Merdeka Belajar Curriculum Training on Teachers' Understanding

Hierarchical regression analysis was conducted to identify significant variables influencing geography teachers' understanding. In the first model (M1), only background variables as geography teachers were included, and the results were not significant ($p > 0.05$). Meanwhile, in the second model (M2), when the variable of participation in the Merdeka Belajar Curriculum training was added, a significant increase in the R^2 value and model significance was found.

Table 3. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.049[a]	.002	-.008	7.27839	.002	.243	1	100	.623
2	.293[b]	.086	.067	7.00231	.083	9.041	1	99	.003

a. Predictors: (Constant), Geography teacher

b. Predictors: (Constant), Participating in the Merdeka Belajar Curriculum training

Source: Researcher, 2025

The results of hierarchical regression analysis in this study indicate a significant difference between the first model, which only uses geography teacher status as a predictor, and the second model, which adds the variable of participation in the Merdeka Curriculum training. Based on Table 3, Model Summary, it is known that Model 1 can only explain 0.2% of the variability in the implementation of differentiated learning ($R^2 = 0.002$), with a significance value of F Change of 0.623, indicating that this model is not statistically significant. This means that being a geography teacher alone is not sufficient to influence the implementation of differentiated learning. Conversely, when the variable of participation in the Merdeka Curriculum training is added to Model 2, there is an increase in the R Square value to 0.086 or 8.6%, with a significant change in R Square of 0.083 (Sig. F Change = 0.003). This indicates that participation in Merdeka Curriculum training is a stronger predictor in explaining the success of differentiated learning implementation.

Table 4. Results of Variance Analysis (ANOVA) Hierarchical Regression

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12.857	1	12.857	.243	.623[b]
	Residual	5297.496	100	52.975		
	Total	5310.353	101			
2	Regression	456.144	2	228.072	4.651	.012[c]
	Residual	4854.209	99	49.032		
	Total	5310.353	101			

a. Dependent Variable: Differentiated Learning

b. Predictors: (Constant), Geography Teachers
c. Predictors: (Constant), Participating in the Merdeka Belajar Curriculum training
Source: Researcher, 2025

This finding is reinforced by the results of the ANOVA analysis presented in Table 4**.** Model 1, which relies on only one predictor, produces an F value of 0.243 with a significance of 0.623, meaning that the model is not significant. Meanwhile, Model 2 shows an F value of 4.651 with a significance level of 0.012, confirming that the regression model involving Merdeka Curriculum training is statistically significant in influencing differentiated learning. Thus, relevant and systematic training is one of the key factors in transforming teachers' conceptual understanding into practical actions in the classroom.

Table 5. Regression Coefficient for Each Variable

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	69.651	1.110		62.752	.000
	Geography Teacher	-.719	1.459	-.049	-.493	.623
2	(Constant)	64.585	1.995		32.379	.000
	Geography Teacher	-.642	1.404	-.044	-.457	.648
	Participating in the Merdeka Belajar Curriculum training	5.887	1.958	.289	3.007	.003

a. Dependent Variable: Pembelajaran Berdiferensiasi
Source: Researcher, 2025

Furthermore, Table 5, which presents the regression coefficients, shows that in Model 1, the geography teacher variable has a negative regression coefficient (B = -0.719) and is not significant (Sig. = 0.623). This indicates that the status of geography teachers, without training support, does not contribute significantly to the implementation of differentiated learning. In Model 2, although the geography teacher variable remains insignificant (Sig. = 0.648), participation in the Merdeka Curriculum training has a significant positive effect on differentiated learning with a coefficient value of B = 5.887 and significance of 0.003. This means that teachers who participate in the training are more likely to be able to effectively apply a differentiated approach in the learning process.

Overall, these results indicate that although teachers' understanding of differentiated learning concepts is quite high, as found in the descriptive data, this does not automatically correlate with the level of implementation in the classroom. Training has proven to be a key element in bridging the gap between knowledge and practice. Therefore, teacher capacity-building policies should focus not only on conveying concepts but also on strengthening implementation skills through training that is applied, contextual, and sustainable.

Previous regression results show that participation in the *Merdeka Belajar* Curriculum training significantly influences the implementation of differentiated learning, while being a geography teacher alone does not show a significant relationship. These findings are in line with a number of literature sources that state that the main obstacle in implementing the *Merdeka Belajar* Curriculum is not teachers' theoretical understanding, but technical and structural factors that hinder practice in the field. Zulaiha et al (2023), highlight various problems faced by teachers in implementing the Merdeka Curriculum, including a lack of technical guidance, limited infrastructure, and high administrative burdens, making it difficult for teachers to practice an approach that should be flexible and responsive to students' needs. In addition, the training conducted so far has not fully addressed the practical needs of teachers. Wahira et al (2023), found that training is still predominantly theoretical and has not facilitated teachers in developing differentiated teaching tools in a meaningful way. This is reinforced by Novelti et al (2023), who emphasize that training should be designed to build teachers' practical competencies, particularly in designing diagnostic assessments, developing differentiated lesson plans, and conducting ongoing evaluations of student learning outcomes based on their learning styles. Jannah et al (2022) also emphasize that the transition to the Merdeka Belajar paradigm requires adjustments in teachers'

mindsets and habits. Many teachers still struggle to shift their teaching approach from a uniform one to one that is responsive and adaptive to student diversity. Therefore, the implementation of differentiated learning cannot rely solely on individual teachers' understanding but must be supported by school policies, strengthened learning communities, and academic supervision that encourages reflection and improvement in teaching practices. Furthermore, Hadi et al (2023), view the Merdeka Curriculum as a new paradigm that requires systemic changes, including in terms of planning, implementation, and evaluation of learning. Therefore, the success of differentiated learning implementation is greatly influenced by the readiness of the education system to support this transformation. In other words, effective training must be accompanied by a supportive work environment, adequate time for planning, and collaboration among teachers in developing best practices.

Thus, the results of this study not only demonstrate the importance of training in supporting the implementation of differentiated learning, but also emphasize that teachers' understanding needs to be contextualized in practice and supported by an adaptive learning system. This means that strategies to strengthen teachers' competencies should not stop at improving curriculum literacy, but should be directed toward strengthening implementation capacity through applied training, collaborative mentoring, and strengthening a reflective and dynamic learning ecosystem.

3.3. Practical Implications for Teacher Professional Development

The finding that only the training variable of the Merdeka Curriculum significantly influences geography teachers' understanding of differentiated learning has important implications for teacher professional development policies and practices. Statistically, participation in training increased teachers' understanding scores by 5,887 points. This indicates that systematic, relevant, and sustained training programs play a key role in equipping teachers with the pedagogical competencies needed to effectively implement a differentiated approach (Lestari et al., 2023). These results are reinforced by a study by Yahya et al. (2023), which shows that teachers who participate in practice-based training in the Merdeka Curriculum have a higher ability to design learning that is adaptive to student diversity. Similarly, Amiruddin et al. (2023), emphasize the importance of independent teacher training as a key strategy in supporting the success of curriculum transformation. A study by Andrianto, Mu'amalah, & Wulandari (2024), also found that training based on real classroom needs has a significant impact on encouraging teachers to adopt innovative and contextual instructional strategies.

However, the contribution of the regression model to the overall understanding of teachers is only 8.6%, indicating that more than 90% of other variables are not covered in this model. This means that teachers' understanding of differentiated learning is also greatly influenced by institutional and psychosocial contexts, such as school culture, principal support, administrative pressure, and teacher self-efficacy (Azmi et al., 2023). Research by Gunawan & Bahari (2024), emphasizes that teacher development policies need to consider workplace factors, including administrative workload, availability of learning resources, and access to professional learning communities. Meanwhile, a study by Oktaviani & Ramayanti (2023), shows that teachers' perceptions of the usefulness of training greatly influence the effectiveness of internalizing differentiation strategies in learning. Therefore, training policies that are based on real-world practice, contextual to the field of study, and sustainable are important strategies for improving the quality of adaptive and meaningful geography learning.

In order to strengthen the professional development of geography teachers in the Merdeka Curriculum, this study proposes a subject-specific, contextual, practice-based, and sustainable training framework. The results of a bibliometric study by Nugroho et al (2025), emphasize that the lack of clarity in themes and pedagogical inconsistencies in geography teaching are often caused by poorly targeted training, highlighting the need for the implementation of a geography curriculum based on geospatial technology and appropriate learning media in instructional management. Teacher development should go beyond conceptual understanding and focus on classroom application, supported by ongoing guidance and collaboration. Additionally, integrating this framework into Continuing Professional Development (CPD) programs will enhance institutional sustainability and

relevance (Darling-Hammond et al., 2019). Additionally, providing model lesson plans and teaching aids tailored to geography, as recommended by Tomlinson & Imbeau (2023), will support teachers in designing differentiated learning aligned with geographical thinking. Collaboration between MGMP, universities, and curriculum centers should also be prioritized to ensure training remains pedagogically sound and grounded in context.

3.4. The Context of Geography Learning and Opportunities for Differentiation

Geography, as an interdisciplinary subject that theoretically examines the relationship between natural and social phenomena, is well suited to a differentiated learning approach. The contextual, current, and diverse nature of geography material in terms of themes and scale provides great opportunities for teachers to tailor learning to students' interests, readiness, and learning styles (Silviariza et al., 2020). However, the results of this study indicate that having a background as a geography teacher does not significantly influence the level of understanding of differentiated learning. This suggests that while geography is inherently compatible with differentiation, it has not yet been optimally utilized in practice. These findings are consistent with research by Nufus et al (2019), which states that geography learning tends to be one-sided and teacher-centered if not supported by specialized pedagogical training. In a study conducted by Mahat et al (2020), it was found that geography teachers tend to rely on lecture-based teaching methods and the use of textbooks, leaving little room for differentiation in both the products and processes of learning. However, spatial project-based approaches, the use of geospatial data, and locally-based learning are effective strategies for implementing differentiation in geography education (Sumarmi et al., 2021). The gap between geographical potential and implementation reality highlights the importance of providing specialized pedagogical training for geography teachers. Such training should focus on integrating differentiation approaches into spatial-based learning design, problem-based learning, and the exploration of maps and GIS technology as adaptive learning tools (Isromi et al., 2022). Additionally, strengthening geography learning communities, teacher collaboration, and disseminating best practices from schools that have successfully implemented differentiated learning in geography can be key to improving the quality of geography education in Indonesia (Hickman, 2023).

To implement differentiated learning in geography, teachers can tailor the material by assigning students with higher spatial reasoning abilities to work with GIS platforms such as QGIS or ArcGIS Online, while other students can analyze simpler printed thematic maps or use Google Earth to explore spatial data (Puertas-Aguilar et al., 2021). In terms of process differentiation, discovery-based tasks can be differentiated: students with high readiness can conduct field observations and spatial analysis independently, while others work collaboratively to interpret case studies or visual materials (Dunn & Darlington, 2016). For product differentiation, students can demonstrate their understanding of urbanization patterns through formats that align with their learning profiles, such as essays, multimedia story maps, posters, or oral presentations. This strategy promotes student engagement and autonomy, as well as better learning outcomes and motivation (Akhiruddin et al., 2024). As emphasized by Mark (2017), personalization in geography is not only about adjusting the level of difficulty but also about enabling students to connect geographical knowledge with their life experiences, which can be effectively achieved through flexible and differentiated instruction.

4. CONCLUSION

This study shows that although most geography teachers in Indonesian high schools have a high level of understanding of differentiated learning in the *Merdeka Belajar* Curriculum, this understanding does not automatically lead to effective implementation in geography lessons. The main findings indicate that participation in Merdeka Curriculum training significantly enhances teachers' ability to apply differentiated instruction, particularly in the dimensions of content, process, product, and learning environment. On the other hand, being a geography teacher alone, without relevant training, does not significantly affect the depth of understanding of differentiated learning. These results indicate

that pedagogical training is crucial for transforming theoretical knowledge into practical teaching strategies that address student diversity in the classroom, especially in geography learning.

These findings emphasize the urgent need to strengthen teacher training policies and practices. Teacher professional development should focus on practice-based and subject-specific training, supported by ongoing guidance and integration into the Continuing Professional Development (CPD) system. Education authorities, such as the Ministry of Education and regional curriculum centers, should provide model lesson plans specific to geography, instructional resources, and facilitate collaboration through MGMP networks and partnerships with universities. Schools should also adopt supportive policies that allocate sufficient time and reduce administrative burdens so that teachers can plan and implement differentiated instruction effectively.

Future research should explore qualitative dimensions to understand the contextual barriers and drivers shaping teachers' ability to implement differentiated instruction in geography classrooms. Longitudinal studies are recommended to analyze how ongoing training influences teaching practices in classrooms over time. Intervention-based research can also be conducted to evaluate the effectiveness of specific training models or mentoring systems in improving differentiated instruction in geography classrooms. Such research will be able to make significant contributions to designing scalable, evidence-based strategies for implementing differentiation in Indonesia's evolving curriculum landscape.

Acknowledgments: Thank you to the Geography Teacher who kindly filled out the research questionnaire so that this research could be carried out. Thank you to Universitas Sebelas Maret for funding this research through the Research Group Assistance Scheme for 2025.

Conflicts of Interest: The authors declare no conflict of interest.

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