

Socio-culturally responsive differentiated instruction in EFL classrooms: The mediating role of UDL in enhancing students' higher-order thinking skills

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ABSTRACT

This study investigates the effectiveness and underlying mechanisms of socio-culturally responsive differentiated instruction in English as a foreign language (EFL) classrooms within the *Merdeka Belajar* curriculum. Although differentiated instruction has been widely adopted, its integration with students' socio-cultural backgrounds and its contribution to higher-order thinking skills remain underexplored. This study integrates differentiated instruction, socio-cultural learning theory, and universal design for learning (UDL) within a quantitative explanatory design. Data were obtained from junior secondary students through academic records ($n = 239$) and survey responses ($n = 184$) and analyzed using the Wilcoxon Signed-Rank Test and partial least squares structural equation modeling (PLS-SEM). The findings show a significant improvement in students' academic achievement following the implementation of socio-culturally responsive differentiated instruction ($p < .001$, $r = .86$). Motivation and engagement, and the relevance and contextual adaptation of learning significantly enhanced students' understanding, which subsequently supported higher-order learning skills and learning satisfaction. Understanding and learning outcomes also mediated the relationships between the instructional predictors and higher-order outcomes. The findings suggest that meaningful EFL learning can be strengthened when differentiated instruction is responsive to learners' socio-cultural contexts and supported by flexible and accessible learning pathways. The study contributes an integrated model for inclusive, context-sensitive, and cognitively enriching EFL practice, while acknowledging the need for validation across broader and more diverse settings.

Keywords: differentiated instruction; EFL classroom; higher-order thinking skills; socio-cultural learning; universal design for learning

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INTRODUCTION

In contemporary education, responding to learner diversity requires more than adapting instruction to differences in academic readiness or learning preferences; it also requires recognizing the socio-cultural contexts through which students experience, interpret, and construct knowledge (Ladson-

[Billings, 1995](#); [Gay, 2002](#)). This perspective is consistent with culturally responsive teaching, which views students' cultural backgrounds, identities, prior experiences, and community-based knowledge as valuable resources for meaningful learning rather than as peripheral characteristics of the classroom ([Gay, 2002](#); [Tanase, 2021](#)). Drawing on the traditions of culturally relevant pedagogy and culturally responsive teaching, socio-cultural responsiveness emphasizes the importance of connecting curriculum, instructional practices, and classroom interactions with the social and cultural realities of learners ([Gay, 2002](#); [Ladson-Billings, 1995](#)). More recently, culturally sustaining pedagogy has extended this perspective by emphasizing that education should not merely acknowledge cultural diversity but should also sustain and value students' diverse linguistic, literate, and cultural repertoires ([Alim et al., 2017](#)). These perspectives are particularly relevant to English as a foreign language (EFL) education because language learning is inherently connected to social interaction, cultural meaning, identity, and communication. In the Indonesian context, EFL classrooms are situated within a highly diverse socio-educational environment in which students bring different linguistic repertoires, local cultural experiences, educational backgrounds, and ways of making meaning into the learning process. Previous research has also highlighted the importance of developing EFL pedagogy that is responsive to the cultural and socio-educational realities of Indonesian learners ([Munandar & Newton, 2021](#)). Consequently, effective EFL instruction should not treat learners as a homogeneous group but should recognize socio-cultural diversity as an important dimension of instructional design.

Within this context, socio-culturally responsive instruction complements differentiated instruction by extending the focus of differentiation beyond students' readiness, interests, and learning profiles to include the cultural and social contexts that influence how learners access, interpret, engage with, and apply knowledge ([Gay, 2002](#); [Tomlinson & Imbeau, 2023](#)). In line with these demands, differentiated instruction (DI), developed by [Tomlinson and Imbeau \(2010\)](#), offers a pedagogical framework that allows teachers to tailor learning content, processes, and products based on students' readiness, interests, and learning profiles. Although DI has been widely adopted in various educational contexts, several studies indicate that its implementation still tends to focus on cognitive and individual aspects, without explicitly integrating the social and cultural dimensions that shape students' learning experiences ([Santoro et al., 2020](#); [Darling-Hammond et al., 2019](#)). In the context of EFL learning, which is rich in linguistic and cultural dimensions, this limitation becomes even more significant, given that the meaning of language cannot be separated from the social context in which it is used ([Dayton et al., 2022](#); [Engman & Hermes, 2021](#)). Therefore, a differentiated approach that consciously incorporates learners' socio-cultural experiences may provide a more context-sensitive basis for meaningful EFL learning.

Beyond accommodating learner diversity, contemporary EFL education is also expected to promote students' higher-order thinking skills (HOTS), particularly because language learning increasingly requires learners to engage critically and reflectively with information, ideas, and communicative contexts rather than merely reproduce linguistic knowledge ([Erdiana & Panjaitan, 2023](#); [Pradana & Awanda, 2025](#)). Drawing on the revised taxonomy of Bloom, cognitive processes range from remembering, understanding, and applying to the more complex processes of analyzing, evaluating, and creating, with the latter three commonly associated with higher-order thinking ([Anderson et al., 2001](#)). In language learning, these abilities are essential because learners are not merely expected to recognize vocabulary or comprehend grammatical structures, but also to interpret meanings, analyze information, evaluate arguments and perspectives, make inferences, solve communicative problems, and construct or synthesize new ideas through language ([Moghadam et al., 2023](#); [Wale & Bishaw, 2020](#)). Thus, the development of HOTS represents an important dimension of meaningful EFL learning, particularly when English is positioned not only as an object of linguistic study but also as a medium through which learners inquire, communicate, reflect, and construct knowledge. Recent evidence from EFL instructional materials further indicates the importance of intentionally integrating higher-order cognitive activities into language learning, as EFL learning materials and classroom tasks frequently remain dominated by lower-order cognitive processes,

limiting opportunities for students to engage in analysis, evaluation, and creation (Shabrina et al., 2025; Kusrini et al., 2019).

Universal design for learning (UDL) provides a complementary framework for addressing learner variability by emphasizing the proactive design of flexible learning environments rather than relying primarily on instructional adaptations after learning barriers have emerged. The framework is organized around three interconnected principles: multiple means of engagement, multiple means of representation, and multiple means of action and expression (Almeqdad et al., 2023). Multiple means of engagement address the different ways learners become interested in, sustain effort toward, and develop meaningful connections with learning. Multiple means of representation provide alternative pathways for accessing, processing, and constructing meaning from information, while multiple means of action and expression recognize that learners may differ in how they communicate, apply, and demonstrate what they know. Together, these principles are intended to reduce barriers to participation and learning by providing flexible pathways that acknowledge learner variability across motivation, perception, meaning-making, communication, and strategic action (Bucheli et al., 2024). In this respect, UDL is compatible with differentiated instruction because both frameworks seek to respond to learner diversity, although they approach this goal from different but complementary directions. Differentiated instruction primarily emphasizes adapting instructional content, processes, products, and learning environments in response to learner characteristics, whereas UDL emphasizes proactively designing multiple pathways that can make learning accessible and meaningful for a broad range of learners from the outset.

Previous research provides support for considering UDL and differentiated instruction as complementary rather than competing frameworks. A systematic review by Griful-Freixenet et al. (2020) identified several conceptual relationships between UDL and differentiated instruction and highlighted the need for stronger empirical investigation of their integration. Subsequently, an empirical study by Griful-Freixenet et al. (2021) found that UDL and differentiated instruction were distinct but highly interrelated inclusive teaching practices and shared several important predictors, supporting their potential integration within a coherent approach to learner variability. More recently, research examining the relationship between the two frameworks has continued to demonstrate that the connection between UDL and differentiated instruction can be explained through underlying instructional and psychological mechanisms rather than being treated as a simple combination of two independent strategies (Zhussip & Almukhambetov, 2026). In addition, a meta-analysis of 20 studies and 50 individual effects reported a moderate positive effect of UDL-based instruction on learner achievement, providing broader empirical support for its contribution to learning outcomes (King-Sears et al., 2023). Taken together, these findings suggest that UDL may play a process-oriented role within differentiated learning by helping translate responsive instructional conditions into flexible opportunities for engagement, representation, action, and expression.

In the present study, this process-oriented perspective provides the theoretical basis for positioning UDL as an intervening learning-design mechanism. Socio-culturally responsive differentiated instruction is expected to recognize differences in learners' readiness, interests, learning profiles, cultural identities, prior experiences, and ways of making meaning. However, responsiveness to learner diversity does not necessarily guarantee equivalent opportunities to access information, sustain engagement, construct understanding, or demonstrate complex learning. UDL may therefore function as the mechanism through which responsive instructional conditions are translated into multiple and accessible learning pathways. Through these pathways, students may be better positioned to develop conceptual understanding, strategic participation, and knowledge construction required for higher-order thinking. Although previous studies have established meaningful relationships between UDL and DI, direct empirical examination of UDL as a mechanism linking socio-culturally responsive differentiated instruction with higher-order learning remains limited. This gap is particularly important in the Indonesian EFL context, where research has increasingly emphasized local cultural knowledge, learner identities, and culturally relevant practices but has also indicated that socio-cultural

responsiveness is not always systematically integrated into broader instructional design (Munandar & Newton, 2021; Munandar, 2025).

Addressing this gap, the present study integrates socio-culturally responsive differentiated instruction, UDL, and higher-order learning outcomes within a single analytical framework. The study has two complementary purposes. First, it examines whether the implementation of socio-culturally responsive differentiated instruction is associated with changes in students' academic achievement. Second, it investigates the structural relationships among motivation and engagement, relevance and adaptation to learning, understanding, difficulties and learning outcomes, and higher-order learning skills and learning satisfaction. In the empirical model, Understanding, Difficulties, and Learning Outcomes (UDLO) is treated as the learner-level mediating construct, whereas UDL refers to the theoretical and instructional design framework that informs the learning conditions. This distinction enables the study to examine how responsive and contextually relevant instruction may be translated into accessible learning opportunities and subsequently associated with higher-order learning outcomes. The study therefore seeks to contribute an empirically grounded perspective on how differentiation, socio-cultural responsiveness, and inclusive learning design may operate together in Indonesian EFL classrooms.

LITERATURE REVIEW

The differentiated learning approach has experienced significant development in recent years, especially in the context of EFL education. Recent research shows that differentiation is no longer understood simply as an instructional variation strategy, but rather as a pedagogical framework that accommodates the diversity of student characteristics in a more holistic manner, including cognitive, affective, and socio-cultural aspects. The study by Puspitarini et al. (2025) emphasized that learning that considers students' social context can significantly increase academic engagement and literacy. In line with this, Bi (2025) shows that learning based on cultural responsiveness contributes to the creation of an inclusive and meaningful learning environment, especially for language learners with diverse backgrounds.

Strengthening the socio-cultural dimension in EFL learning leads to the integration of socio-cultural learning theory as an epistemological foundation. This perspective emphasizes that the learning process occurs through social interaction and the construction of meaning based on students' real experiences. In this context, language learning not only functions as a transfer of linguistic knowledge but also as a means of negotiating meaning in a particular cultural context. Research by Fitri et al. (2025) underlines that culturally responsive pedagogy is able to increase the relevance of learning while strengthening students' learning identities. Furthermore, Schnitzler et al. (2021) found that student engagement built through authentic social interactions has a strong correlation with increased academic achievement.

In subsequent developments, the need to ensure learning accessibility for all students gave rise to the integration of UDL in pedagogical practice. UDL emphasizes flexibility in presenting material, varying ways of involvement, and various forms of expression of learning results. Research by Arranz-Sánchez (2025) shows that systematic implementation of UDL can reduce learning barriers and increase students' conceptual understanding. In addition, Sun and Xu (2024) emphasized that learning environments designed based on UDL principles have great potential in encouraging the development of higher-order thinking skills through providing more equitable cognitive access.

In the present study, this process-oriented perspective provides the theoretical basis for examining understanding, difficulties, and learning outcomes (UDLO) as a mediating construct. UDL provides the instructional design framework through which flexible and accessible learning opportunities are created, while UDLO captures the learner-level experiences and outcomes associated with those instructional conditions. Thus, the empirical model examines whether motivation and engagement and the relevance and adaptation of learning are associated with higher-order learning skills and learning satisfaction through students' understanding, learning difficulties, and learning outcomes. The study by Lu et al. (2021) shows that conceptual understanding acts as an

important mediator in linking learning factors with higher-order thinking skills. This finding was confirmed by [Salzmann-Erikson and Olsson \(2025\)](#), which states that learning structures that support deep understanding will directly facilitate students' analysis, evaluation, and synthesis abilities. Thus, the quality of understanding is key in the transformation of learning from a basic level to high-level cognition.

Finally, current literature shows that the effectiveness of EFL learning is not only determined by teaching strategies alone, but by the synergy between differentiation, socio-cultural relevance, and inclusive learning design. [Panglipur and Triayan \(2025\)](#) emphasized that the application of UDL in contextual learning can significantly increase student participation and the quality of thinking. Meanwhile, [Chen et al. \(2023\)](#) found that high-level cognitive skills were closely correlated with learning satisfaction when the learning environment was designed adaptively and meaningfully. Therefore, an integrative approach that combines these three dimensions is an important basis for creating EFL learning that is not only academically effective but also contextually relevant and sustainable.

Taken together, the reviewed literature suggests that differentiated instruction, socio-cultural responsiveness, and UDL address complementary dimensions of learner diversity, yet these perspectives have often been examined separately. Differentiated instruction provides adaptive responses to differences in learners' readiness, interests, and learning needs, whereas socio-cultural responsiveness extends this adaptation by recognizing learners' cultural identities, prior experiences, linguistic repertoires, and social contexts. UDL further complements these approaches by providing multiple and flexible pathways through which diverse learners can engage with, access, and demonstrate their understanding of learning content. However, existing research provides limited evidence regarding how these approaches operate together as an integrated instructional system and, more specifically, whether UDL functions as a mechanism through which socio-culturally responsive differentiated instruction (DI) contributes to higher-order learning outcomes. This conceptual limitation provides the basis for the present study and supports the proposed analytical relationships among motivation and engagement, relevance and adaptation to learning, understanding and learning outcomes, and higher-order learning skills and satisfaction

METHOD

This study employed a quantitative explanatory design with an intervention-based effectiveness component and a structural model component. The first component examined changes in students' academic achievement following the implementation of socio-culturally responsive differentiated instruction, whereas the second component examined the relationships among the learning constructs associated with students' higher-order learning outcomes. The instructional treatment in this study was socio-culturally responsive differentiated instruction, which constituted the primary pedagogical intervention. The treatment design was represented as O_1-X-O_2 , where O_1 represents students' academic achievement before the implementation of the intervention, X represents the implementation of socio-culturally responsive differentiated instruction, and O_2 represents students' academic achievement after the implementation of the intervention. The effectiveness component therefore examined whether students' academic achievement changed following the instructional intervention. In the explanatory component, motivation and engagement aspects (MEA) and relevance and adaptation to learning (RAL) were specified as predictor variables, understanding and learning outcomes (ULO) were specified as the mediating variable, and higher-order learning skills and learning satisfaction (HOLS) were specified as the outcome variable. Conceptually, the study integrates differentiated instruction (DI), socio-cultural learning theory, and UDL to explain how responsive and accessible learning conditions may contribute to students' higher-order learning outcomes. This design was chosen because it enabled researchers to not only empirically identify changes in learning outcomes but also analyze the structural relationships among latent variables that shape the learning process. Conceptually, this study integrates DI, socio-cultural learning theory, and UDL into a coherent analytical framework.

The research was conducted at two public junior high schools in Soppeng regency, South Sulawesi. Participants were students enrolled in English language learning within the *Merdeka Belajar* Curriculum. Data were collected through two primary sources. First, academic achievement data, consisting of odd- and even-semester grades from 239 students, served as pre- and post-test data to measure the effectiveness of the socio-cultural-based differentiated learning implementation. Second, survey data were obtained from 184 respondents who completed a structured questionnaire to gauge students' perceptions of their learning experiences during the learning process.

The survey sample consisted of 184 students, which was considered adequate for the SEM–PLS analysis employed in this study. The model included four latent constructs measured through a limited number of reflective indicators and involved a relatively simple structural model with a small number of predictor relationships directed toward each endogenous construct. Accordingly, the available sample exceeded commonly used minimum requirements for estimating PLS–SEM models of this level of complexity and was considered sufficient for evaluating both the measurement and structural models. The use of PLS–SEM was also appropriate because of its suitability for prediction-oriented analysis involving latent constructs and small-to-medium sample sizes (Sarstedt et al., 2016).

The research instruments consisted of two types. Academic achievement data were obtained from official school documents reflecting the results of English language learning evaluations in accordance with the *Merdeka Belajar* curriculum standards. Meanwhile, the survey instrument was developed in the form of a Likert-based questionnaire that measures four latent constructs: (1) motivation and engagement aspects (MEA), (2) relevance and adaptation to learning (RAL), (3) understanding and learning outcomes (ULO), and (4) higher-order learning skills and learning satisfaction (HOLS). The development of instrument items was based on a synthesis of DI theory (Tomlinson & Imbeau, 2010), socio-cultural learning (Vygotsky & Cole, 1978), and the principles of UDL (Cast et al., 2021). To ensure the quality of the instrument, validity and reliability tests were conducted through analysis of the measurement model using the SEM–PLS approach, including evaluation of outer loading, composite reliability, average variance extracted (AVE), and discriminant validity.

Data analysis was conducted in two complementary stages. The first stage used non-parametric statistical analysis using the Wilcoxon signed rank test. This test was chosen because the data did not meet the assumption of normality, making it more appropriate to compare pre-test and post-test scores in pairs. Furthermore, effect sizes were calculated to measure the strength of the learning intervention's influence on student academic achievement. The second stage uses SEM–PLS. This approach was chosen because of its ability to analyze causal relationships between latent constructs, accommodate non-normal data distributions, and be suitable for small to medium sample sizes (Sarstedt et al., 2016).

The SEM–PLS analysis procedure is carried out through two main stages: measurement model evaluation and structural model evaluation. At the measurement model stage, indicator reliability, internal consistency, convergent validity, and discriminant validity are tested to ensure that each construct is measured accurately. Furthermore, at the structural model stage, path coefficients, statistical significance (t-statistics and p-values), and direct and indirect effect analyses are conducted to examine the mediating role of UDL variables in the relationship between MEA, RAL, and HOLs. In addition, the coefficient of determination (R^2) and effect size (f^2) values are analyzed to evaluate the model's predictive power.

The socio-culturally responsive differentiated instruction model was implemented through a sequence of interconnected instructional stages. First, the learning context and learner characteristics were identified to provide a basis for instructional planning. This stage focused on students' learning readiness, interests, and learning needs, while also considering relevant socio-cultural characteristics, including students' prior experiences, local cultural knowledge, linguistic backgrounds, and everyday contexts that could be meaningfully connected to English language learning. The information obtained during this stage was used to design learning activities that were responsive to both learner variability and socio-cultural diversity.

Second, the learning content and classroom activities were differentiated according to students' identified learning characteristics. Drawing on the principles of differentiated instruction, teachers provided varied pathways for students to engage with the learning content and participate in the learning process. The instructional activities were designed to accommodate differences in students' readiness and learning needs while maintaining common learning objectives. At the same time, socio-cultural contexts were incorporated into learning materials, examples, classroom discussions, and learning tasks so that English language learning could be connected with students' familiar experiences and meaningful social and cultural contexts.

Third, the principles of UDL were incorporated to provide flexible opportunities for participation and learning. Multiple means of engagement were used to support students' interest and sustained participation, multiple means of representation were provided to facilitate access to and understanding of learning materials, and multiple means of action and expression enabled students to demonstrate their understanding through different forms of learning performance. These flexible pathways were intended to reduce potential barriers arising from differences in students' learning characteristics and to support more equitable access to the instructional activities.

Fourth, students participated in learning activities that encouraged them to construct meaning through interaction, contextual exploration, discussion, and the application of English in relevant communicative situations. The learning process was designed to move beyond the acquisition of vocabulary and grammatical knowledge toward activities requiring students to interpret information, analyze ideas, evaluate perspectives, solve problems, and develop or express their own responses. In this way, the differentiated and socio-culturally responsive learning activities were expected to support the development of students' HOTS.

Finally, students' learning outcomes were evaluated through the academic assessment procedures used in the participating schools. The resulting academic achievement data were used to examine changes in students' performance following the implementation of the instructional model, while questionnaire data were collected to examine students' perceptions of motivation and engagement, relevance and adaptation to learning, understanding and learning outcomes, and higher-order learning skills and learning satisfaction. The combination of these data enabled the study to examine both the effectiveness of the instructional implementation and the structural relationships among the learning constructs.

Prior to data collection, permission to conduct the study was obtained from the relevant school authorities. Participation in the questionnaire component was voluntary, and students were informed about the purpose of the study and the use of the collected data for research purposes. Because the participants were junior secondary school students, the data collection procedures were conducted in accordance with the schools' applicable administrative and ethical requirements. Participants' identities were not included in the research dataset, and all information was anonymized and treated confidentially. Academic achievement data obtained from school records were analyzed only for research purposes and were reported in aggregated form.

FINDINGS

Results of instructional effectiveness

The descriptive analysis results show a consistent improvement in students' academic achievement after the implementation of socio-culturally responsive differentiated learning in EFL classes. The students' average grades increased substantially from the previous semester to the next, indicating a positive shift in learning performance. This finding is further supported by the Wilcoxon signed rank test results, which show a significant difference between pre-test and post-test scores ($p < .001$), with a relatively large effect size ($r = 0.86$). The large effect size confirms that the changes are not merely statistical phenomena but rather reflect a real pedagogical impact in the context of English learning. These statistical findings can be seen in [Table 1](#), [Table 2](#), and [Table 3](#) below:

Table 1

Normality Test

	Kolmogorov–Smirnov Sig.	Shapiro–Wilk Sig.	Interpretation
Pre-Test Grade	<.000	<.000	Not normal
Post-Test Grade	<.000	.002	Not normal

Table 2

Wilcoxon Signed Rank Test Result

Comparison	Z	Asymp.Sig (2-tailed)	Decision
Post-Test – Pre-Test	-13.34	< .001	Significant

Table 3

Effect Size

Statistic	Value
Z value	-13.34
Sample size (N)	239
Effect size (r)	0.86
Interpretation	Large effect

More deeply, this improvement can be understood as a consequence of a learning approach that focuses not only on varying teaching strategies but also on linking learning materials to students' social and cultural contexts. When students perceive the English material being studied as relevant to their lives, the learning process becomes more meaningful and understanding-oriented. In this case, learning is no longer positioned as a mere transfer of knowledge, but rather as a process of constructing meaning that involves students' experiences and identities. This finding aligns with the view that contextualized and responsive learning tends to produce more optimal academic outcomes (Puspitarini et al., 2025; Hien et al., 2022).

Descriptive statistics of the measurement model results

The measurement model assessment indicates that all indicators across the four constructs demonstrated adequate outer loading values, meeting or exceeding the recommended threshold of 0.70 as suggested by Dzin and Lay (2021). Indicators under the MEA construct exhibited very strong performance, with loading values ranging from 0.822 to 0.945, reflecting excellent item contributions to the latent construct. Indicators for the RAL construct also showed consistent and satisfactory performance (0.768–0.853), confirming that these items reliably capture students' perceptions of socio-cultural relevance and adaptation in the learning process (Tomlinson & Imbeau, 2010). The Understanding, difficulties, and learning outcomes (UDLO) construct demonstrated acceptable indicator loadings (0.725–0.805), indicating strong representation of students' comprehension and learning outcomes, further supporting the principles of UDL (Capp, 2017; dos Santos & Cirillo, 2021; Espada-Chavarria et al., 2023). Indicators for higher-order learning skills and satisfaction (HOLS) also meet the required measurement criteria, with loading values between 0.724 and 0.798, suggesting that the construct is well measured and conceptually aligned with higher-order cognitive skills literature (Elfeky, 2019; Feraco et al., 2023).

Regarding reliability (Table 3), in terms of reliability, all constructs recorded Cronbach's Alpha, rho_A, and composite reliability values above the minimum threshold of 0.70, demonstrating strong internal consistency (Sarstedt et al., 2016). The HOLs construct exhibited the highest reliability, with a Cronbach's Alpha of 0.928 and a Composite Reliability of 0.949, indicating excellent stability and measurement precision. The MEA, RAL, and UDL constructs also demonstrated strong reliability, with composite reliability values of 0.844, 0.850, and 0.851, respectively, all exceeding recommended benchmarks for psychological and educational constructs (Cheung et al., 2024; Haji-Othman & Yusuff, 2022). Furthermore, the AVE values for all constructs exceeded the recommended minimum of 0.50, with HOLs at 0.824, MEA at 0.644, RAL at 0.586, and UDL at 0.589. These results confirm

that each construct possesses strong convergent validity, since more than 50% of the variance in its indicators is explained by the underlying latent variable (Baharum et al, 2023; Fithri et al., 2024).

Table 4

Outer Loading, Cronbach's Alpha, Rho A, Composite Reliability, AVE

Variable	HOLS	MEA	RAL	UDLO	Cronbach's Alpha	rho_A	Composite Reliability	AVE
HOLS1				0.724	0.928	0.930	0.949	0.824
HOLS2				0.798				
HOLS3				0.752				
HOLS4				0.793				
MEA1	0.822				0.728	0.754	0.844	0.644
MEA2	0.933							
MEA3	0.926							
MEA4	0.945							
RAL1		0.785			0.764	0.765	0.850	0.586
RAL2		0.853						
RAL3		0.768						
UDLO1			0.725		0.767	0.770	0.851	0.589
UDLO2			0.766					
UDLO3			0.805					
UDLO4			0.765					

Overall, the measurement model evaluation confirms that all indicators and constructs in this study are valid and reliable, allowing the analysis to proceed to the structural model (*inner model*) to examine the relationships among variables as specified in the research questions.

Outer model analysis

Figure 1 presents the reflective outer model generated using SmartPLS, illustrating the relationships between each latent construct and its indicators. The diagram shows four key constructs: MEA, RAL, UDLO, and HOLS, each measured by multiple reflective indicators.

Figure 1

Outer Model

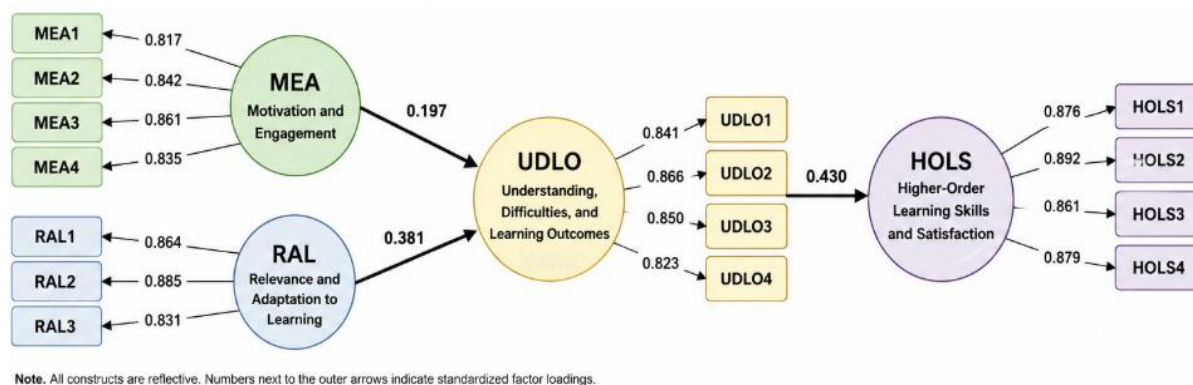


Figure 1 presents the reflective outer model generated using SmartPLS, illustrating the relationships between each latent construct and its respective indicators. The model comprises four empirical constructs: motivation and engagement aspects (MEA), relevance and adaptation to learning (RAL), understanding, difficulties, and learning outcomes (UDLO), and higher-order learning skills and learning satisfaction (HOLS), each measured by multiple reflective indicators. The model demonstrates that all indicators load strongly onto their respective constructs, with loading values consistently exceeding the recommended threshold of 0.70 (Hair et al, 2025). This indicates that each

item meaningfully represents its underlying construct and contributes reliably to the measurement model.

For terminological clarity, the construct represented in [Figure 1](#) as understanding, difficulties, and learning outcomes is denoted exclusively as UDLO, with its four indicators labeled UDLO1–UDLO4. These indicators represent the empirical learner-level construct examined in the PLS-SEM analysis and should not be interpreted as indicators of universal design for learning. In contrast, UDL refers exclusively to universal design for learning, which functions as the theoretical and instructional design framework underpinning the study and is therefore not treated as a latent construct in the measurement model.

Indicators for MEA exhibit particularly high loadings, reflecting strong alignment with students' motivation and engagement in socio-culturally grounded learning. Indicators for RAL, UDLO, and HOLS also demonstrate satisfactory loading patterns, supporting the reliability, convergent validity, and empirical distinctiveness of the four latent constructs. Accordingly, all measurement descriptions, indicator labels, and statistical scores presented in the outer model refer to the corresponding empirical constructs, with UDLO used consistently for understanding, difficulties, and learning outcomes.

The structure of [Figure 1](#) confirms that the measurement relationships meet the criteria for reliability and convergent validity, demonstrating that the reflective model is robust and theoretically coherent ([Pinheiro et al., 2024](#); [Razak et al., 2019](#)). This provides a strong foundation for advancing to structural model analysis in subsequent sections, in which the hypothesized relationships among the latent constructs are subsequently examined.

Cross loading

The cross-loadings from [Table 5](#) provide additional evidence supporting the discriminant validity of the measurement model. In reflective measurement models, each indicator should load highest on its assigned construct and significantly lower on all other constructs. The results in the table show that all indicators satisfy this requirement, as each item demonstrates its strongest loading on the construct it is intended to measure. This confirms that the indicators are not capturing overlapping dimensions across constructs.

Table 5

Cross Loading

Indicators	Higher-Order Skills and Learning Satisfaction Aspects	Motivation and Engagement Aspects	Relevance and Adaptation to Learning Aspects	Understanding, Difficulties, and Learning Outcomes Aspects
UDLO4	0.426	0.209	0.375	0.765
UDLO3	0.486	0.284	0.312	0.805
UDLO2	0.431	0.253	0.360	0.766
UDLO1	0.436	0.266	0.334	0.725
RAL3	0.254	0.205	0.768	0.297
RAL2	0.384	0.353	0.853	0.428
RAL1	0.298	0.265	0.785	0.339
MEA4	0.474	0.945	0.318	0.307
MEA3	0.440	0.926	0.301	0.254
MEA2	0.434	0.933	0.289	0.301
MEA1	0.515	0.822	0.356	0.327
HOLS4	0.793	0.437	0.251	0.387
HOLS3	0.752	0.303	0.331	0.489
HOLS2	0.798	0.410	0.295	0.524
HOLS1	0.724	0.439	0.343	0.374

This pattern of loadings indicates that the model fulfils the traditional Fornell–Larcker discriminant validity criterion, as well as the more stringent requirements recommended by [Li and Lay](#)

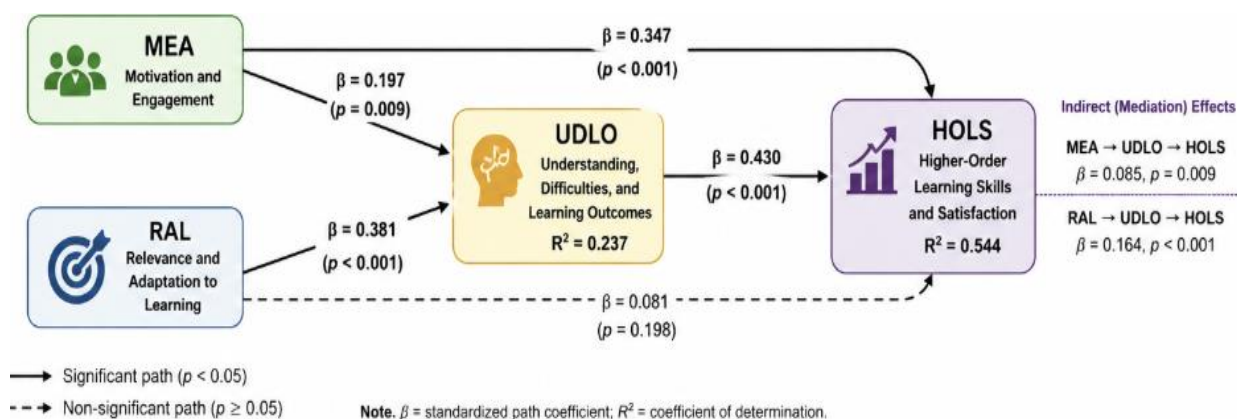
(2024). Thus, the constructs within this study are empirically distinct and measure different aspects of students' socio-cultural learning experiences.

Inner model analysis

The inner model analysis evaluates the hypothesized structural relationships among the empirical constructs in the study. To ensure terminological clarity, the structural model distinguishes between universal design for learning (UDL) and understanding, difficulties, and learning outcomes (UDLO). In the present analysis, UDLO represents the empirical learner-level construct examined through PLS-SEM, whereas UDL refers exclusively to the theoretical and instructional design framework underpinning the study. Therefore, the path coefficients, coefficient of determination (R^2), effect sizes (f^2), and mediation effects reported in the inner model refer to the UDLO construct, not to UDL as a theoretical framework.

Figure 2 presents the inner model and illustrates the hypothesized structural relationships among motivation and engagement aspects (MEA), relevance and adaptation to learning (RAL), understanding, difficulties, and learning outcomes (UDLO), and higher-order learning skills and learning satisfaction (HOLS). The model examines the direct effects of MEA and RAL on UDLO and HOLs, as well as the effect of UDLO on HOLs. Accordingly, the structural paths are specified as MEA $\rightarrow$ UDLO, RAL $\rightarrow$ UDLO, MEA $\rightarrow$ HOLs, RAL $\rightarrow$ HOLs, and UDLO $\rightarrow$ HOLs. The UDLO construct serves as the empirical mediating construct in the model, while UDL remains the theoretical framework used to explain the instructional conditions underlying the learning process.

Figure 2
Inner Model



Path coefficient analysis

The path coefficient analysis summarized in Table 6 presents the hypothesized structural relationships among the empirical constructs. Importantly, all structural paths involving the construct of Understanding, difficulties, and learning outcomes are specified using UDLO, not UDL. Thus, the coefficients reported for the relationships with UDLO represent the empirical effects involving students' understanding, learning difficulties, and learning outcomes. UDL is not treated as a measured latent variable in the inner model; rather, it refers to universal design for learning as the theoretical and instructional design framework used to contextualize the empirical relationships.

The path coefficient analysis summarized in Table 6 provides an overview of the direct effects tested within the structural model. The first hypothesis (H1), which examined the influence of motivation and engagement aspects (MEA) on understanding, difficulties, and learning outcomes (UDLO), was supported with a statistically significant path coefficient of $\beta = 0.197$, $t = 2.598$, and $p = 0.009$. This result indicates that higher levels of student motivation and engagement, when embedded in socio-cultural learning contexts, contribute positively to students' understanding, help reduce perceived learning difficulties, and support improved learning outcomes. Although the effect

size is relatively small, the finding aligns with socio-cultural learning theory, suggesting that motivated and engaged learners are more likely to develop deeper understanding and overcome learning difficulties through meaningful and culturally relevant learning experiences.

The second hypothesis (H2) tested whether relevance and adaptation to learning (RAL) significantly predicted understanding, difficulties, and learning outcomes (UDLO). The results show a strong and highly significant effect ($\beta = 0.381$, $t = 5.574$, $p < 0.001$), confirming that socio-culturally relevant and well-adapted learning materials contribute positively to students' understanding, reduce learning difficulties, and improve learning outcomes. Compared with MEA, RAL appears to be a more influential predictor of UDLO, reinforcing the importance of culturally aligned and contextually relevant learning experiences in facilitating comprehension, addressing learning difficulties, and supporting students' academic outcomes. This finding is consistent with the principles of differentiated instruction and universal design for learning (UDL), which emphasize flexible and responsive learning environments that accommodate learner variability.

The third hypothesis (H3), which investigated the direct effect of MEA on HOLS, also received strong support. The path coefficient of $\beta = 0.347$, with a highly significant t -value of 6.282 and $p < 0.001$, demonstrates that student motivation and engagement play a direct and meaningful role in shaping higher-order cognitive skills and satisfaction. This finding suggests that motivated learners not only develop a stronger understanding of learning content but also engage more actively in deeper analytical, evaluative, and problem-solving processes.

In contrast, the fourth hypothesis (H4), which proposed a direct effect of RAL on HOLS, was not supported. The path coefficient ($\beta = 0.081$) is positive but not statistically significant ($t = 1.288$, $p = 0.198$). This indicates that relevance and adaptation alone do not directly enhance higher-order thinking skills or learning satisfaction. Instead, their influence may operate indirectly through Understanding, Difficulties, and Learning Outcomes (UDLO). The absence of a direct effect suggests that culturally relevant and appropriately adapted learning materials may contribute to higher-order learning primarily by first improving students' understanding, reducing learning difficulties, and supporting learning outcomes.

Finally, the fifth hypothesis (H5), which assessed the direct influence of UDLO on HOLS, was strongly supported. The path coefficient of $\beta = 0.430$, with $t = 7.756$ and $p < 0.001$, represents the strongest direct relationship in the model. This finding demonstrates that students who experience clearer understanding, fewer learning difficulties, and improved learning outcomes are more likely to develop higher-order cognitive abilities and experience greater learning satisfaction. Thus, UDLO represents an important proximal learning construct linking students' learning experiences with higher-order learning skills and satisfaction.

Table 6
Path Coefficient Analysis

Variable	Original Sample (O)	T Statistics (O/STDEV)	P Values	Result
MEA -> UDLO	0.197	2.598	0.009	H1 Accepted
RAL -> UDLO	0.381	5.574	0.000	H2 Accepted
MEA -> HOLS	0.347	6.282	0.000	H3 Accepted
RAL -> HOLS	0.081	1.288	0.198	H4 Not Supported (direct)
UDLO -> HOLS	0.430	7.756	0.000	H5 Accepted

The second hypothesis (H2) tested whether relevance and adaptation to learning (RAL) significantly predicted understanding, difficulties, and learning outcomes (UDLO). The results show a strong and highly significant effect ($\beta = 0.381$, $t = 5.574$, $p < 0.001$), confirming that socio-culturally relevant and well-adapted learning materials contribute positively to students' understanding, help reduce learning difficulties, and improve learning outcomes. Compared with MEA, RAL appears to be a more influential predictor of UDLO, reinforcing the importance of culturally aligned and

contextually relevant learning experiences in facilitating comprehension, addressing learning difficulties, and supporting students' academic outcomes. This finding is consistent with the principles of differentiated instruction and universal design for learning (UDL), which emphasize flexible and responsive learning environments that accommodate learner variability.

The third hypothesis (H3), which investigated the direct effect of MEA on HOLS, also received strong support. The path coefficient of $\beta = 0.347$, with a highly significant t-value of 6.282 and $p < 0.001$, demonstrates that student motivation and engagement play a direct and meaningful role in shaping higher-order cognitive skills and satisfaction. This finding suggests that motivated learners not only understand content more effectively but also engage in deeper analytical, evaluative, and problem-solving processes.

In contrast, the fourth hypothesis (H4), which proposed a direct effect of relevance and adaptation to learning (RAL) on higher-order learning skills and learning satisfaction (HOLS), was not supported. The path coefficient ($\beta = 0.081$) is positive but not statistically significant ($t = 1.288$, $p = 0.198$). This indicates that relevance and adaptation alone do not directly enhance higher-order thinking skills or learning satisfaction. Instead, their influence may operate indirectly through understanding, difficulties, and learning outcomes (UDLO). The absence of a direct effect suggests that culturally relevant and appropriately adapted learning materials may contribute to higher-order learning primarily by improving students' understanding, reducing learning difficulties, and supporting better learning outcomes. Thus, the role of RAL in promoting HOLS appears to depend on the extent to which it first facilitates students' understanding, addresses their learning difficulties, and improves their learning outcomes.

Finally, the fifth hypothesis (H5), which assessed the direct influence of UDL on HOLS, was strongly supported. The path coefficient of $\beta = 0.430$, with $t = 7.756$ and $p < 0.001$, represents the strongest direct relationship in the model. This demonstrates that students who experience clearer understanding, fewer learning difficulties, and enhanced learning outcomes are more likely to develop higher-order cognitive abilities and experience greater learning satisfaction. This result underscores the central importance of UDL as a key mechanism linking socio-cultural instructional elements to advanced cognitive learning outcomes.

Mediation test

The mediation analysis presented in Table 6 shows that understanding and learning outcomes (UDLO) plays a significant mediating role in the structural model. The indirect effect of MEA on HOLS through UDL is $\beta = 0.085$, with $t = 2.623$ and $p = 0.009$, indicating a significant partial mediation. This means that SME influences HOLS both directly and indirectly by enhancing students' understanding and learning outcomes. Meanwhile, the indirect effect of relevance and adaptation to learning (RAL) on HOLS through UDL is $\beta = 0.164$, with $t = 4.098$ and $p < 0.001$, demonstrating a significant full mediation. Unlike SME, RAL does not exert a direct effect on HOLS, and its influence occurs entirely through improvements in UDL. These results collectively confirm UDL as a central mediating mechanism through which socio-cultural factors shape higher-order thinking and learning satisfaction.

Table 7

Indirect Effects

Variable	Original Sample (O)	T Statistics (O/STDEV)	P Values	Result
MEA-UDL-HOLS	0.085	2.623	0.009	H6 Supported (partial mediation)
RAL-UDL-HOLS	0.164	4.098	0.000	H6 Supported (full mediation)

R-square & F-square

The coefficient of determination (R^2) results should be interpreted in relation to the complexity of educational learning processes rather than through rigid statistical labels alone. The R^2 value of 0.237 for understanding and learning outcomes (UDLO) indicates that motivation and engagement,

together with relevance and adaptation to learning, explain a meaningful proportion of the variance in students' understanding, while also suggesting that other cognitive, instructional, and contextual factors contribute to this outcome. Similarly, the R^2 value of 0.462 for HOLS indicates that the proposed predictors explain nearly half of the variance in the outcome construct. Given the multifaceted nature of higher-order learning in educational settings, this level of explained variance provides meaningful evidence for the explanatory value of the proposed model while also confirming that higher-order learning is influenced by additional factors beyond those examined in the present study.

Table 8

R Square

Variable	R Square	R Square Adjusted
UDL	0.237	0.228
HOLS	0.462	0.453

The f^2 effect size results show that MEA has a moderate effect on HOLS ($f^2 = 0.188$) but only a small effect on understanding and learning outcomes (UDLO) ($f^2 = 0.045$). RAL exhibits a small effect on HOLS ($f^2 = 0.009$) but a moderate effect on UDL ($f^2 = 0.167$), indicating its stronger influence on comprehension outcomes than higher-order skills. Meanwhile, UDL demonstrates a moderate effect on HOLS ($f^2 = 0.263$), making it the most influential predictor of higher-order thinking skills among all variables. These findings align with recommended f^2 interpretation thresholds (small = 0.02, moderate = 0.15, large = 0.35), reflecting meaningful contributions of UDL and MEA within the structural model.

Table 9

F-Square

Variable	HOLS	MEA	RAL	UDL
MEA	0.188			0.045
RAL	0.009			0.167
UDL	0.263			

DISCUSSION

This study examined whether socio-culturally responsive differentiated instruction could improve students' academic achievement and how motivation and engagement, relevance and adaptation to learning, and students' understanding, difficulties, and learning outcomes were associated with higher-order learning skills and learning satisfaction. Overall, the findings indicate that learning becomes more meaningful and cognitively productive when differentiation is connected to students' socio-cultural contexts and supported by flexible learning opportunities. The results also show that students' understanding, learning difficulties, and learning outcomes constitute an important proximal pathway through which learning experiences are associated with higher-order learning skills and satisfaction. Rather than functioning as separate pedagogical components, differentiation, socio-cultural relevance, and inclusive learning design appear to operate as interconnected dimensions of the EFL learning process.

The first major finding is the improvement in students' academic achievement following the implementation of socio-culturally responsive differentiated instruction. This finding suggests that instructional responsiveness may be particularly meaningful when learning activities connect English content with students' existing experiences, local contexts, and ways of making meaning. Such contextualization may help students perceive English not simply as an abstract school subject but as a meaningful communicative resource. This interpretation is consistent with previous research emphasizing the importance of contextual relevance in EFL learning and its contribution to students' comprehension and academic performance (Sandoval & Joseph, 2025; Stevani et al., 2022). The finding therefore extends the rationale for differentiated instruction by suggesting that instructional

variation may be more meaningful when the substance and context of learning are also responsive to students' socio-cultural experiences.

The second major finding concerns the structural relationships among students' motivation and engagement, relevance and adaptation to learning, and UDLO. Motivation and engagement were positively associated with UDLO, suggesting that students who perceive learning as meaningful are more likely to participate cognitively and affectively in activities that support understanding. This interpretation is consistent with socio-cultural perspectives in which learning develops through interaction, participation, and engagement in meaningful social practices (Schnitzler et al., 2021; Ginting, 2021; Kassab et al., 2022). Relevance and adaptation showed an even stronger relationship with UDLO, indicating that learning materials connected to students' real-life experiences and socio-cultural contexts may provide a stronger foundation for comprehension and the reduction of learning difficulties. This finding aligns with research suggesting that meaningful and contextualized learning can strengthen information processing, knowledge retention, and transfer by connecting new knowledge with prior experience (Agra et al., 2019; Polman et al., 2021; Selvianiresa; Prabawanto., 2017).

The third major finding is the strong relationship between UDLO and higher-order learning skills and satisfaction. The result suggests that higher-order cognitive activity depends substantially on students first having sufficient understanding and manageable learning difficulties. In EFL learning, this is particularly important because students need to move beyond recognizing linguistic forms toward interpreting information, evaluating perspectives, solving problems, and constructing responses in context. This interpretation is consistent with previous research showing that learning processes that strengthen understanding can facilitate higher-order thinking (Salzmann-Erikson et al., 2025; Elim, 2026; Lu et al., 2021). It also complements research on UDL-informed learning environments, which indicates that providing equitable cognitive access and flexible learning opportunities can support critical thinking and problem-solving (Panglipur and Triayani 2025; Root et al., 2019; Walters-Williams, 2022). The present findings therefore suggest that understanding is not merely an intermediate learning outcome but an important condition for more complex cognitive engagement.

The most distinctive finding concerns the mediating role of UDLO, which represents students' understanding, learning difficulties, and learning outcomes, within the theoretical framework of UDL. The significant indirect relationships indicate that motivation and engagement and relevance and adaptation are associated with higher-order learning outcomes partly through improvements in students' understanding and learning experiences. This provides empirical support for the process-oriented interpretation of UDL developed in the introduction: UDL is not treated as another independent instructional technique but as a design framework through which responsive instructional conditions can be translated into accessible opportunities for engagement, representation, action, and expression. In this sense, the findings extend previous research on UDL and differentiated instruction (Levicky-Townley et al., 2021; Panglipur and Triayani, 2025; Suleymanov, 2022) by suggesting that the value of inclusive learning design may lie partly in how it supports learner-level understanding and reduces barriers to participation. The findings therefore refine the relationship between socio-cultural responsiveness, differentiation, and UDL by highlighting an intervening learner-level process.

From a theoretical perspective, the findings support an integrated interpretation of differentiated instruction, socio-cultural learning, and UDL. Differentiated instruction provides a basis for responding to differences in readiness, interests, and learning needs, while socio-cultural responsiveness extends this perspective by recognizing learners' identities, prior experiences, linguistic repertoires, and social contexts. UDL complements these approaches by providing flexible pathways through which learners can access information, sustain engagement, construct meaning, and demonstrate learning. The present findings therefore do not simply confirm that these frameworks can coexist; they suggest that their integration can be understood as a sequence in which responsive instructional conditions create opportunities for meaningful and accessible learning experiences,

which in turn support understanding and higher-order learning. This theoretical interpretation extends the complementary perspective identified in previous research by providing an empirically grounded explanation of how these pedagogical dimensions may operate together in an EFL context.

The findings have several implications for EFL teachers and curriculum designers. For teachers, differentiated instruction should extend beyond grouping students according to academic readiness and should incorporate learners' prior experiences, linguistic repertoires, local cultural knowledge, and everyday contexts when designing learning activities. Teachers can also use UDL principles to provide multiple means of engagement, representation, and action and expression so that students can access and demonstrate learning through flexible pathways. For curriculum designers, socio-cultural relevance should be integrated into learning materials, classroom tasks, and assessment rather than being treated only as additional cultural content. The findings also suggest that assessment should provide opportunities for students to demonstrate understanding and higher-order thinking through varied forms of action and expression. These implications are particularly relevant to EFL environments in which learner diversity and cultural variation can directly influence how students interpret and participate in English learning.

Several limitations should be considered when interpreting these findings. First, the study was conducted in only two public junior secondary schools in Soppeng Regency, South Sulawesi, and therefore the findings may not be generalizable to EFL settings with different educational, socio-cultural, or institutional characteristics. Second, the study used a quantitative explanatory design, which enabled the examination of structural relationships but provided limited access to the depth of students' lived experiences, classroom interactions, and individual interpretations of culturally responsive learning. Third, the academic achievement component used semester-based school records as pre- and post-intervention evidence, meaning that changes in achievement should be interpreted within the specific instructional and institutional context of the participating schools. These limitations do not invalidate the findings but indicate that the proposed relationships should be interpreted as contextually grounded rather than universally established.

Future research should therefore examine the proposed model across a broader range of schools, regions, learner populations, and socio-cultural settings to determine whether the observed relationships remain stable across contexts. Mixed-methods and longitudinal designs would also be valuable for examining how students experience socio-culturally responsive differentiated instruction over time and how UDL-informed learning pathways develop during classroom interaction. Future studies could further investigate whether the model produces similar effects when implemented with different English language skills, grade levels, and instructional materials. Such research would help clarify the conditions under which socio-cultural responsiveness, differentiation, and UDL are most effective in supporting higher-order learning. Overall, the central contribution of this study is the proposition, supported by the empirical model, that inclusive EFL learning is strengthened when differentiated instruction is made socio-culturally responsive and when flexible learning design is used to translate that responsiveness into accessible opportunities for understanding and higher-order learning.

CONCLUSIONS

This study indicates that socio-culturally responsive differentiated instruction is associated with improved academic achievement in the Indonesian EFL context and that students' motivation and engagement and the relevance and adaptation of learning are positively related to their understanding, learning difficulties, and learning outcomes. The findings further show that UDLO functions as an important learner-level pathway through which these learning experiences are associated with higher-order learning skills and learning satisfaction. Within the theoretical framework of UDL, flexible opportunities for engagement, representation, action, and expression provide a plausible learning-design mechanism for translating differentiated and socio-culturally responsive instruction into more accessible learning experiences. The study therefore contributes to EFL pedagogy by highlighting the potential value of integrating differentiated instruction, socio-cultural responsiveness, and inclusive

learning design. However, the findings are contextually bounded by the involvement of two junior secondary schools and by the quantitative explanatory design, which limits the extent to which students' lived experiences and classroom interactions can be captured. Future research should test the proposed relationships across broader and more diverse educational settings and use mixed-methods or longitudinal approaches to examine implementation processes and the sustainability of learning effects.

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CONFLICT OF INTEREST STATEMENT:

The authors certify that there is no conflict of interest concerning the publication of this manuscript.

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