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THE EFFECTIVENESS OF COOPERATIVE LEARNING INTEGRATED WITH HUYULA VALUES AND VARIETY OF MEDIA TO IMPROVE SCIENCE MASTERY IN INCLUSIVE ENVIRONMENTS

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ABSTRACT

Science learning in public schools should be designed to accommodate both regular students and students with special education needs. This is also one of the implementations of SDG 4, Sustainable Development, specifically related to quality education and inclusive education. This study aims to measure the effectiveness of cooperative learning integrated with local wisdom values of Huyula in improving science concept mastery among regular students and students with special education needs in public schools. The study employs a pre-experimental design with a one-group, pretest-posttest approach. The study was conducted in five schools involving 323 regular students and 12 students with special education needs. The research results on the effectiveness of cooperative learning integrated with the local wisdom values of Huyula showed a significant increase in science concept mastery. This is indicated by the hypothesis test through the Wilcoxon signed-rank test with a value of z = -15.84, through the N-Gain test (high category, average 0.74), and a strong effect size through the rank-biserial correlation value (-1.00). This study concludes that the implementation of science learning integrated with Huyula values and media variety has an influence and is effective in improving the science concept mastery of regular students in the high category and students with special education needs in the medium category. This finding highlights the importance of integrating local wisdom values and media variety in supporting the improvement of science concept mastery through meaningful and inclusive teaching for all students.

Keywords: local wisdom; huyula; inclusive education; science learning

INTRODUCTION

Local wisdom values are one of the potential resources a region has based on the interaction of society with its natural environment, which is passed down from generation to generation. Local wisdom includes ideas, values, norms, practices, and traditional technologies that have stood the test of time. The application of local wisdom in various aspects of life makes these elements meaningful to the people in the region, including education, such as the integration of values in the learning process. The integration of local wisdom in education, in general, and in teaching, in particular, is essential (Suprapto et al., 2021). Integrating local culture in Indonesia in teaching by teachers is highly recommended to be converted into an interesting learning resource for students (Parmin et al., 2024, 2022; Parmin & Trisnowati, 2024). Integrating local wisdom into education presents a more relevant and meaningful learning process for students (Anwari et al., 2016; Kurniawati et al., 2017; Hadi et al., 2019; Ahanonye et al., 2024; Li et al., 2025).

Integrating local wisdom values in learning, for example, science, allows students to understand science concepts from a perspective closer to reality. Local wisdom is rooted in stu-

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dents' life experiences and cultural contexts that can help them better understand the relationship between what they learn and their own lives (Anwari et al., 2016; Kurniawati et al., 2017). This can make science education more engaging and accessible to students, especially those from diverse cultural backgrounds (Laughter & Adams, 2012; Tapia et al., 2017; Rioux & Smith, 2019; Jin, 2021; Zheltukhina et al., 2023; Sarkingobir & Bello, 2024).

Thus, students learn science theoretically and observe its application in the daily practices of local communities. Culture can be integrated through ethnoscience and ethnopedagogy. Research and integration of culture as a learning resource have been widely conducted.

In the context of education that is constantly changing and demanding innovation, the integration of local wisdom through ethnopedagogy aligns with curriculum policies that encourage contextual and meaningful learning and are oriented towards character development. Students must understand science as a collection of facts and theories and an inseparable part of life. Thus, it is hoped that students can grow into individuals who are critical, creative, and responsible for the environment and culture, and possess positive values, such as helping one another.

The cultural value of helping one another or mutual cooperation can be applied to teaching because students' physical, intellectual, and other needs vary. The diversity of student backgrounds requires the value of helping one another in the local community. Mutual cooperation and helping one another among students during learning, especially in science, is essential. It can be practiced during individual and group work for regular students and students with difficulties completing tasks or related problems. Teachers can facilitate this by creating an inclusive classroom culture that values diversity and collaboration. Teachers can encourage students to ask each other for help (Mirošević, 2019; Hansen & Dawson, 2020).

Teaching that considers all the needs of students, including students with special education needs, is known as inclusive teaching. The implementation of inclusive education in Indonesia is divided into three service delivery models: full regular classes, regular classes with special education teachers, and full special classes (Sujarwanto et al., 2018). In general, inclusive teaching is carried out in full regular classes, where students with special education needs and their peers learn together all the time, using the public school curriculum. Teaching in regular classes with special education teachers is similar to teaching in full regular classes, but special education teachers accompany students with special education needs in addition to the class or subject teachers. Meanwhile, full special classes include teaching in general schools, where students with special education needs are grouped and accompanied by special education teachers. This group can be combined or separated with regular classes in particular subjects and at certain times.

The implementation of inclusive education has become a must for all schools in Indonesia. This requirement is supported by government regulations related to inclusive education, which state that all educational units are obligated to implement inclusive education (Kemendikbudristek, 2023). This is also in line with one of the goals of SDGs 4, namely quality education, especially the target of eliminating gender gaps in education and ensuring equal access to all levels of education for vulnerable groups, including people with disabilities (Hay & Beamish, 2025; Kementerian PPN/Bappenas, 2024; Perpres RI, 2017).

In public schools with special education teachers and special schools, specific and individual curricula are implemented through the Individual Learning Program (Arriani et al., 2022). Public schools without special education teachers require learning innovations that cater to the diverse needs of both regular students and those with special education needs. Initial observations made at one of the state junior high schools in Gorontalo found that several children with learning barriers attended the public school. It was also found that there were no special education teachers; however, subject teachers participated in inclusive school training (Saleh et al., 2025).

Several studies have found that many teachers feel unprepared to teach students with various needs, especially students with special education needs such as autism or intellectual disabilities (Gilic & Chamblin, 2017; Jaffal, 2022; Khazanchi & Khazanchi, 2023). Other practical challenges include large classes, inadequate resources and teaching materials, and limited time for differentiation and individualization (Lyon et al., 2020; Tafirenyika et al., 2023).

Facing these challenges requires emphasis on the importance of developing empathy and understanding in students toward peers with special needs (Maher & Morley, 2019; Maher et al., 2019). Challenges can also be addressed by implementing cooperative learning strategies, such as group work and peer tutoring, which encourage students to support and help each other (Strogilos & King-Sears, 2018; Jordan, 2018; Fur-

rer et al., 2020). This approach encourages social participation, interaction, and togetherness in inclusive classrooms (Furrer et al., 2020). Collaborative classroom approaches, technology-mediated learning activities, and peer learning can also play a significant role in the development of all students, particularly those with special educational needs (O'Sullivan et al., 2020).

In the effort to implement inclusive education in Indonesia, particularly in public schools without special education teachers, students with special education needs require curriculum adaptation and models that integrate various aspects, such as values and media, tailored to their needs. By integrating values and media, the needs of students with special education needs can be met.

One of the values that can be integrated is the value of local wisdom in the area where the student lives. One of the values of local wisdom in Indonesia, especially in Gorontalo, is *huyula*. *Huyula* is a local wisdom value that embodies mutual cooperation and helping one another. *Huyula* activities are categorized into *ambu*, *hileiya*, and *ti'ayo* (Rahman, 2022).

Ambu helps each other and works together on joint activities. *Hileiya* helps one another and works together to assist community members who experience disasters. Meanwhile, *ti'ayo* helps each other and works together to lighten or complete the personal work of community members.

Implementation of Huyula activities in science teaching can be done. During group work, the *ambu* value is used. In individual work, *ti'ayo* is used. *Hileiya* is used when helping friends who are in trouble, such as students with special education needs, including those with both physical and intellectual disabilities. The integration of local wisdom values is also a direct implementation of one of the goals of SDGs 4, namely quality education with the target of sustainable education that promotes culture, appreciation of cultural diversity, and cultural contribution to sustainable development (Perpres RI, 2017; Kuroda & Nakasato, 2023; Kementerian PPN/Bappenas, 2024). Through the integration of learning about the value of local wisdom, Huyula is implemented in public schools to improve the quality of inclusive teaching for students with disabilities studying in public schools, which is one of the novelties in this study.

Based on the research background, it is necessary to hold an innovation in inclusive learning that focuses more on public schools without special education teachers and special curriculum in special schools and inclusive schools. Innovation also focuses on ethnopedagogy by integrating Huyula values in facilitating inclusive teaching and learning. This study supports previous research, particularly in Indonesia, on the integration of local wisdom in learning (Anwari et al., 2016; Kurniawati et al., 2017; Hadi et al., 2019; Parmin et al., 2024, 2022; Parmin & Trisnowati, 2024).

The learning environment in a heterogeneous regular school, where there are regular students and students with special educational needs, demands that teachers employ not only effective teaching strategies but also consider all aspects, including learning needs such as learning styles, cognitive and social-emotional abilities of students. Gaitas et al. (2025) emphasized the importance of teachers in creating learning settings that are responsive to students' social and academic needs through strategies such as task differentiation and the use of collaborative learning media. A variety of varied and adaptive media can improve student learning outcomes in science concepts. This finding aligns with Odja et al. (2024), who found that the use of varied learning media, such as science kits, PhET, and videos, can improve learning outcomes, particularly in the concept of wave mechanics.

Other research supports the notion that integrating technology into learning media has a significant positive impact on the academic engagement and development of both regular students and students with special educational needs. The use of digital devices and online services provides students with alternative access to absorb material and complete assignments, allowing for personalized learning according to the needs of each student (Karagianni & Drigas, 2023). This finding aligns with Pérez-Salas et al. (2021), who demonstrate that teacher-student relationships and participation support in schools significantly influence the level of cognitive, emotional, and social involvement of students with special educational needs, ultimately affecting student learning outcomes. In this context, technology-based learning media innovations, including visual, interactive, and multimedia aids, are important strategies to bridge the learning gap and ensure the active participation of all students in an inclusive classroom environment.

The formulation of the problem in this study is as follows: How is the effectiveness of integrated cooperative teaching with Huyula values and media variations on the mastery of science concepts in an inclusive learning environment? This study aims to measure the effectiveness of cooperative learning integrated with local wisdom values of Huyula in improving science concept mastery in an inclusive environment. The

targeted findings in this study are the impact of implementing science learning tools and processes integrated with local wisdom values of Huyula and media variety in improving science concept mastery. In addition, this study is expected to enhance students' understanding of local wisdom values in Gorontalo, which are increasingly less known and implemented by the next generation of students.

METHODS

The study employs a pre-experimental design with a one-group pretest-posttest approach (Fraenkel et al., 2012; Creswell, 2014). The study design was chosen because one of the research subjects, students with special education needs in public schools, was not evenly distributed across the study population. Based on this reason, the research sample was selected using purposive sampling. The study was conducted in five schools in three districts and one city, involving 335 students: 323 regular students and 12 students with special education needs. One student was categorized as having physical disabilities/ physically disabled, and 11 students were slow learners. The adaptation of the research design, specifically the one-group pretest-posttest design, is presented in Figure 1.

O	X Treatment	O
Pre Test	Cooperative Learning Integrated with Huyula Values and Variety of Media to Improve Science Mastery in Inclusive Environments	Post Test

Figure 1. Research Design

This study compares learning outcomes before and after treatment (cooperative learning integrated with local wisdom values of Huyula and media variety). Learning outcomes are assessed through standardized tests for all students, including both regular students and those with special education needs. The study was carried out in grade VIII at the junior high school level. The concept of science learned is the concept of work and simple machines. The research instruments used were learning devices, student activity sheets, learning outcome tests, and teaching materials. After validation and testing, the teaching materials were declared suitable for science learning. The average expert validation score related to the integrated cooperative learning tool is as follows: for the lesson plan, it is 3.48; the average score for student worksheets and teaching materials is 3.47, based on a maximum assessment score scale of 4 (Modeong et al., 2024; Rahim et al., 2024). For the science concept mastery test, the average expert validation score was 3.59 out of a maximum score of 4 (Rahim et al., 2024). The instrument for screening students with special education needs was from the Directorate of PSLB (2010).

Data analysis was performed using the appropriate mean difference test. If the data meet the assumption test (normality), use the Paired Samples T-Test; if they do not meet the assumption (non-normality), then use the Wilcoxon signed-rank test. The assumption test used the Shapiro-Wilk test (Silverman, 1986; Dunlap et al., 1996; Morey, 2008; Borenstein et al., 2009; Sellke et al., 2001; Moore et al., 2012; Whitlock & Schluter, 2015). Statistical data analysis was performed using the JASP (Jeffrey's Amazing Statistics Program) application, version 0.19.3.

The effect size test was also conducted to measure the effect of cooperative learning integrated with the local wisdom values of Huyula on students' learning outcomes. The JASP 0.193 application was used to calculate the Rank-Biserial Correlation Test, which measures the effect size. Correlation analysis by following the following categories: $< 0 \pm 0.1$ = Weak effect; $< 0 \pm 0.3$ = Modest effect; $< 0 \pm 0.5$ = Moderate effect; $< 0 \pm 0.8$ = Strong effect; $\geq \pm 0.8$ = Very strong effect (Cohen et al., 2018). The effectiveness of learning is tested through the N-Gain Test. This test aims to calculate the increase in learning outcomes after implementing Huyula-integrated cooperative learning on the concept of work and simple machines.

Hake (1998) stated that the analysis of the average gain is normalized to be defined as the ratio of the actual average gain to the maximum possible average gain, as expressed in a mathematical equation. N-Gain is calculated by comparing the difference between the final test score and the initial test score to the maximum possible difference between the maximum score (usually 100) and the initial test score. The N-Gain value indicates the extent to which learning contributes to improving students' understanding. After the calculation, the results are interpreted in accordance with the criteria outlined in Table 1.

Table 1. N-Gain Category

Gain	Category
$\langle g \rangle \geq 0.7$	High
$0.3 \leq \langle g \rangle \leq 0.7$	Medium
$\langle g \rangle \leq 0.3$	Low

A gain test is conducted to see the effectiveness of treatment in affecting a variable. The normalized average gain score becomes a measure of effectiveness. If the gain test is in the average or high category, then integrated cooperative-based learning tools are effective (positive) in improving the learning outcomes of regular students and students with special education needs.

RESULTS AND DISCUSSION

The results of this study highlight the importance of inclusive learning in public schools. Three hundred thirty-five regular students and students with special education needs serve as the research sample. The percentage of students in inclusive teaching is shown in Figure 2.

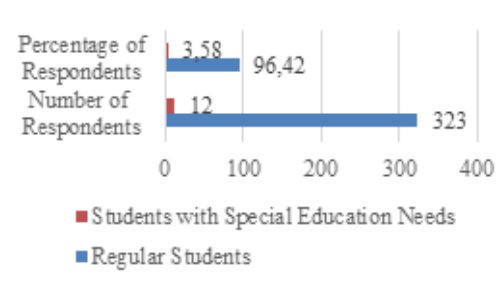

Figure 2. Percentage of Regular Students and Students with Special Education Needs

Figure 2 shows the small percentage of students with special education needs in public schools. There were 323 regular students and 12 students with special education needs. One student was categorized as having physical disabilities/physically disabled, and 11 students were slow learners.

Students with special education needs who enroll in public schools vary. For example, in China, only about 5.5% of individuals with intellectual disabilities attend public schools (Ge et al., 2019). Implementing inclusive education practices is influenced by various factors, including teacher attitudes and severity, which influence placement decisions in general versus special education settings (Ahmmed et al., 2012; Mann et al., 2018).

In Indonesia, more specifically Gorontalo, students with special education needs who enroll in public schools have mild to moderate levels of disabilities. The severity in public schools varies greatly. Many students have mild to moderate disabilities, while only some have severe disabilities. Many children with special educational needs in public school environments have mild disabilities, such as learning difficulties, slow learners, or attention deficit hyperactivity disorder (Kabasakal & Emıroğlu, 2021).

Students' science learning outcomes before (collected through a pre-test) and after (collected through a post-test) huyula-integrated cooperative learning in facilitating inclusive teaching are shown in Figure 3.

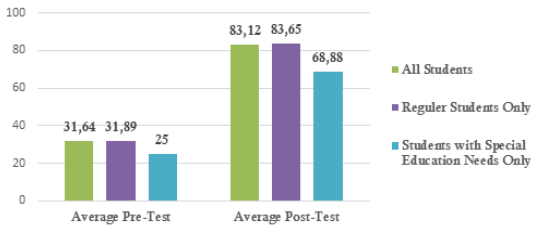

Figure 3. The Average Pre-test and Post-test Scores

Figure 3 compares the average pre-test and post-test scores for the three groups: all students, regular students only, and students with special education needs only. Better post-test averages for all students, regular students only, and students with special education needs only indicate improved learning outcomes. This improvement demonstrates that cooperative learning, which integrates the local values of wisdom huyula, has significantly improved students' scores from the pre-test to the post-test.

Improving learning achievement for regular students and students with special education needs in inclusive teaching can be achieved through a cooperative model that is integrated with the Huyula value (*Ambu* value) when collaborating in groups. Group work is conducted on the concept of science, specifically focusing on work and simple machines. Students collaborated to carry out simple experiments using science kits, including calculating the value of work and determining the mechanical advantages of simple machines, such as inclined planes and levers. In learning, videos and tutorials are also provided for the implementation of experiments using PhET media, allowing students with special education needs and those with visual learning styles to use and reinforce simple business concepts and plans independently. Regular students and students with special education needs help each other with assignments given individually (*Ti'ayo* value). During the implementation of science learning, students are encouraged to empathize (*hileyi'a* value) with other students who have obstacles in learning, including students with special education needs.

Students' learning outcomes in inclusive teaching can be improved through several strategies focusing on collaboration and responsive learning methods. Teaching adapts the material to students' social, cultural, and experiential contexts. Students with special education needs and their regular peers

benefit from inclusive learning environments where appropriate pedagogical approaches, such as those incorporating science, technology, engineering, arts, culture, and mathematics, emphasize hands-on activities (Wade et al., 2023). Recent findings related to inclusive teaching, progressive, and participatory teaching models and methods suggest that students learning together and collaborating can overcome inclusion challenges and promote better learning outcomes (Romanova, 2020; Moyagabo & Johnson, 2024).

A hypothesis test was conducted to determine the significance of increased science learning outcomes with a cooperative model integrated with Huyula values. Previously, a Shapiro-Wilk assumption test was conducted. Assumption testing was conducted using JASP software version 0.19.3. The results of the normality test are shown in Table 2.

Table 2. Test of Normality (Shapiro-Wilk) All Students

Measure 1	Measure 1	p
Pre-test	Post-test	< .001

The reported p-value is <0.001. The null hypothesis is rejected if the p-value is smaller than the significance level used (0.05). This means that the learning outcome data is not normally distributed. The assumption for using parametric tests is not met, so non-parametric tests are used; in this case, the Wilcoxon Signed-Rank Test is selected. The results of the Wilcoxon Signed-Rank Test are shown in Table 3.

Table 3. Wilcoxon Signed-Rank Test All Students

Measure 1	Measure 2	W	z	p
Pre-test	Post-test	0.00	-15.84	< .001

Table 3 shows the value of W = 0.00, indicating that all post-test scores are consistently greater or less than the pre-test scores without any balanced differences. A p-value less than 0.001 indicates that the difference between the pre-test and post-test is statistically significant.

To determine the significance of learning outcomes for science concepts in regular students and students with special education needs, hypothesis tests are presented in Tables 4, 5, 6, and 7.

Table 4. Test of Normality (Shapiro-Wilk) Regular Students

Measure 1	Measure 1	p
Pre-test	Post-test	< .001

The reported p-value is <0.001. The null hypothesis is rejected if the p-value is smaller than the significance level used (0.05). This means that the learning outcome data is not normally distributed. The assumption for using parametric tests is not met, so non-parametric tests are used; in this case, the Wilcoxon Signed-Rank Test is selected. The results of the Wilcoxon Signed-Rank Test are shown in Table 5.

Table 5. Wilcoxon Signed-Rank Test Regular Students

Measure 1	Measure 2	W	z	p
Pre-test	Post-test	0.00	-15.55	< .001

Table 5 shows the value of W = 0.00, indicating that all post-test scores are consistently greater or less than the pre-test scores without any balanced differences. A p-value less than 0.001 indicates that the difference between the pre-test and post-test is statistically significant.

Table 6. Test of Normality (Shapiro-Wilk) With Special Education Needs

Measure	P
Pre-test	0.68
Post-test	0.32

The reported p-values are 0.68 for the pre-test and 0.32 for the post-test. Since both p-values are greater than the significance level of 0.05, the null hypothesis of normal distribution is not rejected. This indicates that the learning outcome data are normally distributed. Therefore, the assumption for using parametric tests is met, and a parametric test, such as the paired samples t-test, is appropriate for analyzing the differences between pre-test and post-test scores. The results of the Paired Samples t-test are shown in Table 7.

Table 7. Paired Samples t-test Students With Special Education Needs

Measure 1	Measure 2	t	df	p
Pre-test	Post-test	-16.54	11	< .001

Table 7 presents the results of the paired samples t-test for students with special education needs, with a t-value of -16.54 and 11 degrees of freedom (df). The p-value is less than 0.001, indicating a statistically significant difference between the pre-test and

post-test scores. The large negative t-value suggests that post-test scores were substantially higher than pre-test scores, confirming the effectiveness of the intervention or treatment applied.

This means a fundamental change in students' learning outcomes after *Huyula-integrated and media-variety* cooperative learning. Significant differences are possible because the learning syntax is more directed at small-group cooperation and encourages empathy for fellow students, especially students with special education needs. *Huyula* values are integrated and practiced in group work to instill empathy. The *ambu* value in group work is applied mainly in class. The *ti'ayo* value emphasizes cooperation in completing independent tasks, particularly outside the classroom. In comparison, the *hileiya* value is integrated and practiced in fostering empathy, especially for students who experience obstacles during learning, including students with physical and intellectual disabilities.

Empathy for students with special education needs needs to be emphasized during inclusive learning. Negative attitudes and misunderstandings about disabilities can create an unfriendly environment for students with special education needs in public schools (Eckes & Gibbs, 2012; Jury et al., 2021).

Integrating cultural values into teaching is essential for creating a holistic educational environment that values and encourages diversity. One effective approach is ethnopedagogy, which emphasizes the integration of local cultural values into educational practices. This method enhances students' engagement and fosters their cultural identity and social responsibility (Sulistyani et al., 2018; Ariani et al., 2022; Wibawa & Awaliah, 2023). For example, integrating local wisdom into the curriculum can significantly improve students' character development and academic performance (Muhammad et al., 2021; Ramadhana et al., 2023).

The significance of science learning outcomes taught through a cooperative model integrated with *Huyula* values also pays attention to aspects of learning according to the nature of science, which involves presenting phenomena in everyday life that are contextualized using an approach that combines observation in real labs and virtual labs. Contextual teaching related to everyday life is essential for understanding science concepts. One effective strategy is to incorporate direct experiments that utilize materials or tools commonly found in everyday life, thereby making scientific concepts more relevant and accessible to students (Baynes, 2015). For example, using common items such as vinegar and baking soda to demonstrate chemical reactions attracts students' attention and reinforces theoretical knowledge through practical applications (Funa & Prudente, 2021).

The cooperative model, integrated with Huyula values , is also designed to improve science concept mastery through simple experimental activities, directly facilitated by virtual technology such as PhET video practicums and science concept videos. Videos and virtual technology can be accessed anytime and anywhere, especially for students with special education needs who are slow learners. Experimental activities are expected to improve science concept mastery. Though the tools are limited, improving science concept mastery can be achieved through direct experimental activities (Shao et al., 2024). Another alternative experiment is the use of educational technology, such as PhET simulations, which effectively increases student engagement and understanding (Olugbade et al., 2024; Diab et al., 2024). Additionally, video practicums can serve as an effective alternative to direct experiments when facilities are limited, providing a valuable means of demonstrating science concepts (Shao et al., 2024).

In addition to hypothesis testing, an effect size test was carried out. The effect size test enables the determination of the magnitude of the effect of a treatment or the relationship between variables, which is particularly helpful in evidence-based decision-making. The results of the effect size test are shown in Table 8.

Tabel. 8. Effect Size Test with Rank-Biserial Correlation Test

Measure 1	**Measure 2**	***Rank -Biserial Correlation***	**SE Rank -Biserial Correlation**
Pre Test	Post test	-1.000	0.063

Table 8 shows a Rank-Biserial Correlation value of -1.000, which falls within the very strong effect category. This result shows a strong relationship between the pre-test and post-test scores, indicating that the cooperative model integrated with huyula values significantly impacts students' mastery of science concepts. The results are also supported by the Standard Error (SE) value of 0.063, indicating a minimal error rate estimate. This suggests that the correlation results obtained are quite precise and reliable.

Local wisdom-based learning is implemented through huyula-integrated cooperative learning as one of the main factors contributing to improving students' science concept mastery. This aligns with various previous studies, which confirm that integrating local cultural values in learning can enhance stu-

dents' understanding, cultural awareness, and critical thinking skills (Ramdani et al., 2021; Sukadari et al., 2023; Arjaya et al., 2024).

In addition, according to Toharudin et al. (2021), the application of learning methods with traditional artifacts as part of local wisdom has also been shown to increase students' participation and involvement in learning. Thus, local wisdom-based methods have an impact on academic outcomes and support students' character development in accordance with local cultural values (Astuti, 2021; Wibawa & Awaliah, 2023).

However, it is essential to note that implementing this method can also present challenges, particularly in accommodating students with special education needs. Several studies have emphasized the need for more inclusive and adaptive teaching strategies, as well as support from various parties, to ensure the involvement of all students in local wisdom-based learning (Abba & Rashid, 2020; Delafontaine et al., 2024). The successful implementation of the cooperative model, integrated with Huyula values , can facilitate inclusive education and be applied directly in the classroom. Before implementing it, prospective teachers or educators must train in inclusive teaching strategies to be applied to both regular students and students with special education needs. Training educators in inclusive practices and fostering positive attitudes towards diversity are important components for successfully implementing these strategies (Alhumaid et al., 2022; Sánchez-Díaz et al., 2024). Ultimately, these strategies foster empathy and empower students to help one another, enriching their learning experiences (Sullivan, 2023).

To test the effectiveness of the cooperative model integrated with *Huyula* values, a test of learning outcome improvement was also conducted through N-Gain test analysis. The results of the N-Gain analysis are shown in Table 9 and Figures 4 and 5.

Table 9. The Average Scores of Pre-Test, Post-Test, and N-Gain

Inclusion Category	Average Pre-test Score	Average Post-test Score	N-Gain	Category
All Students	31.64	83.12	0.74	High
Regular Students Only	31.89	83.65	0.75	High
Students with special education needs only	25.00	68.88	0.58	Medium

Table 9 shows the average N-Gain of all students and regular students, who are in the high category, while students with special education needs are in the medium category. The average post-test scores of all students and regular students are above 70, while some students with special education needs score below 70.

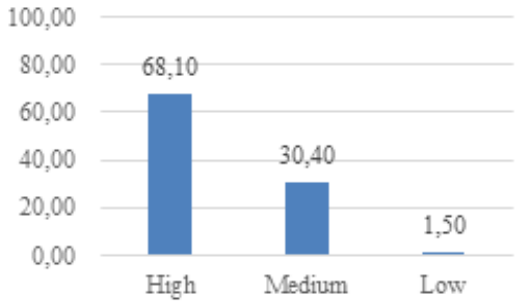

Figure 4. Distribution of N-Gain Values Based on N-Gain Categories

Figure 4 shows that the increase in learning outcomes of science concepts is spread across all N-Gain categories. The highest percentage is in the high category, and the lowest is in the low category.

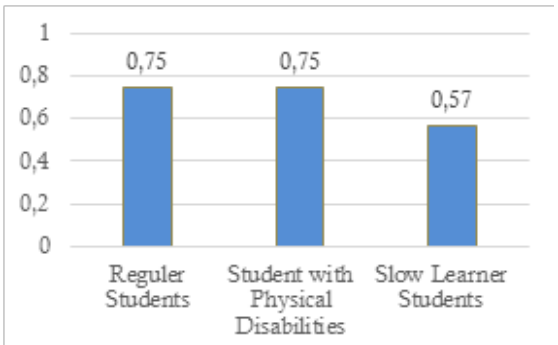

Figure 5. Distribution of N-Gain Values Based on Inclusion Category

Figure 5 shows that the increase in scores for regular students and students with special education needs is in the medium and high categories. For regular students and students with physical disabilities (physically disabled), the N-Gain score is included in the high category. In comparison, slow learners are categorized as medium learners.

N-Gain and effect size analysis show that implementing *Huyula*-integrated and media variety in cooperative learning can positively improve learning outcomes for all students in inclusive

teaching. Integrating Huyula values in cooperative learning provides a strong foundation for inclusive teaching. *Huyula* values, local wisdom originating from Gorontalo, not only increase a sense of togetherness but also create a supportive learning environment for all students in an inclusive environment.

In the context of regular students, *Huyula*-integrated cooperative learning facilitates more productive interaction and cooperation to help each other achieve learning goals. Meanwhile, for students with special education needs, *Huyula* values creating space for active participation that is often difficult to achieve in regular learning settings. By involving students with special education needs directly in *huyula*-integrated cooperative learning, this approach can reduce social stigma and increase self-confidence. This is driven by huyula values that emphasize group task cooperation (*ambu*), cooperation on individual tasks (*ti'ayo*), and empathy (*hileiya*) for students with special education needs.

Cooperative learning strategies encourage positive interactions with peers, which can reduce negative stereotypes associated with disabilities (García-Carrión et al., 2018). By incorporating Indigenous values, teachers can practice them and make them more relevant and culturally appropriate, which increases acceptance and reduces stigma (Gómez-Zúñiga et al., 2023).

Thus, integrating Huyula values is not only pedagogically relevant but also ethical, given the importance of inclusive and equitable education. Local wisdom often embodies community values and cultural practices that encourage acceptance and understanding, which can counteract negative stereotypes associated with disability (Miroševi**ć**, 2019; Abba & Rashid, 2020).

In addition, *Huyula*-integrated cooperative learning encourages collaboration among students, engaging them in shared tasks that foster mutual respect and understanding. This interaction is crucial to eliminating barriers and misconceptions about disabilities (Bombardelli, 2020). When working together, students tend to develop positive attitudes toward their peers with disabilities, thereby reducing stigma (Tafirenyika et al., 2023). Additionally, integrating local wisdom can enhance students' sense of belonging and identity, thereby further strengthening inclusive practices in the classroom (Lipka et al., 2020).

In *Huyula*-integrated cooperative learning, regular students and students with special education needs work together on simple science experiments. The value of cooperation in Huyula, both cooperation for one's interests (ti'ayo) and cooperation in groups (*ambu*), is facilitated in the learning of syntax. Likewise, the value of empathy (*hileiya*) can facilitate inclusive teaching for students with special education needs, both physical and intellectual. Simple experimental activities, both through direct experiments and virtual and video demonstrations, significantly contribute to science concept mastery, especially in the areas of work and simple machines. Students involved in practical experiments tend to understand better and connect theory with practice (Kapıcı et al., 2019; Byukusenge et al., 2023).

Student assistance and cooperation do not only occur in the classroom. Science kits, video media, and PhET simulations in Huyula-integrated cooperative learning help regular students and students with special education needs independently learn and review previously learned concepts, assisted by their peers (*ti'ayo* and *hileiya*) outside class hours. Videos can enhance student engagement and facilitate active learning, allowing students to learn independently and collaborate in groups (Debba**ğ** et al., 2021; Saidkhani et al., 2024). Additionally, videos serve as a reflection tool, helping teachers and students analyze the learning process and identify potential conceptual errors (Hoppe et al., 2020). Furthermore, practicum videos enable students to observe real-world applications of the theories they have learned, thereby strengthening the connection between theoretical knowledge and practice (Mufit et al., 2022).

The integration of the local wisdom value approach and digital technology reflects the main principle of the SDGs, namely quality education, particularly target 4.5, which aims to eliminate the gap in access to education for vulnerable groups, such as students with special needs as well as target 4.7, which promotes sustainable development-based education, respect for human rights, cultural diversity, and intercultural collaboration (Tonegawa, 2023). In addition, the use of ICTs, such as video and interactive simulations, is in line with global efforts to ensure a digitally equitable and adaptive learning system, enabling transformative and inclusive learning that is grounded in both technology and local values (eytia Bucheli et al., 2024; Bhaduri et al., 2025). Thus, this strategy is not only pedagogically relevant but also a significant contribution to achieving the Sustainable Development Goals in the education sector.

However, although the study results indicate high effectiveness, some practical implications must be considered. The lower N-Gain value of students with special education needs compared

to regular students indicates that challenges must be overcome in implementing this learning tool. Several factors may influence these results, including the initial level of readiness of students with special education needs, the complexity of science materials, and the need for more individualized adaptation. Therefore, the development of learning tools and evaluation in the future needs to pay more attention to the differentiation of teaching strategies and the provision of appropriate scaffolding for students with special education needs, oriented towards local wisdom. This is in line with one of the studies related to the conceptual framework of SGDs policy, which states that inclusive education needs to consider the diversity of students, especially students with special needs, and can also accommodate the local context of students, such as local culture (Ydesen & Elfert, 2023).

The novelty of this study, compared to previous studies, can be reviewed in several aspects, including the integration of local wisdom values, particularly those from Gorontalo, which provide new contributions to local wisdom-based learning models. Another aspect is inclusiveness in learning in public schools, which focuses on the joint learning of science concepts between regular students and students with special education needs.

Overall, this study makes an important contribution to inclusive education by emphasizing the role of local wisdom values, particularly *Huyula* in Gorontalo, Indonesia, in enhancing the quality of learning, especially inclusive education. The findings suggest that huyula-integrated cooperative learning is cognitively effective and supports social inclusion in the classroom. This success opens up opportunities for further research that can test the application of similar approaches in various cultural contexts and other educational levels.

CONCLUSION

This study concludes that implementing *Huyula*-integrated and media variety in cooperative learning significantly impacts students' learning outcomes in science concepts, supporting inclusive education in public schools. Implementing cooperative learning effectively improves science concept mastery for regular students and students with special education needs. Huyula values, which include the value of mutual cooperation in group (*ambu*) and individual (*ti'ayo*) assignments, as well as empathy (*hileiya*), strengthen positive social interactions and create an inclusive learning environment. Thus, this study has successfully improved students' learning outcomes and contributed to supporting inclusive education policies that strengthen local cultural values, thereby facilitating the implementation of SDG goals related to quality education.

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