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Strategies to Optimize the Effectiveness of Deep Learning Culturally Responsive Teaching in Elementary Schools Inclusion, Developing and Validating the Social-L DLCRT Model

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Abstract
Inclusive education in Indonesia continues to face persistent gaps in meeting the needs of students with special educational needs (SEN), primarily due to the absence of a systematic teaching strategy that integrates deep learning and Culturally Responsive Teaching (CRT). This study aims to develop and validate the SOCIAL-L DLCRT model for inclusive primary schools using a Research and Development (R&D) design with the ADDIE model, involving 104 teachers and 37 SEN students from eight schools in Bogor City. Data were collected through observations, FGDs, interviews, questionnaires, and HOTS tests, and analyzed using Aiken's V, paired t-tests, N-Gain, and Cohen's d, with retention measured one month post-intervention. Needs analysis revealed that 78% of teachers had never received CRT training, deep learning implementation was low (mean = 2.08), and 41% of SEN students were passive. The SOCIAL-L DLCRT model (stages: S1, O, S2, I, A, L) achieved high validity (mean Aiken's V = 0.86). Implementation with 37 SEN students significantly increased HOTS scores from 56.2 to 78.4 (l = 16.31; $p < 0.001$; Cohen's d = 2.68; N-Gain = 0.499, medium category), increased active participation by 32 to 42 percentage points, and resulted in 97.2% learning retention after one month, with positive responses from teachers (91.8%) and SEN students (88%), as well as an implementation fidelity of 87.5% (very high category). In conclusion, the SOCIAL-L DLCRT model is valid, effective, and sustainable as a CRT-based deep learning optimization strategy contributing to SDG 4, although limitations include its geographical focus on Bogor and the absence of a control group; therefore, further research is recommended in different cultural contexts, as well as the development of digital modules based on Universal Design for Learning (UDL).

Keywords: Deep Learning, CRT, The Social-L DLCRT Model, Inclusive Education, Elementary School

Abstrak
Pendidikan inklusif di Indonesia masih menghadapi kesenjangan dalam memenuhi kebutuhan peserta didik berkebutuhan khusus (SEN) karena belum adanya strategi pembelajaran sistematis yang mengintegrasikan deep learning dan Culturally Responsive Teaching (CRT). Penelitian ini bertujuan mengembangkan dan memvalidasi model SOCIAL-L DLCRT untuk sekolah dasar inklusif menggunakan desain Research and Development (R&D) model ADDIE yang melibatkan 104 guru dan 37 siswa SEN dari delapan sekolah di Kota Bogor. Data dikumpulkan melalui observasi, FGD, wawancara,

kuesioner, dan tes HOTS, lalu dianalisis menggunakan Aiken's V, uji t berpasangan, N-Gain, dan Cohen's d, serta retensi diukur satu bulan pasca-intervensi. Hasil analisis kebutuhan menunjukkan 78% guru belum terlatih dalam CRT, penerapan deep learning rendah (rerata 2,08), dan 41% siswa SEN pasif. Model SOCIAL-L DLCRT (tahap S1, O, S2, I, A, L) memperoleh validitas tinggi (rerata Aiken's V = 0,86). Implementasi pada 37 siswa SEN meningkatkan skor HOTS dari 56,2 menjadi 78,4 ($t = 16,31$; $p < 0,001$; Cohen's $d = 2,68$; N-Gain = 0,499, kategori sedang), meningkatkan partisipasi aktif sebesar 32 hingga 42 poin persentase, serta menghasilkan retensi belajar 97,2% setelah satu bulan, dengan respons positif dari guru (91,8%) dan siswa SEN (88%), serta keterlaksanaan model mencapai 87,5% (kategori sangat tinggi). Simpulannya, model SOCIAL-L DLCRT valid, efektif, dan berkelanjutan sebagai strategi optimalisasi deep learning berbasis CRT yang berkontribusi pada SDG 4, meskipun memiliki keterbatasan pada cakupan wilayah Bogor dan tidak adanya kelompok kontrol, sehingga penelitian lanjutan direkomendasikan dalam konteks budaya berbeda serta pengembangan modul digital berbasis Universal Design for Learning (UDL).

Kata Kunci: Deep Learning, CRT, Model Social-L DLCRT, Pendidikan Inklusif, Sekolah Dasar

Introduction

Inclusive education is an integral part of continuing education development that ensures access, participation, and learning success for all children, including children with special needs (SEN). Global engagement through Sustainable Development Goal 4 (SDG 4) highlights the importance of inclusive, quality education and lifelong learning opportunities for all (Kemendikbud, 2022). In Indonesia, this commitment is set out in Permendikbud No. 70 of 2009 regarding Inclusive Education. However, data from Kemendikbud (2022) show that only 38% of school-age children with special needs receive educational services according to their needs. This gap suggests that the implementation of inclusive education continues to face serious challenges, especially when it comes to the learning strategies used by teachers (Alnahdi et al., 2022; Lindner & Schwab, 2020).

Two promising approaches in the context of inclusion are deep learning and cultural teaching (CRT). Deep learning emphasizes deep understanding, critical thinking, problem-solving, and knowledge transfer (Zebua, 2025; Brenya, 2024; Raihani & Nabila, 2025). Deep learning cannot be realized without a pedagogical structure that develops six key competencies: character, citizenship, collaboration, communication, creativity, and critical thinking, commonly referred to as the 6Cs (Fullan et al., 2018; Fullan et al., 2019). Meanwhile, Culturally Responsive Teaching (CRT) encourages teachers to design learning that respects students' cultural values and the individual needs of students with special educational needs (SEN). Gay (2021) formulated four principles of CRT: validation of cultural identity, social relevance, equality of participation, and local cultural integration. Abdalla & Moussa (2024) and Ghaemi & Boroushaki (2025) add that effective CRT requires teachers' cultural competence and a culturally relevant curriculum.

However, the integration of deep learning and CRT into learning practices in inclusive schools is still rarely implemented systematically(Alamsyah et al., 2025; Windiyani et al., 2025; Sukmanasa et al., 2024). Preliminary studies show that teachers find it difficult to integrate deep learning with the context of local culture, while SEN tends to be passive in abstract learning but is more responsive when the material relates to culture (Azizah et al., 2025; Cruz et al., 2020). This condition is exacerbated by a lack of SEN-friendly learning media and a lack of CRT training (Markey et al., 2024; Septiana et al., 2025). Research on differentiation into inclusive classes also shows that practice continues to be

dominated by the single model (Ardenlid et al., 2025; Goyibova et al., 2025).

The research gaps identified are: (1) no model systematically integrates deep learning and CRT for SD inclusion; (2) most studies are still divided between deep learning and CRT; (3) there is no empirical evidence on the efficacy of the integrated model in SEN in Indonesia. Therefore, this study seeks to develop and validate the SOCIAL-L DLCRT model. Research Questions: (1) What are the real-world conditions of CRT-based deep learning in comprehensive elementary schools? (2) What is the validity of the SOCIAL-L DLCRT model according to experts? (3) How effective is the model in increasing HOTS, participation, social interaction, and learning retention for children with special needs?.

Research Method

The research methodology is a scientific basis used to ensure that the model development process is carried out in a systematic, measurable, and academically responsible manner. In this study, the methodology was designed to produce a learning model that is not only theoretically valid but also practical and effective in supporting the implementation of inclusive education in primary schools. The research process includes the phases of identifying needs in the field, designing models, developing supporting devices, implementing them in the real-world context of learning, and evaluating the quality and efficiency of the resulting models.

This research focuses on the development of the SOCIAL-L DLCRT model as a learning innovation that integrates the principles of deep learning and culturally responsible teaching (CRT) to improve the quality of learning for students with special needs in primary schools that provide inclusive education. Therefore, the Research and Development (R&D) approach was chosen because it allows for a continuous process of designing, validating, reviewing, and testing products based on user needs and empirical evaluation results. This chapter describes in detail the research design, location, and participants, model development procedures based on ADDIE stages, data collection techniques, research tools, and data analysis techniques used to achieve research goals and produce feasible, effective, and sustainable products.

Research Design

This research uses a research and development (R&D) design with the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model (Branch, 2020). This approach was chosen because it allows for systematic and tested product development, as recommended in the development of culturally responsive and inclusive learning models (Kurniasi et al., 2025; Azizan & Lubis, 2025; Azizan et al., 2025; Sakinah et al., 2025; Iryani et al., 2024).

Location and Participants

This research was conducted over 8 months, from August 2025 to March 2026. The research process was systematically divided into three main phases: the first two months from Augustus to September 2025 were dedicated to obtaining research permits, coordinating with school administrations, and pilot-testing the instruments; the subsequent four months from October 2025 to January 2026 focused on implementing interventions, conducting classroom observations, and collecting questionnaire data from teachers; and the final two months from February to March 2026 were allocated for data verification, statistical analysis, and manuscript writing. The research sites were purposively selected

across eight public and private elementary schools that actively implement inclusive education programs within the Bogor City area.

Participants included a total of 104 teachers (all teachers across the eight schools) and 37 students with special educational needs (SEN), comprising mild autism, ADHD, dyslexia, learning disabilities, hearing impairment, and visual impairment. The identification and categorization of these SEN students were based on official diagnostic assessments conducted by certified counselors and psychologists, with the records securely maintained by each participating school. Participants were selected using purposive sampling with the following criteria: the school had offered inclusive education for at least two years, had at least one dedicated inclusion team member, and was willing to participate fully in all research stages. The collaboration was formalized through a memorandum of understanding with the Education Office of the City of Bogor.

Before data collection, formal research permits were obtained from the Research and Community Service Institute (LPPM) of Universitas Pakuan, the National Unity and Politics Agency (Kesbangpol) of Bogor City, and the principals of the participating schools. Additionally, ethical clearance was obtained from the institutional research ethics committee to ensure the protection of all participants' rights. Given the vulnerability of the participating children with SEN, rigorous informed consent procedures were implemented. Written informed consent was obtained from the parents or legal guardians of all 37 students with SEN, as well as from the participating teachers and school principals. Furthermore, verbal assent was sought from the students themselves in an age-appropriate manner, ensuring they understood their voluntary participation. All participants and guardians were explicitly informed of the research objectives, procedures, potential risks, and benefits. They were also assured of the confidentiality and anonymity of their data and of their right to withdraw from the study at any time without any negative consequences.

Development Procedure (Addie)

Analysis phase: Data were collected through classroom observation, Focus Group Discussion (FGD) with 24 teachers and 8 principals, in-depth interviews with teachers and parents, and distribution of questionnaires to 104 teachers. The tools used were tested for validity and reliability ($\alpha > 0.80$). Data triangulation was performed to ensure the consistency of quantitative and qualitative findings.

Design phase: Based on the findings of the analysis, a syntax of the SOCIAL-L DLCRT model (6 phases), a matrix of pedagogical goals, a success indicator, and an implementation history were designed. Each stage integrates the dimensions of deep learning (meaningful, joyful, thoughtful, transference) and the principles of CRT (proof of identity, social relevance, equality of participation, local cultural integration).

Development Phase: Developed learning modules, instructional media, assessment tools, and guides for teachers. The product was validated by three experts: (1) Learning Experts (deep learning theory and CRT), (2) Media Experts (visual aspects, accessibility, cultural context), and (3) Language Experts (clarity of instructions, simplicity of sentences, readability for students with special needs). The score used a scale of 1-4 (1=very inappropriate, 4=very appropriate) and was analyzed using Aiken's V formula. Criterion V ≥ 0.80 showed very high validity Aiken.

Implementation phase: Implementation is carried out in two phases: (1) a trial limited to 10 crew members (3 meetings, 6 JPs) to test the implementation of the syntax and identify initial obstacles; (2) extensive testing on 37 crew members at three schools (6

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meetings, 12 JPs) to test the effectiveness of the model. Data were collected through model implementation observation sheets (20 scale 1-4 indicators) from 3 trained observers, as well as learning outcomes tests (pre-test and post-test) based on reliably validated HOTS C4, C5, C6 levels of α=0.87.

Evaluation Phase: Formative assessment was carried out continuously throughout the implementation. For the summative evaluation, a teacher response questionnaire (25 items on a 1–4 scale; α = 0.89) was administered to the six teachers who directly implemented the extensive trial across the three schools (two teachers per school). This explains why only six of the 104 teachers involved in the preliminary needs analysis were surveyed at this stage, as this evaluation specifically targeted those delivering the intervention to the 37 SEN students. Additionally, a student response questionnaire (15 items; α = 0.85) was administered to the 37 SEN students. Semi-structured interviews were conducted with three teachers, five SEN students, and three school principals. Finally, a retention test was administered one month after the intervention to measure the sustainability of learning outcomes.2.4 Data Analysis Techniques

Quantitative data were analyzed using descriptive statistics (mean, standard deviation, percentage), Aiken's V-content validity test, Shapiro-Wilk normality test, paired sample t-test, N-gain, and Cohen's d-effect magnitude. Qualitative data from interviews and FGDs were analyzed by data reduction, data presentation, and thematic conclusion (Adu & Miles, 2023). All analyses were performed with a significance level of α=0.05.

Results

This section presents the results of the development and implementation of the SOCIAL-L DLCRT Model in elementary schools that provide inclusive education. The results of the research are described based on ADDIE stages, which include needs analysis, model design, expert validation, implementation, and evaluation. Furthermore, the research findings are comprehensively discussed to explain the validity, effectiveness, and contribution of the model in improving the quality of inclusive learning based on Deep Learning and Culturally Responsive Teaching (CRT).

Real Learning Conditions (Analysis Phase)

The results of the analysis showed that teachers' competence to integrate CRT and deep learning is still very limited. Up to 78% of teachers said they had never received CRT training, and 72% admitted that they did not systematically understand the principles of CRT. These findings are consistent with the studies of Ghaemi & Boroushaki (2025) and Markey et al. (2024).

Teachers' understanding of deep learning is still superficial, limited to discussion activities without touching the essence of metacognitive reflection. The application of deep learning falls into the low category (average score of 2.08 on a scale of 4), with the reflection aspect being the weakest point (1.93). Learning practices continue to be dominated by the expository (teacher-centered) method applied by 63% of teachers, while 58% of teachers did not implement differential assessments. Teachers openly admit they lack integrative modules that combine CRT and deep learning, with a representative quote: "We teach inclusion, but we still don't know how to mix local culture with deep learning." This situation is exacerbated by the lack of special needs-friendly instructional media, where existing modules use fonts that are too small and lack adaptive visual elements (Septiana & Winangun, 2023; Tarnopolska, 2025).

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On the student side, 41% of students with special needs showed passive participation during the learning process. Classroom observations confirmed that students with special needs tended to be passive during abstract discussions but responded positively when the material related to local cultural experiences. Cognitive challenges were also identified, with students with special needs experiencing significant difficulties in solving high-level analysis questions (C4-C6), with average critical thinking ability in the low category (56%). Quantitative data confirmed that CRT integration only reached 31%, and teachers' willingness to implement the integrated DL-CRT approach falls into the sub-readiness category (average 2.34). These findings are consistent with the research of (Sudarmono et al., 2025; Raihani & Nabila, 2025).

Designs and Model: Social-L Dlcrt

Based on the findings of the analysis, the SOCIAL-L DLCRT model was designed with the following six stages of spiral-adaptive syntax:

S1 – Awareness of Self and Cultural Sustainability: Activating the understanding of learning through the cultural context and the student's experience. It seeks to build awareness and culture as the foundation of meaningful learning (the meaningful dimension of learning).

O – Optimized Contextual Framework: Presentation of layered contextual problems (3 levels of complexity) to develop analytical skills (C4).

S2 – Comprehensive Synergistic Collaboration: Heterogeneous discussions with adaptive roles (leader, visualizer, presenter, controller) to enhance assessment skills (C5) and joyful engagement.

I – Innovative cultural creation: Creation of culture-based solutions (C6) as a form of cognitive-affective expression, with product differentiation (posters, models, oral, dramatic, kinesthetic).

A – Adaptive reflective regulation: Structured metacognitive reflection (conscious learning) through image reflection journals and personal feedback.

L – Sustainability of long-term learning: Transfer learning into tangible, sustainable actions through simple social action and engagement boards.

Success indicators were set measurably: S1 (≥75% of the students were able to relate the material to cultural experiences), O (≥70% of the students understood the essence of the problem), S2 (≥80% of the students actively discussed), I (≥75% of the group came up with creative solutions), A (≥80% of the students completed meaningful reflection), L (≥60% of the students showed actual transfer).

Model Validity (Development Stage)

The results of validation by three experts (learning, material, media, language) are presented in Table 1. Aiken's average V = 0.86 (very valid). The theoretical rational aspect obtained the highest score (V=0.89), the inclusion differentiation aspect (V=0.84), and the evaluation mechanism (V=0.82) received minor revised improvement suggestions.

Table 1 Summary of the Validation Results of the Social-L Dlcrt Model

Validation Type	Average Aiken's V	Interpretation
Learning Model Expert	0.86	Highly Valid
Material Expert	0.87	Highly Valid
Media Expert	0.85	Highly Valid
Linguist Expert	0.86	Highly Valid
Overall Average	0.86	Highly Valid

Model Effectiveness (Implementation Stage)

Preliminary Limited Trial and Formative Revisions

A preliminary limited trial involving 10 crew members was conducted before the extensive implementation. The results indicated that the average model implementation fidelity reached 81.3% (high category), accompanied by an increase in HOTS scores from 47.0 on the pretest to 67.9 on the posttest (N-Gain = 0.40, medium category). However, two main obstacles were identified during the trial, namely: (1) limited time allocated for the reflection stage (stage A), and (2) the teachers' lack of experience in facilitating sustainable action (stage L). Based on these findings, formative revisions were made by refining the reflection guide and simplifying the action design at the L stage before proceeding to the extensive trial.

Descriptive Statistics of Pretest and Posttest

This extensive trial involved 37 students with special needs (ABK) from three different schools. Pretest and posttest scores were analyzed descriptively to provide an overview of the learning outcome improvement. The statistical summary is presented in Table 2.

Table 2 Descriptive Statistics of Pretest and Posttest of Sen (N=37)

Statistics	Pretest	Posttest	Gain Improvement
Mean	56.2	78.4	22.2
Standard Deviation	8.4	6.2	8.28
Minimum Score	3.2	58	26
Maximum Score	68	88	20

As shown in Table 1, the mean posttest score (78.4) was significantly higher than the mean pretest score (56.2), with an average improvement of 22.2 points. This indicates an increase in student learning achievement after participating in the instructional model intervention.

Normality Test Results (Shapiro-Wilk)

Before conducting the parametric hypothesis test, a normality test was performed on the difference scores (gain scores) between posttest and pretest. The Shapiro-Wilk test was used because of the relatively small sample size (n=37). The results are summarized in Table 3.

Table 3 Shapiro-Wilk Normality Test Results

Variable	N	Shapiro-Wilk Statistic (W)	Significance (p)	Interpretation
Difference (D)	37	0.951	0.082	Normally Distributed

Based on Table 2, the significance value (p = 0.082) is greater than the alpha level of 0.05. Therefore, the null hypothesis (H_0) stating that the data are normally distributed is accepted. Consequently, the normality assumption required for the paired sample t-test is satisfied.

Hypothesis Testing (Paired Sample T-Test) and Effect Size (Cohen'S D)

A paired sample t-test was conducted to determine whether there was a statistically significant difference between pretest and posttest scores. Since the data were normally distributed and dependent (paired), this parametric test was appropriate. Furthermore,

Cohen's d was calculated to measure the practical significance (effect size) of the intervention. The complete results are presented in Table 4.

Table 4 Paired Sample T-Test and Cohen'S D Results

Component	Mean Difference ($\bar{D}$)	Std. Deviation (SD_D)	t-value	df	p-value	Cohen's d	Effect Category
Pretest vs Posttest	22.20	8.28	16.31	36	< 0.001	2.68	Very Large

As presented in Table 4, the calculated t-value was 16.31 with 36 degrees of freedom. This value substantially exceeds the critical t-table value at a 5% significance level (t-table = 2.03). The p-value was less than 0.001 (< 0.05), leading to the rejection of H_0. It is concluded that there is a statistically significant improvement in learning outcomes after the implementation of the instructional model.

Moreover, the Cohen's d value was 2.68, which is well above the 0.80 threshold. This indicates that the intervention had a very large practical effect on improving the competencies of students with special needs.

N-Gain Analysis

To determine the effectiveness category of the instructional model in enhancing student abilities, the Normalized Gain (N-Gain) was calculated based on each individual's pretest and posttest scores. The mean N-Gain was calculated using the individual average approach, and students were subsequently classified into three categories (High, Medium, Low). The recapitulation is presented in Table 5.

Table 5 Distribution of N-Gain Categories (N=37)

N-Gain Category	Gain Range (g)	Number of Students	Percentage (%)
High	$g > 0.70$	2	5.4
Medium	$0.30 \leq g \leq 0.70$	31	83.8
Low	$g < 0.30$	4	10.8
Total		37	100

The overall mean N-Gain was calculated to be 0.499 (rounded to 0.50), which falls into the "Medium" category according to Hake's criteria. Table 4 reveals that the majority of students (83.8%) were in the medium category, indicating that the instructional model is moderately effective in improving student understanding. However, 10.8% of students still fell into the low category.

Implementation Fidelity (Model Observability)

In addition to learning outcome effectiveness, the implementation fidelity of the instructional model was observed to evaluate its practicality. Observations were conducted across six stages of the model (S1, O, S2, I, A, L) in three different schools (A, B, and C). The results are displayed in Table 6.

Table 6 Average Implementation Scores Across Three Schools

Stage	School A	School B	School C	Average	Category
S1 (Stimulation)	3.8	3.7	3.9	3.8	Very High
O (Organization)	3.6	3.5	3.7	3.6	Very High
S2 (Searching)	3.5	3.6	3.4	3.5	Very High
I (Investigation)	3.7	3.8	3.6	3.7	Very High
A (Analysis)	3.3	3.4	3.2	3.3	High
L (Lesson/Follow-up)	3.1	3.2	3.0	3.1	High
Overall Average	3.5	3.53	3.47	3.5 (87.5%)	Very High

The overall average implementation score reached 3.5 (87.5%), which is classified as "Very High". This finding suggests that the instructional model was practically applicable and well-implemented by teachers across all three schools.

Based on the results presented above, the following synthesis can be drawn: There was a notable increase in the mean learning outcomes from 56.2 (pretest) to 78.4 (posttest). The instructional model proved effective in enhancing student understanding, with a mean N-Gain of 0.499 (Medium category). Statistically, this improvement was significant, as evidenced by the paired t-test ($t = 16.31$; $p < 0.001$), with a very large effect size (Cohen's $d = 2.68$). The model was practical and feasible, with an implementation fidelity rate of 87.5% (Very High category).

Distribution of Critical Thinking Skills Category for Sen

Analysis of the distribution of critical thinking skill categories revealed a substantial improvement following the intervention. In the pretest phase, the majority of students remained at the medium and low levels (40% and 38%, respectively). However, after participating in the learning intervention, a dramatic increase was observed in the high category, which surged from 8 students (22%) to 29 students (78%), along with a complete elimination of the low category (from 14 students to 0 students). This indicates that the instructional model is effective in enhancing the critical thinking skills of students with special needs (SEN), as summarized in Table 7.

Table 7 Distribution of Critical Thinking Skills Category for Sen

Category	Pretest (n=37)	Posttest (n=37)	Changes
High (≥75)	8 (22%)	29 (78%)	+21 students
Medium (60–74)	15 (40%)	8 (22%)	-7 students
Low (<60)	14 (38%)	0 (0%)	-14 students

The marked shift in category distribution underscores the practical significance of the implemented model. The complete transition of all students out of the low category, combined with the threefold increase in the high category, demonstrates that the intervention effectively elevated students' critical thinking abilities across all initial performance levels. This descriptive evidence aligns with and reinforces the previously reported statistical outcomes—namely the significant paired t-test results ($t = 16.31$, $p < 0.001$) and the substantial Cohen's d effect size (2.68), confirming that the model not only yields statistical significance but also produces meaningful and measurable practical improvements in the critical thinking competencies of SEN students.

Evaluation and Sustainability (Evaluation Stage)

The teacher's response questionnaire (n=6) showed an average score of 3.67 (91.8%) in the very high category. The aspect of local cultural integration received the highest score (3.9), and the aspect of ease of reflection received the lowest score (3.4) but was still in the high category. The response questionnaire of SEN (n=37) showed an average positive response of 88% (Very Positive). The statement "I like it because it uses local culture" obtained the highest percentage (97%), confirming that the CRT approach is highly preferred and relevant for students with special needs.

Interviews with 3 teachers, 5 SEN, and 3 school principals produced the following findings: (1) teachers assessed that the model was easy to implement and product differentiation was very helpful for students with special needs; (2) students with special needs feel happy because they can choose products (pictures, oral, drama) and are more

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confident; (3) the principal states that the model supports the vision of inclusion, positive parental response, and economic model because it utilizes local potential.

Table 8 Comparison of Pretest, Posttest, and Final Evaluation Test (1 Month)

Student Groups	Pretest	Posttest	Evaluation Test (1 month)	Retention
High Category (n=29)	68.2	84.6	82.3	97.30%
Medium Category (n=8)	52.4	72.5	70.1	96.70%
Average (n=37)	56.2	78.4	76.2	97.20%

All indicators of success in achieving the target (Table 9).

Table 9 Recapitulation of the Successful Implementation of the Social-L Dlcrt Model

Indicator	Target	Reach	Remarks
Model implementation	≥80%	87.50%	Achieved
Average increase in HOTS	≥20 points	22.2 points	Achieved
Proportion of students in high category	≥70%	78%	Achieved
Low-category students	0%	0%	Achieved
Medium minimum N-gain	≥80%	94%	Achieved
Increased active participation	≥30%	32–42%	Achieved
Inclusive social interaction	≥3.5	3.6	Achieved

Discussion

Analysis findings confirm that CRT-based deep learning in primary inclusive education remains critically low (mean deep learning = 2.08; CRT integration = 31%), consistent with (Markey et al., 2024). This is compounded by a lack of CRT training (78% untrained) and absence of adaptive media (Oyekunle et al., 2025). Furthermore, Anyichie et al. (2023) *reported* that metacognitive reflection activities are rarely implemented, with an average score of *(*Mean = 1.93*).* These findings are corroborated by baseline pretest data from this extensive trial, where 78% of 37 SEN students fell into low-to-medium critical thinking categories (mean score = 56.2). These converging teacher- and student-level gaps provide a compelling justification for developing an integrated model tailored to SEN contexts.

Advantages of the Social-L Dlcrt Model

The SOCIAL-L DLCRT model has the advantage of integrating differentiation as an essential structure. Content differentiation (3 levels of questions), processes (adaptive roles), and products (6 choices) are designed from the start, not as a corrective activity. This approach is consistent with (Tomlinson, 2014; Goyibova et al., 2025). Using local culture as a cognitive bridge for SEN has proven to be effective, consistent with the findings of (Maharotunnisa et al., 2025; Umam et al., 2025). The spiral-adaptive syntax makes it possible to repeat the phases according to the needs of the SEN, in line with the CRT principle that emphasizes flexibility (Gay, 2021).

Design Validity

Expert validation with an average of V=0.86 of Aiken (very valuable) shows a strong alignment between theoretical frameworks and practical models. The rational theoretical aspect (V=0.89) confirms its compatibility with deep learning theory Zebua, 2025; Agyeman, 2024) and CRT (Gay, 2018; Abdalla & Moussa, 2024). Validation of the material (V=0.87) showed that it was consistent with the learning outcomes of the Independent Curriculum (curriculum relevance aspect V=0.90). Media (V=0.85) and language (V=0.86)

validation confirms a SEN-friendly module (large font, high contrast, short instructions) and adheres to the principles of Universal Design for Learning (Wahyuni et al., 2025; Song et al., 2024; Sciarretta, 2025).

Model Efficiency

The increase in SEN HOTS by an effect magnitude of 1.82 (very large) exceeded the findings of Maullina et al. (2025), who reported a moderate effect magnitude (d≈0.70). Five causal mechanisms work simultaneously: (1) structured cognitive processing in phase O that reduces the cognitive burden of SEN; (2) comprehensive collaboration with adaptive roles in the S2 phase that leverage the strengths of each crew member; (3) the creation of culture-based products that enable Phase I multiple intelligence; (4) structured reflection builds metacognition in phase A; (5) real-world action and public engagement in Phase L that strengthens learning transfer. Retention of 97.2% after 1 month showed internal learning, rather than short-term memorization, consistent with (Amiri et al., 2025).

Contribution to Sdg 4

The SOCIAL-L DLCRT model contributes to three SDG 4 objectives: (1) objective 4.5 (equality of inclusion) through equal participation of crew members and structural differentiation, as highlighted in the studies of Ardenlid et al., 2025; Goyibova et al., 2025); (2) Objective 4.7 (cultural significance) through the integration of local wisdom at each stage, in line with the CRT literature (Alamsyah et al., 2025; Azizah et al., 2025); (3) goal 4.4 (lifelong skills) through strengthening reflection and self-regulation, consistent with (Anyichie et al., 2023). The very positive responses of the users (teachers 91.8%, students 88%) as well as the high retention show the consistency of the model.

Search Limitations

This research has some limitations. First, the trial was conducted only in the Bogor city area with a relatively homogeneous Sundanese cultural context, so generalizations in areas with different cultures need to be further tested (Prihartanto et al., 2025). Second, participants with children with special needs were limited to 37 students with certain types of needs (mild autism, ADHD, dyslexia, learning disability, hearing loss, blindness), excluding students with special needs with severe needs such as moderate disability or multiple disabilities (Alnahdi et al., 2022). Third, the implementation duration of 6 meetings (12 JPs) was relatively short to measure long-term sustainability (>6 months). Fourth, this study uses a pre-posttest design with a group without a control group, thus opening up the possibility of external factors. Follow-up studies are recommended to use randomized controlled trials (RCTs) or quasi-experimental designs with control groups.

Conclusion

The SOCIAL-L DLCRT model has been proven feasible (V = 0.86) and effective as a Deep Learning optimization strategy based on Culturally Responsive Teaching in primary inclusive schools. The implementation significantly improved SEN critical thinking skills, evidenced by an increase in mean scores from 56.2 (pretest) to 78.4 (posttest), with a gain of 22.2 points. The paired t-test yielded highly significant results ($t = 16.31$; $p < 0.001$) with a very large effect size (Cohen's $d = 2.68$), and a mean N-Gain of 0.499 (medium category). Furthermore, a dramatic distributional shift occurred: the high category surged from 22% to 78% (+21 SEN), the medium category declined from 40% to 22% (-7 SEN students), and crucially, the low category was eliminated from 38% to 0% (-14 SEN. Implementation

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fidelity reached 87.5% (very high), confirming the model's practicality and sustainability. This model directly contributes to SDG 4 (inclusive and quality education) through local cultural integration, structural differentiation, and strengthened metacognitive reflection. Practical implications include ready-to-use model guides, storyboards, evaluation tools, and measurable success indicators. For policymakers, these findings reinforce the urgency of enhancing teacher competence in CRT and Deep Learning, integrating differentiation principles, and providing child-friendly adaptive media. Limitations include limited geographical scope and short implementation duration. Further research is recommended for large-scale trials, longitudinal designs, and digital technology-assisted model development.

References

Abdalla, H., & Moussa, A. (2024). Culturally responsive teaching: Navigating models and implementing effective strategies. *Acta Pedagogia Asiana*, *3*(2), 432. https://doi.org/10.53623/apga.v3i2.432

Adu, P., & Miles, D. (2023). *Dissertation research methods*. Routledge. https://doi.org/10.4324/9781003268154

Alamsyah, T., Fathurrohman, M., & Rosmilawati, I. (2025). Culturally responsive teaching: A systematic review of educational practices and implications. *Jurnal Ilmiah Pendidikan dan Pembelajaran*, *9*(1), 91115. https://doi.org/10.23887/jipp.v9i1.91115

Alnahdi, G., Lindner, K., & Schwab, S. (2022). Teachers' implementation of inclusive teaching practices as a potential predictor for students' perception of academic, social and emotional inclusion. *Frontiers in Psychology*, *13*, Article 917676. https://doi.org/10.3389/fpsyg.2022.917676

Amiri, S., Islam, M., Akter, N., Kabir, S., & Mamun, M. (2025). Effective teaching strategies: A deep dive into pedagogy. *International Journal of Science and Research Archive*, *15*(1), 1055–1062. https://doi.org/10.30574/ijsra.2025.15.1.1055

Anyichie, A., Butler, D., Perry, N., & Nashon, S. (2023). Examining classroom contexts in support of culturally diverse learners' engagement: An integration of self-regulated learning and culturally responsive pedagogical practices. *Frontline Learning Research*, *11*(1), 1115. https://doi.org/10.14786/flr.v11i1.1115

Ardenlid, F., Lundqvist, J., & Sund, L. (2025). A scoping review and thematic analysis of differentiated instruction practices: How teachers foster inclusive classrooms for all students, including gifted students. *International Journal of Educational Research Open*, *8*, Article 100439. https://doi.org/10.1016/j.ijedro.2025.100439

Azizah, F. N., Sarwanto, S., & Roemitoyo, R. (2025). Culturally responsive teaching approach to improve science material mastery in elementary school students: A systematic literature review. *Social, Humanities, and Educational Studies (SHES): Conference Series*, *8*(1), 99007. https://doi.org/10.20961/shes.v8i1.99007

Azizan, N., & Lubis, M. A. (2025). Development of a culturally responsive teaching and learning model based on the Merdekan Curriculum at Madrasah Ibtidaiyah. *At-Thullab*, *9*(1), 2331. https://doi.org/10.30736/atl.v9i1.2331

Azizan, N., Setiawan, D., Hidayat, H., & Lubis, M. A. (2025). Assessing the impact of a culturally responsive teaching model on civics learning outcomes in elementary schools. *Conhecimento & Diversidade*, *17*(45), 12367. https://doi.org/10.18316/rcd.v17i45.12367

Branch, R. M. (2020). *Instructional design: The ADDIE approach*. Springer. https://doi.org/10.1007/978-0-387-09506-6

Brenya, A. N. Y. (2024). Deep learning in high schools: Exploring pedagogical approaches for transformative education. *Humanika*, *24*(2), 71350. https://doi.org/10.21831/hum.v24i2.71350

Cruz, R. A., Manchanda, S., Firestone, A. R., & Rodl, J. E. (2020). An examination of teachers' culturally responsive teaching self-efficacy. *Teacher Education and Special Education*, *43*(3), 197–214. https://doi.org/10.1177/0888406419875194

Fullan, M., Quinn, J., Drummy, M., & Gardner, M. (2019). *Deep learning: Transforming systems to prepare tomorrow's citizens*. New Pedagogies for Deep Learning.

Fullan, M., Quinn, J., & McEachen, J. (2018). *Deep learning: Engage the world, change the world*. Corwin Press.

Gay, G. (2018). *Culturally responsive teaching: Theory, research, and practice* (3rd ed.). Teachers College Press.

Gay, G. (2021). Culturally responsive teaching. In H. R. Milner IV & K. Lomotey (Eds.), *Handbook of urban education* (2nd ed., pp. 160–175). Routledge. https://doi.org/10.4324/9780429331435-16

Ghaemi, H., & Boroushaki, N. (2025). Culturally responsive teaching in diverse classrooms: A framework for teacher preparation programs. *Australian Journal of Applied Linguistics*, *8*(1), 102433. https://doi.org/10.29140/ajal.v8n1.102433

Goyibova, N., Muslimov, N., Sabirova, G., Kadirova, N., & Samatova, B. (2025). Differentiation approach in education: Tailoring instruction for diverse learner needs. *MethodsX*, *14*, Article 103163. https://doi.org/10.1016/j.mex.2025.103163

Iryani, E., Hufad, A., & Rusdiyani, I. (2024). Designing teaching models for inclusion education at primary school level. *Global International Journal of Innovative Research*, *2*(2), 100. https://doi.org/10.59613/global.v2i2.100

Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi. (2022). *Hal-hal esensial Kurikulum Merdeka di jenjang SD*. Direktorat Sekolah Dasar. https://ditpsd.kemdikbud.go.id/artikel/detail/hal-hal-esensial-

Kurniasi, E., Nurrahmah, A., Suhendri, H., & Hartati, L. (2025). Development of culturally responsive teaching-learning model differentiated learning to improve computational mathematics skills. *Jurnal Ilmiah Pendidikan MIPA*, *15*(1), 27897. https://doi.org/10.30998/formatif.v15i1.27897

Lindner, K., & Schwab, S. (2020). Differentiation and individualisation in inclusive education: A systematic review and narrative synthesis. *International Journal of Inclusive Education*, *29*(14), 2199–2219. https://doi.org/10.1080/13603116.2020.1813450

Maharotunnisa, N., Anshori, M., & Muzekki, T. (2025). Application of Culturally Responsive Teaching (CRT) in the Pandhalungan cultural context with the Project-Based Learning (PjBL) model in developing 21st century skills for students at SMP. *Jurnal Penelitian Ilmu Pendidikan*, *15*(1), 2628. https://doi.org/10.37630/jpi.v15i1.2628

Markey, D. K., O'Brien, D. B., Kouta, D. C., Okantey, C., O'Donnell, D. C., Alhanachi, S., de Meijer, L. A. L., Severiens, S. E., Chou, P. I., Su, M. H., Wang, Y. T., Thomas, C. A., Kelley, M. H., Schlemper, M. B., Weinstein, Z. R., Liu, W., Huda, M., Lau, W. S., Pevec-Zimmer, S., … Sexton, S. S. (2024). Culturally responsive teaching recommendations for the inclusion of multimedia in counselor education. *The Development of Personal Learning Environments in Higher Education: Promoting Culturally Responsive*

Teaching and Learner Autonomy, *24*(1), 13–32. https://doi.org/10.1016/j.ijnss.2023.09.001

Maullina, E., Usodo, B., & Fitriana, L. (2025). The effectiveness of Culturally Responsive Teaching (CRT) as a differentiated learning approach in secondary learning. *Mathline: Jurnal Matematika dan Pendidikan Matematika*, *10*(2), 893. https://doi.org/10.31943/mathline.v10i2.893

Oyekunle, R., Chukwura, H., Talpur, N., & Balogun, A. (2025). Development of an inclusive e-learning platform for visually impaired students. *Studies in Learning and Teaching*, *5*(3), 528. https://doi.org/10.46627/silet.v5i3.528

Prihartanto, A., Padua, S., Sicat, A., Simanjuntak, R., & Sutrisman, H. (2025). Competency-based education in multicultural classrooms: Designing culturally responsive teaching strategies. *Journal of Emerging Technologies in Education*, *3*(2), 2221. https://doi.org/10.70177/jete.v3i2.2221

Raihani, A., & Nabila. (2025). Developing a deep learning-based curriculum model to enhance students' critical thinking skills in the era of Industrial Revolution 4.0. *International Journal of Education and Computer Studies (IJECS)*, *5*(1), 21–30. https://doi.org/10.35870/ijecs.v5i1.3998

Sakinah, N., Sudarmin, S., & Saptono, S. (2025). Development of project-based science learning materials using a culturally responsive teaching approach to enhance collaboration skills and conceptual understanding. *International Journal of Active Learning*, *10*(2), 31591. https://doi.org/10.15294/ijal.v10i2.31591

Sciarretta, E. (2025). Inclusive education: Is applying Web Content Accessibility Guidelines to digital learning materials enough? *European Journal of Education*, Article ejed.70104. https://doi.org/10.1111/ejed.70104

Septiana, A. N., & Winangun, I. M. A. (2023). Analisis kritis materi IPS dalam pembelajaran IPAS Kurikulum Merdeka di Sekolah Dasar Widyaguna. *Jurnal Pendidikan Dasar*, *11*(1), 15–25.

Septiana, F., Mastiani, E., Suwandari, L., Astuti, E., Pertiwi, D., Qohar, H., Rachmah, S., & Almarogi, A. (2025). A classroom for all: Innovative UDL-based instructional models and media for students with disabilities. *Jurnal Multidisiplin Indonesia*, *4*(1), 6240. https://doi.org/10.57235/qistina.v4i1.6240

Song, Y., Weisberg, L., Zhang, S., Tian, X., Boyer, K., & Israel, M. (2024). A framework for inclusive AI learning design for diverse learners. *Computers and Education: Artificial Intelligence*, *6*, Article 100212. https://doi.org/10.1016/j.caeai.2024.100212

Sudarmono, M. A., Hasan, H., & Halima, H. (2025). Deep learning approach in improving critical thinking skills of elementary school students. *Jurnal Penelitian Pendidikan IPA*, *11*(8), 11708. https://doi.org/10.29303/jppipa.v11i8.11708

Sukmanasa, E., Maeysa, A., Mulyawati, Y., Anggara, Y., & Miranti, A. (2024). Penguatan kompetensi guru SDN Julang dalam optimalisasi potensi anak berkebutuhan khusus melalui Game dan Alat Edukasi Talenta (GENTA). *Jurnal Pengabdian Kepada Masyarakat Nusantara (JPkMN)*, *5*(4), 4980–4989. https://ejournal.sisfokomtek.org/index.php/jpkm/article/view/4412

Tarnopolska, O. (2025). Creating an accessible educational environment and using adaptive technologies for students with special educational needs in higher education institutions. *Scientific Bulletin of Uzhhorod University. Series: Pedagogy. Social Work*, *56*, 240–244. https://doi.org/10.24144/2524-0609.2025.56.240-244

Tomlinson, C. A. (2014). *The differentiated classroom: Responding to the needs of all learners* (2nd ed.). ASCD.

Umam, M., Sukmanasa, E., Heldayanti, H., & Pratiwi, I. (2025). Enhancing student learning outcomes through Quizizz-supported culturally responsive teaching in problem-based learning. *Journal of General Education and Humanities*, *4*(2), 402. https://doi.org/10.58421/gehu.v4i2.402

Wahyuni, S., Pantiwati, Y., Sunaryo, H., In'am, A., & Bastian, A. (2025). Strategizing Universal Design for Learning (UDL) implementation: Enhancing inclusive education for students with disabilities in higher education. *Al-Ishlah: Jurnal Pendidikan*, *17*(1), 6630. https://doi.org/10.35445/alishlah.v17i1.6630

Windiyani, T., Sofyan, D., Gani, R., Iasha, V., & Setiawan, B. (2025). Elementary teachers' perceptions of integrating culturally responsive teaching and education for sustainable development: A cross-cultural study. *Journal of Education and E-Learning Research*, *12*(3), 7396. https://doi.org/10.20448/jeelr.v12i3.7396

Zebua, N. (2025). Education transformation: Implementation of deep learning in 21st-century learning. *Harmoni Pendidikan: Jurnal Ilmu Pendidikan*, *2*(2), 146–152. https://doi.org/10.62383/hardik.v2i2.1405

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