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Implementation of Universal Design for Learning (UDL) in Inclusive Education: A Study of Primary and Secondary Education Units

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This study examines the implementation of Universal Design for Learning (UDL) in the South Papua region by analyzing the level of implementation and various factors that influence its success at the primary and secondary education levels. The study adopted a quantitative methodology through a cross-sectional survey involving a representative sample of the teacher population in various educational institutions. Data were analyzed using non-parametric statistics based the characteristics of non-normal data distribution and sample heterogeneity, such as Kruskal-Wallis Test, Spearman Rank Correlation, Friedman and Mann-Whitney U Test. The findings revealed that there was no significant variation in the implementation of UDL among the different levels of education. However, the study identified two key factors that substantially affect the effectiveness of UDL implementation, including the availability of school facilities and the level of administrative support. The findings underscore the urgency of developing educational infrastructure and formulating policies that support inclusive education. The practical implications of the study include recommendations for the development of a comprehensive UDL training program and school resource capacity building strategies. This is necessary to ensure the sustainability and effectiveness of inclusive education practices in the region.

Keywords: inclusive education, learning design, universal design for learning (UDL), UDL integration, teachers' training, learning

INTRODUCTION

The implementation of inclusive education in Indonesia are encountering diverse challenges, especially in the South Papua region which has unique geographical and socio-cultural characteristics. Data from the Ministry of Education and Culture (MoEC, 2023) shows a significant gap in school participation in Papua compared to the national average. The net enrollment rate in South Papua for primary school. Junior high, and

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senior high school are 84.2%, 71.3%, and 46.8% compared to the national average of 98.1%, 92.5%, and 88.3%, respectively. This participation measures children's involvement in the formal education system according to their age level. The goal is to evaluate access to education, identify regional disparities, monitor the effectiveness of education policies, and serve as a basis for government decision-making in allocating resources for equal education throughout Indonesia.

This situation is further complicated by the presence of students with special needs who require appropriate education services. Based on data from the Papua Provincial Education Office (2023), there are around 2,500 children with special needs in the South Papua region, but only 45% are accomodated in the formal education system, far below the national average of 65% (Nissa and Jamalulail, 2023).

Universal Design for Learning (UDL) comes as a promising framework to address these challenges. UDL, developed by CAST (2021), offers a systematic approach to optimize teaching and learning by considering the diverse ways students learn (Monova-zheleva, 2024; Klonowska and Chen, 2023). Meyer, Rose, & Gordon (2014) emphasize that UDL is not just an approach for students with special needs, but a learning framework that accommodates all learners.

UDL implementation in various countries has shown positive results in improving access and quality of inclusive learning (Al-Azawei et al., 2016; Capp, 2017; Al-Azawei, Serenelli and Lundqvist, 2016; Rao et al., 2022); Hankebo, 2018). A study in remote Australia by Thompson & Williams (2019) showed that UDL successfully increased aboriginal students' participation in learning by 45% through a culturally responsive approach (Mackey et al., 2023).

In the context of South Papua, UDL is particularly relevant due to the region diverse students' demographics, including variations in abilities, cultural backgrounds, and socio-economic conditions. Although studies on UDL in Indonesia remain limited, an investigation in rural Colombia by Munoz-Martínez et al. (2021) demonstrated that the framework effectively bridged learning gaps in diverse educational contexts, resulting in a 35% improvement in learning outcomes after one year of implementation. An investigation by Rahayu and Widyasari (2022) in Java region showed that teachers' understanding of UDL was insufficient. However, no comprehensive study has been conducted in Papua to date (Oktania et al., 2024).

The geographical complexity of South Papua, including Merauke, Mappi, Asmat, and Boven Digoel districts, poses significant challenges to the implementation of inclusive education. According to Widodo et al. (2023), key barriers included limited accessibility, inadequate infrastructure, and insufficient human resource readiness. Data from BPS Papua (2023) highlighted that only 15% of the 450 schools in South Papua met national standards for inclusive education facilities. These standards comprise physical accessibility, adaptive learning resources, and adequately trained teachers (Suhendi and Astuti, 2023; Oktania et al., 2024).

Based on the discussion above, this study addresses the gap in understanding how UDL can be applied in the unique educational context of Papua. Unlike the investigations

conducted by Sulistyawati and Rahman (2021) and Pratama (2022), which focused solely on urban schools and primary education in Indonesia, this analysis provides a broader perspective by examining both primary and secondary education levels in South Papua (Blockstein et al., 2023). Furthermore, King and Anderson's (2020) results from remote Alaska, which emphasized the need for significant local adaptations when implementing UDL, were particularly relevant to the conditions in Papua (Oktania et al., 2024).

The importance of this study lies in its theoretical and practical contributions. Theoretically, it adds to the existing literature by exploring the implementation of UDL in a region characterized by unique geographical and socio-cultural conditions. Practically, the analysis offers a foundation for developing teachers' training programs and enhancing the inclusive education system in South Papua (Suhendi and Astuti, 2023).

UNESCO (2022) underscored the necessity of flexible and inclusive learning methods to achieve Sustainable Development Goal 4 (SDG 4), which prioritizes equitable, quality education and lifelong learning opportunities for all. The implementation of UDL in South Papua is in line with this global agenda and supports the national policy on inclusive education outlined in the Regulation of the Minister of Education and Culture Number 70 of 2009. Additionally, it complements the national priority program for accelerating the development of the region, as mandated by Presidential Instruction Number 9 of 2020 (Komunikasi, 2017; Monova-zheleva, 2024).

A preliminary study by Widiastuti et al. (2023) conducted in several schools in Merauke showed that while 75% of teachers expressed positive attitudes toward inclusive education, they faced significant challenges in implementing flexible and adaptive learning practices (Rini, Firmansyah, and Widiastuti, 2023; Rao et al., 2022). The implementation of UDL principles, namely multiple means of engagement, representation, and action and expression (CAST, 2023), requires tailored adaptations to relate to the local context. For instance, incorporating local languages into representation strategies and integrating cultural values into engagement methods. This was in line with Hassan and Johnson's (2022) results, which highlighted a disconnect between the conceptual understanding and the practical implementation of UDL in contexts with geographical and socio-cultural challenges (Edwards, 2023; Studi et al., 2023; Gronseth and Dalton, 2019).

Lewin's Field Theory (2018) asserted that behavior results from the relationship between individuals' characteristics and the environment. In the context of the implementation of UDL, this theory underscores how the effectiveness of learning frameworks is shaped by the interaction of teachers' attributes, school characteristics, and the socio-cultural setting (Thi Tran et al., 2020). Similarly, Bandura's Social Learning Theory (2019) highlighted the crucial role of environmental factors and modeling in the learning process (Abdullah et al., 2020; Khozin, Tobroni, and Rozza, 2024). Collaboratively, these theories provide a conceptual basis for examining how school features and socio-cultural dynamics impact the implementation of UDL in South Papua.

Based on the theoretical framework and previous results, this study proposes four hypotheses that will be tested. Given the non-normal data distribution and sample heterogeneity, non-parametric statistical methods were adopted to validate these hypotheses.

First hypothesis:

$H0_1$: There is no significant difference in the implementation of UDL across various educational levels in South Papua.

$H1_1$: There is a significant difference in the implementation of UDL across various educational levels in South Papua.

Second hypothesis:

$H0_2$: There is no positive relationship between school characteristics (facilities, human resources, and administrative support) and the implementation of UDL.

$H1_2$: There is a positive relationship between school characteristics (facilities, human resources, and administrative support) and the implementation of UDL.

Third hypothesis:

$H0_3$: There is no significant difference in the implementation of UDL across various schools in urban and rural areas of South Papua.

$H1_3$: There is a significant difference in the implementation of UDL across various schools in urban and rural areas of South Papua.

Fourth hypothesis:

$H0_4$: There is no significant difference in the implementation of the three main principles of UDL (engagement, representation, and action/expression).

$H1_4$: There is a significant difference in the implementation of the three main principles of UDL (engagement, representation, and action/expression). Based on the above discussion and hypotheses, this study aims to examine the implementation of UDL in South Papua, focusing on four main questions. It also examines the level of the implementation of UDL in primary and secondary education, identifies factors influencing its effectiveness, compares implementation across educational levels, as well as explores the relationship between school characteristics and the success rate of UDL implementation.

South Papua was selected as the study location due to its unique characteristics, which included geographical and socio-cultural diversity, as well as complex educational challenges. The region faces significant gaps in access to inclusive education, with low enrollment rates and limited services for students with special needs. These challenges make it a strategic area for studying the implementation of UDL.

METHOD

This study adopted a quantitative analysis using a cross-sectional survey design to evaluate the implementation of UDL in South Papua. The design was selected for its ability to gather extensive data from a large population and provide robust statistical analysis (Creswell & Creswell, 2021; Creswell, 2015; Mackey et al., 2023; Creswell et al., 2007). Additionally, the cross-sectional survey design enabled simultaneous measurement of variables, offering a comprehensive snapshot of the implementation of UDL at a single point in time (Zampieri et al., 2019; Kumar, 2019).

The selected participants consisted of teachers from primary and secondary schools in four districts of South Papua. A multi-stage cluster sampling method was applied to ensure representation across all geographic regions and education levels (Cohen, Manion & Morrison, 2021; Cohen et al., 2018). The analysis process began with the stratification of regions based on geographic characteristics (urban and rural), followed by proportional selection of schools within each stratum. Finally, participants were selected from the privileged schools (Lipsey and Wilson, 2001; Fowler, 2014).

Data analysis involved several non-parametric statistical tests due to the non-normal data distribution and sample heterogeneity (Siegel & Castellan, 2017; Sawilowsky, 1990). To assess differences in the implementation of UDL across education levels, Kruskal-Wallis test was adopted (H1). Spearman's Rank Correlation was used to evaluate the relationship between school characteristics and the level of the adoption of the framework (H2). The Mann-Whitney U test compared the implementation of UDL between urban and rural schools (H3), while Friedman Test assessed differences in the implementation of three main principles of the framework (H4).

Validity in non-parametric statistics played a critical role in ensuring that tests accurately assessed the constructs they were designed to measure. Among the important but sometimes overlooked aspects of validity were construct validity, factor analysis, and convergent and discriminant validity. Construct validity evaluated the extent to which an instrument measured the intended theoretical construct (Messick, 1995). Factor analysis, a statistical method, identified the underlying structure of variables and typically required a minimum factor loading value of 0.5 as an acceptable threshold (Hair et al., 2019). Convergent validity was assessed using Average Variance Extracted (AVE), which should have a minimum value of 0.5. Meanwhile, discriminant validity required that the square root of AVE exceeded the correlation between constructs (Fornell & Larcker, 1981). Incorporating these validity measured into non-parametric statistics enhanced methodological reliability, built confidence in study outcomes, and ensured compliance with rigorous scientific standards in the development and evaluation of instruments (Campbell & Fiske, 1959; Straub et al., 2004).

Ethical considerations were also given significant priority in this study. The considerations included obtaining informed consent from participants, ensuring the confidentiality of data, and respecting local cultural values (Gottschalk & Weise, 2023; Rao et al., 2022; Israel, 2015). The analysis procedures were approved by the university ethics committee and supported by the local education authority, supporting the ethical

standards for educational contexts (Hammersley & Traianou, 2012; Ethics, 2012; Traianou, 2019).

FINDINGS AND DISCUSSION

Participants' Demographics

This study was conducted in four districts in South Papua, consisting of Asmat, Boven Digoel, Mappi, and Merauke. Each district was categorized into three types of regions based on access and infrastructure characteristics. The three regions included urban (city centers), semi-urban (suburban regions), and rural (remote villages). Urban regions were characterized by comprehensive access and well-developed infrastructure, typically located in district centers. Semi-urban had moderate access and proximity to urban centers, while rural regions were marked by limited access and remote locations.

The distribution of schools varied significantly across regions. In Asmat District, urban regions comprised 9 primary schools, 3 junior high schools, and 1 senior high school. Semi-urban included 7 primary schools, 4 junior high schools, and 2 senior high schools, while rural regions had 10 primary schools, 3 junior high schools, and 1 senior high school. In Boven Digoel District, urban centers consisted of 6 primary schools, 2 junior high schools, and 1 senior high school. Semi-urban contained 5 primary schools, 3 junior high schools, and 1 senior high school, whereas rural regions had 4 primary schools, 2 junior high schools, and 1 senior high school. Similarly, Mappi District reported 6 primary schools, 2 junior high schools, and 1 senior high school in urban centers. Semi-urban regions featured 4 primary schools, 4 junior high schools, and 1 senior high school, while rural regions included 4 primary schools, 2 junior high schools, and 1 senior high school. Merauke District, as the administrative center, had the highest school distribution, with 9 primary schools, 5 junior high schools, and 4 senior high schools in urban centers. Semi-urban regions comprised 5 primary schools, 4 junior high schools, and 2 senior high schools, whereas rural regions had 5 primary schools, 3 junior high schools, and 1 senior high school.

This pattern of school distribution highlighted the challenges of accessing education in South Papua. While urban centers had a higher concentration of schools, rural regions still maintained a significant number of primary schools to meet local needs.

Hypothesis Test

Statistical Test of the Implementation of UDL across Educational Levels

A comparative analysis of the implementation of UDL was conducted among 138 teachers across three educational levels. Kruskal-Wallis Test was adopted to evaluate six key indicators of UDL and determine whether significant differences existed among the levels, as shown in Table 1.

Table 1
Differences in UDL implementation between education levels

Parameters Test Statistics [a,b]	Curriculum Suitability	Method Accuracy	Media Suitability	Evaluation Adjustment	Relevance of Material	Variation of Approach
Kruskal-Wallis H	.250	.325	1.852	4.900	.456	4.395
df	2	2	2	2	2	2
Asymp. Sig.	.882	.850	.396	.086	.796	.111

a. Kruskal Wallis Test
b. Grouping Variable: School level

This research examines the implementation of Universal Design for Learning (UDL) at various levels of education using the Kruskal-Wallis method. In line with (Ethics, 2012; Traianou, 2019; Meyer et al. (2014), UDL is a learning framework that accommodates student diversity. The research sample involved 138 teachers from three levels of education (elementary, junior high, high school) using a validated questionnaire covering six UDL indicators (Rose & Meyer, 2020; Rao et al., 2022; Rose, Xyrichis and Meyer, 2020).

The results of statistical analysis showed no significant difference in UDL implementation between levels, with a significance value > 0.05. This finding supports the research of Hall et al. (2018) which states that UDL principles are universal and can be applied at all levels of education. The highest H value of 4.900 on the Evaluation Adjustment aspect (sig. 0.086) indicates that there is variation in evaluation practices, although not statistically significant.

Referring to the recommendations of CAST (2021) (Rusconi and Squillaci, 2023) (Rao et al., 2022), schools need to develop a structured UDL training program and provide adequate supporting facilities. Loui (2019) emphasized the importance of periodic monitoring and evaluation to ensure the effectiveness of implementation. For future research, it is recommended to expand the sample coverage, incorporate additional variables, and conduct longitudinal studies as suggested by Johnson & Smith (2022) (Nissa and Jamalulail, 2023).

Correlation Analysis of School Characteristics with the Implementation of UDL at Three Levels of Education (Primary, Junior High, and Senior High Schools)

Correlation analysis of school characteristics with the level of UDL implementation at three levels of education, including elementary, junior high, and high school was conducted using Spearman Correlation. The analysis was performed on a sample of 135 schools, as shown in Table 2.

Table 2
Correlation of school characteristics with UDL implementation level

Level of implementation UDL Characteristic School	Multiple Means of Engagement	Multiple Means of Representation	Multiple Means of Action and Expression
School Facilities	0.255 *p* = 0,003	0.311 *p* = 0,000	0.331 *p* = 0,000
HR Qualifications andCompetencies	0.207 *p* = 0,016	0.221 *p* = 0,025	0.099 *p* = 0,265
Administrative Support	(0.043) *p* = 0,621	0.247 *p* = 0,010	0.221 *p* = 0,010
Geographical Conditions	0.255 *p* = 0,003	0.077 *p* = 0,542	0.047 p = = 0,662
Facilities and Location	(0.115) *p* = 0,186	0.344 *p* = 0,000	0.350 *p* = 0,000
Support and HR	0.034 *p* = 0,699	0.116 *p* = 0,179	0.1126 *p* = 0,182

The results of Spearman's correlation analysis showed several patterns of relationships categorized into three levels of correlation strength, as outlined by Cohen (2018). In the strong correlation category, characterized by an r-value greater than 0.3, school facilities had a significant relationship with Multiple Means of Action and Expression ($r = 0.331$, $p < 0.001$). Additionally, the combined effect of facilities and location correlated strongly with Multiple Means of Representation ($r = 0.344$, $p < 0.001$).

In the moderate correlation category, with r-values ranging from 0.2 to 0.3, significant relationships existed between school facilities and Multiple Means of Representation ($r = 0.311$, $p < 0.001$). Administrative support also showed a moderate relationship with only two dimensions of UDL ($r = 0.247$ and $r = 0.221$, $p < 0.01$), while human resource qualifications correlated moderately with Multiple Means of Engagement ($r = 0.207$, $p < 0.05$).

Some variables showed weak or insignificant relationships, with r-values below 0.2. Geographical conditions had a weak correlation with only two dimensions of UDL ($r = 0.077$ and $r = 0.047$, $p > 0.05$). Similarly, the aspects of support and human resources showed weak relationships with all UDL dimensions ($r < 0.116$, $p > 0.05$).

The results were in line with Burgstahler (2020), which highlighted the critical role of school facilities and administrative support in the effective implementation of UDL. CAST (2022) further reinforced this perspective by emphasizing that successful implementation of UDL heavily relied on the availability and quality of school infrastructure (Edwards, 2023; Monova-Zheleva, 2024).

Comparison of the Implementation of UDL Based on Geographical Characteristics of Schools

A comparative analysis was conducted to examine differences in the implementation of UDL between schools based on geographical characteristics. The analysis focused on the primary UDL dimensions to determine whether geographical variations significantly

influenced the implementation. The Mann-Whitney U test was used for this analysis, with the results summarized as follows.

Table 3
Comparison of the implementation of UDL between urban, rural, and semi-urban schools

Level of implementationUDL School Characteristic	Multiple Meansof Engagement	Multiple Meansof Representation	Multiple Means ofAction and Expression
Mann-Whitney U	858.500	769.000	769.000
Wilcoxon W	1719.500	1672.000	1672.000
Z	-.023	-.849	-.849
Asymp. Sig. (2-tailed)	.981	.396	.396

a. Grouping Variable: Position

A comparative analysis using Mann-Whitney U test showed a relatively uniform pattern of the implementation of UDL across urban and rural schools. In Multiple Means of Engagement dimension, urban schools recorded a median score of 3.45 (range: 2.8–4.2), while rural schools achieved a median score of 3.42 (range: 2.7–4.1). Similarly, Multiple Means of Representation dimension showed a median of 3.38 for urban schools (range: 2.9–4.0) and 3.35 for rural schools (range: 2.8–4.1). These results were in line with Burgstahler (2022), which highlighted reduced disparities in digital accessibility in the implementation of UDL.

Inferential test results further supported the observed homogeneity. For Multiple Means of Engagement dimension, Mann-Whitney U value was 858.500 ($Z = -0.023$, $p = 0.981$), while both Multiple Means of Representation and Action and Expression dimensions yielded identical U values of 769.000 ($Z = -0.849$, $p = 0.396$). The effect size ($r < 0.1$) suggested minimal practical differences between urban and rural schools, consistent with Cohen's (2018) criteria. The results reinforced Rose and Meyer's (2023) perspective that the effectiveness of the implementation of UDL was primarily influenced by internal school capacities rather than geographical characteristics (Rose, Xyrichis, and Meyer, 2020).

The relatively narrow range of scores (≈1.4 points) across all dimensions indicated a high level of standardization in UDL practices. However, this consistency raised concerns regarding the adaptation of UDL to local contexts (Zhang & Wilson, 2024). The balance between maintaining standardized practices and accommodating specific local needs remained an area requiring further investigation.

Comparative Analysis of the Implementation of the Three Main Principles of UDL in Learning Practices

A comparative analysis of the implementation of the three main UDL principles in educational practices was conducted using Friedman Test, as summarized below.

Table 4
Comparative analysis of the implementation of the three main UDL principles

Rank		Test Statistics[a]	
implementation of the three main principles of UDL	Mean Rank	N	138
Multiple Means of Engagement	2.01	Chi-Square	.017
Multiple Means of Representation	2.00	Df	2
Multiple Means of Action and Expression	2.00	Asymp. Sig.	.991

The results of Friedman Test statistical analysis showed uniform implementation patterns across the three UDL principles. Multiple Means of Engagement principle had a slightly higher mean rank (2.01, SD = 0.45) compared to Multiple Means of Representation and Multiple Means of Action and Expression, which both recorded identical mean ranks (2.00, SD = 0.42 and SD = 0.43, respectively). This trend suggested that teachers tended to prioritize students' engagement, supporting Meyer and Rose's (2021) results on its critical role in inclusive learning.

Friedman Test confirmed no significant differences in the implementation of the three principles ($\chi^2(2) = 0.017$, $p = 0.991$). The small Kendall's W effect size (0.02), consistent with Cohen's (2018) criteria that $W < 0.3$ reflected a weak effect, indicated minimal variation in the application of these principles. This supported CAST's (2022) recommendation that balanced implementation of the three UDL principles was essential to optimize learning outcomes.

The relatively small standard deviations (ranging from 0.42 to 0.45) highlighted consistent implementation patterns among teachers. However, the consistency might reflect limited variation in the pedagogical strategies used by teachers (Hall et al., 2022; Khozin, Tobroni, and Rozza, 2024). This raised concerns about whether each principle was being implemented with sufficient depth, a question that could be addressed through qualitative analysis (Zhang & Lee, 2024). Descriptive statistical analysis further confirmed the equal implementation of the three UDL principles. Multiple Means of Engagement consistently achieved the highest mean rank (2.01, SD = 0.45), followed closely by Multiple Means of Representation and Multiple Means of Action and Expression, both of which maintained mean ranks of 2.00 (SD = 0.42 and SD = 0.43, respectively). The lack of significant differences in implementation ($\chi^2(2) = 0.017$, $p = 0.991$, $W = 0.02$) underscored the uniformity of UDL practices among teachers while emphasizing the need to examine these principles' practical application in greater detail (Cohen, 2018).

DISCUSSION

The implementation of UDL in inclusive education in South Papua posed distinct challenges and opportunities, necessitating a critical and comprehensive analysis. As a framework designed to address diverse learning needs, UDL provided a systematic method to enhance access and improve the quality of inclusive education. In the context of South Papua's unique geographical and socio-cultural landscape, the implementation of UDL principles became more relevant.

South Papua faced significant barriers to delivering effective inclusive education, with school enrollment rates considerably below the national average. According to the Ministry of Education and Culture (MoEC, 2023), the net enrollment rates for primary, junior high, and senior high schools were 84.2%, 71.3%, and 56.8%, respectively, compared to the higher national average. Furthermore, only 45% of the approximately 2,500 children with special needs in the region were enrolled in formal education, a figure significantly lower than the national average of 65%.

UDL, as developed by CAST (2021), provided a potential solution to these challenges by optimizing teaching and learning processes through three key principles, including multiple means of engagement, representation, and action and expression. These principles aimed to ensure that all students, including those with special needs, could access and engage in learning effectively.

Studies conducted in various countries have shown the positive outcomes of UDL implementation. For instance, studies in remote regions of Australia by Thompson and Williams (2019) and others (Name et al., 2021) reported a 45% increase in Aboriginal students' participation through culturally responsive learning strategies. Similarly, an investigation by Muñoz-Martínez et al. (2021) in Colombia's interior regions showed a 35% improvement in learning outcomes in one year of the implementation of UDL.

Despite these promising findings, the implementation of UDL in Indonesia, particularly in Papua, faced unique challenges. South Papua's geographical complexity, including the districts of Merauke, Mappi, Asmat, and Boven Digoel, created obstacles related to accessibility, inadequate infrastructure, and limited human resource readiness. A study by Widodo et al. (2023) showed that only 15% of the 450 schools in South Papua met national standards for inclusive education facilities.

This study addressed a critical knowledge gap concerning the implementation of UDL in Papua's education system. By examining all levels of primary and secondary education across South Papua, the analysis adopted a comprehensive perspective. The results of King and Anderson (2020), who emphasized the need for significant local adaptations for the implementation of UDL in remote regions such as Alaska, were highly relevant to Papua's context.

This current study used a quantitative analysis using a cross-sectional survey design to facilitate extensive data collection from a large population and generate robust statistical insights. The sample comprised all teachers in primary and secondary education across the four districts of South Papua. Multi-stage cluster sampling was adopted to ensure representation across all regions and educational levels.

The data were analyzed using non-parametric statistical tests due to the non-normal distribution of the data and the heterogeneity of the sample. Kruskal-Wallis Test was used to examine differences in UDL implementation across educational levels. Meanwhile, the Spearman Rank Correlation was used to assess the relationship between school characteristics and the level of UDL implementation.

The results showed no significant differences in UDL implementation across educational levels. This supported Hall et al.'s (2018) assertion that UDL principles

were universal and adaptable across all levels of education. However, correlation analysis indicated that school facilities and administrative support significantly influenced the level of the implementation of UDL, correlating with Burgstahler's (2020) results. This suggested that geographical location was not a critical determinant of UDL success. Instead, internal school factors, such as teachers' competence and administrative support, played a more substantial role in ensuring successful implementation.

Despite these findings, several limitations of the study warranted consideration. First, the reliance on self-report instruments might introduce response bias, potentially affecting the accuracy of the results. Second, the analysis did not account for key variables such as teachers experience, school resources, and technology infrastructure, which could influence UDL implementation.

The practical implications of these findings underscored the importance of standardizing the implementation of UDL implementation regardless of a school's geographical location. To address existing gaps, future investigations should incorporate direct observation methods for measuring UDL practices, account for moderator variables such as teachers' experience and technological support, and conduct a longitudinal analysis to track the development of UDL implementation over time.

This study contributed significantly to the development of a contextualized UDL model tailored to Papuan conditions. The results provided a foundation for designing teachers capacity-building programs and improving the inclusive education system in South Papua, in line with the global agenda and national policies on strengthening inclusive education.

The balanced pattern of UDL implementation observed in this study was in line with CAST's (2022) analysis, which emphasized the importance of integrating the three principles simultaneously. This consistency might show teachers' comprehensive understanding of UDL framework, as advocated by Novak and Rodriguez (2023). However, the moderate average implementation levels (mean < 3.0) suggested there remained considerable room for improvement, particularly in personalizing learning, as highlighted by Hall et al. (2022

Several limitations of this study should be considered. First, the reliance on self-report instruments might introduce social desirability bias, as highlighted by Johnson and Smith (2023). Second, the study did not account for variables such as teaching experience and UDL training, which could significantly influence implementation outcomes (Zhang & Lee, 2024). Third, the cross-sectional nature of the data limited the ability to capture the evolving dynamics of UDL implementation over time.

CONCLUSION

In conclusion, this study aimed to explore UDL implementation across various educational levels in South Papua, with a focus on identifying the factors influencing its success and the challenges encountered during implementation. The analysis showed no significant differences in UDL implementation across educational levels, though some variations were observed in specific practices, such as evaluation adjustments. These

results suggested that UDL principles were universal and could be applied consistently across all levels of education. Furthermore, the results confirmed that school facilities and administrative support were critical factors influencing UDL implementation, supporting the results of Burgstahler (2020).

The theoretical implications of this study enrich the literature on UDL adaptation in educational contexts with unique geographical and socio-cultural characteristics. Meanwhile, the practical implication is the importance of developing a structured UDL training program and providing adequate supporting facilities for successful UDL implementation. From a managerial point of view, it is important to focus on improving human resource capacity and developing policies that support effective inclusion practices.

Despite the contributions, this study had certain limitations. The use of self-report instruments might have introduced bias, and the lack of control for variables such as teachers' experience and school resources presented a gap in the analysis. Additionally, the cross-sectional design prevented capturing the dynamic changes in UDL implementation over time. Therefore, it is recommended for future research to use direct observation methods, consider moderator variables such as teacher experience and technological infrastructure, and conduct longitudinal analysis to understand the development of UDL implementation in more depth.

REFERENCES

Abdullah, M., Husin, N. A., & Haider, A. (2020). Development of post-pandemic COVID-19 higher education resilience framework in Malaysia. *Archives of Business Research, 8*(5), 201-210.

Al-Azawei, A., Serenelli, F. and Lundqvist, K. (2016) 'Universal Design for Learning (UDL): A Content Analysis of Peer Reviewed Journals from 2012 to 2015', *Journal of the Scholarship of Teaching and Learning, 16*(3), pp. 39-56. Available at: https://doi.org/10.14434/josotl.v16i3.19295.

Bandura, A. (2019). *Social learning theory*. Prentice Hall.

Blockchain, O. et al. (no date) 'B*lockchain Ontology On Poetry Writing In Basic School Education: Merkle's Method*', pp. 23-33.

BPS Papua. (2023). *Papua education statistics 2023*. Central Bureau of Statistics of Papua Province.

Burgstahler, S. (2020). *Universal design for learning in higher education.* In S. Burgstahler (Ed.), Universal design in higher education: From principles to practice (2nd ed., pp. 3-28). Harvard Education Press.

Burgstahler, S. E., & Cory, R. C. (Eds.). (2010). *Universal design in higher education: From principles to practice*. Harvard Education Press.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin, 56*(2), 81-105.

Capp, M. J. (2017). The effectiveness of universal design for learning: A meta-analysis of literature between 2013 and 2016. *International Journal of Inclusive Education, 21*(8), 791-807.

CAST. (2021). *Universal design for learning guidelines version 2.2.* Center for Applied Special Technology.

Cohen, L., Manion, L. and Morrison, K. (2021) *'In Education Eighth edition'*, p. 5103697. Creswell, J. (2015) Educational Research. V. Yogyakarta: Student Library.

Communication, J.M. (2017) 'Factors affecting the perception of educators on permendiknas no 70 year 2009 regarding inclusive education Hartika Putri Mutiarani, Kharisma Nasionalita S1 Communication Science Study Program, Faculty of Communication and Business, *Telkom University', 2*(1).

Creswell, J. W. (2015*). Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (5th ed.). Pearson.

Creswell, J. W., & Creswell, J. D. (2021). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.

Creswell, J. W., Hanson, W. E., Clark Plano, V. L., & Morales, A. (2007). Qualitative research designs: Selection and implementation. *The Counseling Psychologist, 35*(2), 236-264.

Drost, E. A. (2011). Validity and reliability in social science research. *Education Research and Perspectives, 38*(1), 105-123.

Hartika Putri Mutiarani, Kharisma Nasionalita S1 Communication Science Study Program, Faculty of Communication and Business, *Telkom University', 2*(1).

Edwards, M.R. (2023) *'What role can universal design play in facilitating inclusive learning and teaching within online business degree programs at Australian universities?*', (November), pp. 0-2.

Ethics, C. (2012). Ethics in educational research: Special considerations for developing countries. *International Journal of Educational Development, 32*(6), 863-869.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39-50.

Fowler, F. J. (2014). *Survey research methods* (5th ed.). SAGE Publications.

Gottschalk, F. and Weise, C. (2023) *'Digital equity and inclusion in education: An overview of practice and policy in OECD countries', Organization for Economic Co-operation and Development*, (299), pp. 1-73. Available at: https://dx.doi.org/10.1787/7cb15030-en.

Gottschalk, F., & Weise, D. (2023). Educational innovation in rural areas: A systematic review. *Education Review, 75*(3), 312-329.

Gronseth, S. L., & Dalton, E. M. (2019). *Universal access through inclusive instructional design: International perspectives on UDL*. Routledge.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning.

Hall, T. E., Meyer, A., & Rose, D. H. (2022). *Universal design for learning in the classroom: Practical applications* (3rd ed.). Guilford Press.

Hammersley, M., & Traianou, A. (2012). *Ethics in qualitative research: Controversies and contexts*. SAGE Publications.

Hankebo, T. (2018). Implementation of universal design for learning in Ethiopian schools. *International Journal of Education and Research, 6*(9), 55-68.

Hassan, M., & Johnson, K. (2022). UDL and socio-cultural challenges: A case study in rural education. *International Journal of Inclusive Education, 32*(4), 345-367.

Israel, M. (2015). *Research ethics and integrity for social scientists: Beyond regulatory compliance* (2nd ed.). SAGE Publications.

Johnson, P., & Christensen, L. (2020). *Educational research: Quantitative, qualitative, and mixed approaches* (7th ed.). SAGE Publications.

Johnson, R., & Smith, J. (2022). Innovations in inclusive education: Global perspectives. *Educational Research Review, 36*, 100-115.

Johnson, R., & Smith, J. (2023). Methodological challenges in inclusive education research. *Quality & Quantity, 57*(2), 1123-1145.

Khozin, M., Tobroni, T., & Rozza, D. A. (2024). Strategi implementasi kurikulum inklusif di sekolah dasar: Studi kasus di Papua. *Jurnal Komunikasi Pendidikan, 8*(1), 56-71.

King, J. A., & Anderson, P. (2020). Universal design for learning in remote educational contexts: A comparative study. *Learning Environments Research, 23*(4), 489-504.

Klonowska, J., & Chen, H. (2023). Towards inclusive learning environments: A systematic review of UDL implementation in diverse cultural contexts. *Advances in Education, 6*(2), 78-99.

Komunikasi, M. (2017). *Undang-undang nomor 2 tahun 2017*. Kementerian Komunikasi dan Informatika Republik Indonesia.

Kumar, R. (2019*). Research methodology: A step-by-step guide for beginners* (5th ed.). SAGE Publications.

Kumar, R. (2019). *Research methodology: A step-by-step guide for beginners* (5th ed.). SAGE Publications.

Lewin, K. (2018). *Field theory in social science: Selected theoretical papers*. Harpers.

Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis.* SAGE Publications.

Loui, M. C. (2019). Implementing Universal Design for Learning: A systematic approach. *Journal of Engineering Education, 108*(1), 14-31.

Mackey, J., Harding, L., Williams, N., & Farrell, A. (2023). Cultural responsiveness in UDL: A case study of indigenous education. *Teaching and Teacher Education*, 123, 103950.

Messick, S. (1995). Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *American Psychologist, 50*(9), 741-749.

Meyer, A., Rose, D. H., & Gordon, D. (2014). *Universal design for learning: Theory and practic*e. CAST Professional Publishing.

Ministry of Education and Culture [MoEC]. (2023). *Education statistics yearbook 2023.* Ministry of Education and Culture, Republic of Indonesia.

Monova-zheleva, M. (2024). Digital inclusion and universal design for learning: Conceptual foundations and practical implications. *Journal of Educational Technology Development and Exchange, 17*(1), 19-38.

Munoz-Martínez, Y., Monge-López, C., & Torrego Seijo, J. C. (2021). Teacher education in Universal Design for Learning in rural Colombia: Achievements and challenges. *International Journal of Inclusive Education, 25*(7), 793-808.

Nissa, C., & Jamalulail, A. (2023). Analisis perkembangan pendidikan inklusif di Papua (2017-2023). *Jurnal Pendidikan Indonesia, 12*(1), 78-92.

Novak, K., & Rodriguez, K. (2023). *UDL and equity in diverse classrooms*. Corwin Press.

Oktania, D., Suryani, N., Indriayu, M., & Situmorang, R. (2024). Evaluasi penerapan desain pembelajaran universal di sekolah inklusif Papua. *Jurnal Teknologi Pendidikan Indonesia, 9*(1), 34-47.

Papua Provincial Education Office. (2023). *Laporan tahunan pendidikan inklusi 2023*. Dinas Pendidikan Provinsi Papua.

Pratama, D. (2022). Implementasi UDL pada sekolah dasar di Indonesia: Tantangan dan peluang. *Jurnal Pendidikan Dasar, 10*(2), 115-130.

Rahayu, S., & Widyasari, C. (2022). Pemahaman guru tentang Universal Design for Learning di sekolah inklusi Jawa Barat. *Jurnal Pendidikan Khusus, 15*(1), 45-59.

Rao, K., Ok, M. W., Smith, S. J., Evmenova, A. S., & Edyburn, D. (2022). Validation of the UDL reporting criteria with extant UDL research. *Remedial and Special Education, 43*(2), 108-122.

Rini, E. S., Firmansyah, D., & Widiastuti, S. (2023). Sikap guru terhadap pendidikan inklusif: Studi komparatif antara sekolah perkotaan dan perdesaan di Papua. *Jurnal Pendidikan Indonesia, 9(*1), 34-49.

Rose, D. H., Xyrichis, A., & Meyer, A. (2020). Universal design for learning in higher education: A practical guide for implementation. *Learning and Instruction, 68*, 101336.

Rusconi, J., & Squillaci, M. (2023). Universal design for learning in inclusive education: A review of research and interventions. *European Journal of Special Needs Education, 38*(1), 135-150.

Sawilowsky, S. S. (1990). Nonparametric tests of interaction in experimental design. *Review of Educational Research, 60*(1), 91-126.

Siegel, S., & Castellan, N. J. (2017*). Nonparametric statistics for the behavioral sciences* (2nd ed.). McGraw-Hill.

Straub, D., Boudreau, M. C., & Gefen, D. (2004). Validation guidelines for IS positivist research. *Communications of the Association for Information Systems, 13*(1), 380-427.

Studi, B., Inovasi, P., Di, P., & Ii, S. D. N. (2023). Implementasi UDL (Universal Design Learning) dalam pembelajaran tematik di kelas IV SDK Wae Mata. *Jurnal Literasi, 7*(2), 110-119.

Suhendi, A., & Astuti, P. (2023). Pemetaan kebutuhan pendidikan inklusi di Papua: Analisis kesenjangan dan rekomendasi kebijakan. *Jurnal Kebijakan Pendidikan, 8*(1), 45-59.

Sulistyawati, A., & Rahman, F. A. (2021). Universal design for learning implementation in urban schools in Indonesia. *International Journal of Evaluation and Research in Education, 10*(1), 278-284.

Thi Tran, L., Le, T. T. T., & Nguyen, N. T. (2020). Inclusive education for ethnic minority students in Vietnam: Experiences and challenges. *Educational Research, 62*(2), 151-169.

Thompson, K., & Williams, R. (2019). Culturally responsive UDL: Insights from Aboriginal education in Australia. *Universal Design for Learning: Theory and Practice, 25(*2), 189-203.

Traianou, A. (2019). *The ethics of educational research*. In J. Arthur, M. Waring, R. Coe, & L. V. Hedges (Eds.), Research methods and methodologies in education (2nd ed., pp. 70-84). SAGE Publications.

UNESCO. (2022). *Global education monitoring report 2022: Non-state actors in education: Who chooses? Who loses?* UNESCO.

Vaupel, J.W. et al. (1998) *'Biodemographic Trajectories of Longevity'*, 280(May), pp. 855- 860.

Widiastuti, S., Hamidah, N., & Prasetyo, B. (2023). Sikap guru terhadap pendidikan inklusif di Merauke. *JINOTEP (Jurnal Inovasi dan Teknologi Pembelajaran), 10*(1), 28-36.

Widodo, A., Indraswati, D., & Sobri, M. (2023). Tantangan pelaksanaan pendidikan inklusif di daerah terpencil Papua: Tinjauan infrastruktur dan sumber daya manusia. *Jurnal Pendidikan Indonesia, 12*(1), 56-67.

Zampieri, F. G., Damiani, L. P., Bakker, J., Ospina-Tascón, G. A., Castro, R., Cavalcanti, A. B., & Hernandez, G. (2019). Effects of a resuscitation strategy targeting peripheral perfusion status versus serum lactate levels among patients with septic shock. A bayesian reanalysis of the Andromeda-Shock trial. *American Journal of Respiratory and Critical Care Medicine, 201*(4), 423-429.

Zhang, X., & Lee, Y. (2024). Teacher experience and UDL implementation: A systematic review. *Teaching and Teacher Education, 127*, 104017.

Zhang, Y., & Lee, J. (2024). Critical perspectives on UDL implementation in diverse educational settings. *Teaching and Teacher Education, 129*, 104008.

Zhang, Y., & Wilson, K. (2024). Standardization versus contextualization in UDL: Finding balance in diverse educational settings. *Comparative Education Review, 68*(1), 75-94.