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THE ACADEMIC PERFORMANCE OF STUDENTS WITH HEARING IMPAIRMENT USING THE S.I.F.T.E.R. TEST IN RELATION TO TEACHERS TRAINED IN DIFFERENTIATED TEACHING AND THOSE WHO ARE NOT

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ABSTRACT: Differentiated teaching (DT) is promoted as a means of addressing learner variability in inclusive classrooms, yet there is limited evidence that focuses specifically on students with hearing impairment (HI) in mainstream settings. This study compares teacher-rated educational functioning, screened with the Screening Instrument for Targeting Educational Risk (SIFTER), between students taught by DT-trained teachers and those taught by teachers without DT training. Two cohorts were examined: 10 students taught by DT-trained teachers and 17 students taught by teachers without DT training. Teachers completed the Greek-adapted Primary or Secondary SIFTER, which assess five domains: pre-academics/academics, attention, communication, class participation and school behavior. Across domains and in total scores, the DT-trained cohort outperformed the non-trained cohort. Mean total SIFTER scores were 65.8 for the DT-trained group and 53.4 for the non-trained group. Students taught by DT-trained teachers more frequently achieved scores within the pass range across domains, particularly in class participation and communication, indicating stronger engagement and language-related functioning. By contrast, the non-trained cohort displayed more marginal or failing scores, especially in attention and behavior. These findings suggest that DT training is associated with improved participation, communication, attention and behavior alongside academic performance for students with HI. The results support DT-focused professional development for mainstream teachers working with this population and the routine use of concise screening tools such as SIFTER to monitor educational risk.

KEYWORDS: Differentiated teaching; hearing impairment; SIFTER; inclusive education; teacher’s training

Introduction

Contemporary inclusive education emphasizes pedagogies that acknowledge predictable learner variability and proactively design for it. During the past decade, research has clarified that differentiated teaching (DT) is both promising and conceptually multifaceted, with heterogeneous operationalizations across systems and subjects (Eikeland & Ohna, 2022; Smale-Jacobse et al., 2019). The relationship between DT and Universal Design for Learning (UDL) has been examined systematically, with evidence indicating complementary roles: UDL supports barrier-reducing design at the outset while DT guides responsive

adjustments during instruction (Griful-Freixenet et al., 2020). At the level of practice, post-2015 empirical studies show that teachers value DT but its enactment depends on confidence, time and organizational support; structured professional development tends to strengthen classroom use (Pozas et al., 2020; Smets & Struyven, 2020; van Geel et al., 2019). Mainstream hearing-impaired students require normal educational input. The Screening Instrument For Targeting Educational Risk (SIFTER) is a brief, classroom functioning measure administered by the teacher and has seen adaptation and validation in different contexts; recent works confirm good psychometric properties for its translated version (Khodaei et al., 2021). This study made a comparison of SIFTER scores from classes run by teachers with and without hearing-impaired training using only the dataset and procedure description provided by the authors.

Theoretical background

Differentiated teaching (DT)has evolved over the past decade from a collection of classroom tactics into a broad, design-oriented stance for teaching in heterogeneous classrooms. Contemporary syntheses converge on two claims. First, DT is conceptually multifaceted: it is described either as differentiation of students (e.g., grouping, tracking) or, more defensibly for inclusive aims, as differentiation of teaching, namely, proactive adaptations of content, process, product and learning environment to meet diverse learner needs while maintaining shared curricular goals (Eikeland & Ohna, 2022). Second, despite widespread endorsement in policy and teacher education, implementation varies markedly across systems and subjects, with practice shaped by teachers' beliefs, professional learning opportunities and organizational conditions (Pozas et al., 2020; Smets & Struyven, 2020; van Geel et al., 2019).

A central thread in the recent literature is the clarification of DT's conceptual boundaries and its relationship to adjacent frameworks. Systematic reviews emphasizes that DT is not synonymous with ability grouping or individualized programs detached from common outcomes; rather, it involves sustained attention to learner readiness, interest and profile within a common instructional trajectory (Smale-Jacobse et al., 2019). In parallel, work at the intersection of Universal Design for Learning (UDL) and DT proposes a complementary division of labor: UDL offers principled, ex-ante design options that reduce barriers through multiple means of engagement, representation, and action/expression, whereas DT guides ongoing, in-situ adjustments in response to formative evidence (Griful-Freixenet et al., 2020). This alignment matters in inclusive settings because it preserves high expectations while legitimizing varied pathways, thereby reconciling equity and excellence in day-to-day teaching.The empirical corpus from 2015 presents three-fold insights. The first relates to the influence on student outcomes. One systematic review at the level of secondary education reported small-to-moderate positive relationships regarding within-class differentiation with academic achievement, alongside high variance in study designs and instruments used for measurement (Smale-Jacobse et al., 2019). A

meta-analysis at the primary education level found small-to-moderate increases for language and mathematics when integrated into broad, coherent programs of differentiation infused with systems of technology-enhanced support. On the contrary, homogeneous grouping based on ability alone elicited minimal or negative effects for lower achievers-hence supporting DT as a set of principled variations rather than single structural arrangements. This again emphasizes that the impact of DT rests on the coherence of design, teacher expertise, and quality of formative information.

The second insight concerns teachers' enactment of DT. Large-scale and design-based studies indicate that teachers endorse DT in principle but struggle with its orchestration under real-world constraints such as limited time, curricular pacing and assessment pressures (Pozas et al., 2020; van Geel et al., 2019). Professional development tailored to DT, particularly collaborative, iterative models situated in teachers' own subject areas, has been shown to improve the sophistication and consistency of practice, although progress is gradual and uneven (Smets & Struyven, 2020). Psychometric work has advanced tools such as the DT-Quest instrument to gauge teachers' perceptions and readiness to differentiate, enabling research and schools to track capacity building over time (Coubergs et al., 2017). Collectively, this literature recasts DT competence as a developmental trajectory that benefits from sustained, context-embedded support rather than one-off workshops.

The third insight concerns the mechanisms through which DTis thought to work. Reviews point to three interlocking levers. First, diagnostic and formative assessment allows teachers to estimate proximity to learning goals and to calibrate task demand, scaffolding and pacing accordingly (Smale-Jacobse et al., 2019; van Geel et al., 2019). Second, flexible grouping, temporary, purpose-specific arrangements that change as evidence changes, facilitates targeted instruction without fixed labels and can be combined with peer-mediated approaches to amplify opportunities to respond (Deunk et al., 2018; van Geel et al., 2019). Third, task design that preserves cognitive demand is crucial; DT aims not to simplify content but to create multiple access points to the same disciplinary ideas, thereby protecting rigor and fostering transfer (Griful-Freixenet et al., 2020; Smale-Jacobse et al., 2019). Without actionable evidence, grouping easily falls back into the static tracking method. Without attention to task quality, differentiation sometimes becomes mere busywork. Without flexible organization, evidence-based changes are nothing but a dream.

Comparative research in different countries has revealed the fact that teacher agency and reflective practice become major contextualizing forces for differentiated instruction into a local curriculum and resource ecology (Hasanah et al., 2022). Attitudinal studies found that dispositions toward inclusion and differentiation **are validly measurable and correlate with reported practice; therefore, they have been emphasized as a key focus for capacity building—not knowledge, but beliefs** (Letzel et al., 2020).Technological ecosystems also matter. Adaptive systems and data dashboards can support decisions and set free

time for small-group teaching when coherently integrated into pedagogy (Deunk et al., 2018).In short, DT is a situated practice that thrives where schools align curriculum, assessment and professional learning around responsive teaching.

For students with hearing impairment (HI) in mainstream classrooms, the theoretical rationale for DT is particularly compelling. Listening effort in noise, fluctuating access to incidental language, and variability in language trajectories can combine to depress attention, participation and academic performance unless instruction is designed and enacted with these constraints in view. The literature on inclusive pedagogy therefore argues for barrier-aware design (in line with UDL principles) coupled with real-time adaptation based on observed participation and comprehension, precisely the space where DT operates (Griful-Freixenet et al., 2020). At the same time, routine monitoring is needed to ensure that adaptations translate into improved classroom functioning. The Screening Instrument for Targeting Educational Risk (SIFTER) provides a concise, teacher-completed index with evidence of validity and reliability in translated forms, supporting its use as part of ongoing educational monitoring for students with HI (Khodaei et al., 2021). In theoretical terms, such monitoring supplies the formative evidence that enables DT's feedback loop: it helps teachers detect mismatches between task demands and access supports in domains central to learning, attention, communication, participation and academic skills.

Taken together, post-2015 scholarship positions DT as an inclusive, evidence-seeking pedagogy whose effectiveness depends on design coherence, teacher expertise and supportive organizational conditions. It dovetails with UDL by combining principled anticipation of barriers with responsive adjustments as learning unfolds. In the context of HI, where access to language and classroom discourse is contingent on acoustic environments, technology and interactional norms, DT offers a practical route to maintain rigor while tailoring pathways. The expectation, grounded in the reviewed literature, is not that DT eliminates variability in outcomes but that it systematically organizes that variability so that more students can meet common goals, and that teachers possess the diagnostic and design repertoires to act on evidence. Consequently, studies that examine associations between teachers' DT preparation and classroom indicators, especially those capturing attention, communication and participation, are theoretically well-motivated and address a salient gap in the inclusive education knowledge base.

Methodology

This study employed a comparative, cross-sectional design to examine whether teacher preparation in differentiated teaching (DT)is associated with differences in teacher-rated educational functioning among students with hearing impairment (HI) enrolled in mainstream classes. The analytic focus was restricted to the dataset and procedures provided by the author. The study contrasted two naturally occurring cohorts defined by teachers' prior participation in DT training. Group A consisted of students taught by DT-trained teachers (n = 10), and Group

B consisted of students taught by teachers without DT training (n = 17). No personally identifiable information was collected or retained; all data were anonymized at source.

The screening instrument was the Screening Instrument for Targeting Educational Risk (SIFTER) in its Greek-adapted Primary and Secondary versions, as described by the author. Each version contains 15 items organized into five domains that are central to classroom functioning: pre-academics/academics, attention, communication, class participation, and behavior. Items are rated on a five-point Likert scale anchored from “significantly below peers” (1) to “equal to/better than peers” (5). Domain scores are computed as the sum of their three items (range 3-15), and the total score is the sum across domains (range 15-75), with higher values indicating better educational functioning. For interpretive context, SIFTER guidance specifies categorical bands, meaning pass, marginal, fail, based on domain totals. In the Secondary SIFTER, bands of 10–15 indicate pass, 8-9 marginal, and 3-7 fail across all domains; in the Primary SIFTER, these bands apply explicitly to the pre-academics domain. Given the mixed use of Primary and Secondary forms in the present dataset, domain and total scores were treated primarily as continuous variables to support like-for-like comparison across groups, with categorical bands used descriptively to illustrate patterns of functioning. SIFTER’s brevity and teacher-report format allow administration in approximately ten minutes, making it suitable for routine classroom screening. Evidence from translated versions supports the instrument’s reliability and validity in non-English contexts, which is pertinent to the use of Greek adaptations in the present study (Khodaei et al., 2021).

The study proceeded in four sequential stages, as provided by the author. First, the original SIFTER items were translated into Greek to produce Primary and Secondary forms that preserved item intent and domain structure. Second, content validity was assessed to ensure the linguistic accuracy and contextual appropriateness of the Greek versions relative to the originals. Third, the Greek forms were administered to the teachers of participating students; teachers in Group A had completed institutional training in DT prior to data collection, whereas teachers in Group B had not. Fourth, reliability assessment was undertaken following administration. Because the present manuscript focuses on comparative outcomes at the group level, the reliability results are not reproduced here; the study’s design nonetheless incorporated this quality-assurance step to support the integrity of inferences drawn from the Greek forms.

Data management followed a simple, pre-specified plan. Teacher ratings were entered into a secure spreadsheet with one record per student. All items were complete in the dataset supplied to the author, so no imputation procedures were required. For each student, domain and total scores were computed according to the SIFTER scoring rules. Group membership was coded dichotomously based on the teacher’s DT-training status.

The statistical analysis plan was defined a priori to reflect the sample size and the non-equivalence of group variances typical of naturally occurring cohorts.

Descriptive statistics (means and standard deviations) were calculated for each domain and the total score separately by group. Because the five domains represent distinct facets of classroom functioning rather than interchangeable replications, results were interpreted with attention to their substantive meaning rather than relying solely on multiplicity adjustments. Complementary descriptive references to SIFTER pass/marginal/fail bands were used to contextualize continuous score differences without reclassifying cases across forms.

Ethical and procedural safeguards were integral to the design, since the study relied on teacher-reported screenings that did not involve interventions or the collection of sensitive personal data. Participation entailed routine educational rating by the classroom teacher, and all data supplied to the author were anonymized prior to analysis. The author affirms adherence to responsible research and publication practices, including transparency in methods and data handling.

Results

Table 1 presents the full set of SIFTER scores by student, grouped by whether the teacher had completed training in differentiated teaching (DT)or not. The analytic sample comprised 27 students with hearing impairment enrolled in mainstream classes: 10 students taught by DT-trained teachers and 17 students taught by teachers without DT training. Each student received ratings in five domains, Pre-academics/Academics, Attention, Communication, Class Participation and Behavior, each on a 3-15 scale, and a total score ranging from 15 to 75, with higher values indicating better educational functioning.

Table 1. Individual SIFTER scores by domain and group

Student Group	Student	Pre-Academics	Attention	Communication	Participation	Behavior	Total Score
DT-Trained Teachers	S1	14	13	14	15	13	69
	S2	13	12	13	14	12	64
	S3	12	13	12	13	13	63
	S4	13	14	14	15	14	70
	S5	11	12	12	13	11	59
	S6	15	13	14	15	15	72
	S7	13	13	12	14	13	65
	S8	12	11	13	13	12	61
	S9	14	13	14	15	14	70
	S10	13	12	13	14	13	65
	Group mean	**13.00**	**12.60**	**13.10**	**14.10**	**13.00**	**65.80**

Non-DT Teachers	S11	11	10	11	12	10	54
	S12	10	11	9	10	9	49
	S13	12	11	11	12	10	56
	S14	9	10	8	11	9	47
	S15	11	12	11	12	11	57
	S16	13	12	12	13	12	62
	S17	10	11	10	10	10	51
	S18	12	11	10	12	11	56
	S19	9	10	9	11	9	48
	S20	13	12	12	13	12	62
	S21	10	10	9	11	10	50
	S22	11	11	10	11	11	54
	S23	12	10	11	12	10	55
	S24	10	9	9	10	8	46
	S25	13	13	12	14	13	65
	S26	11	10	10	11	10	52
	S27	9	9	8	10	9	45
	Group mean	**10.94**	**10.71**	**10.12**	**11.47**	**10.24**	**53.47**

At the level of overall functioning, students taught by DT-trained teachers achieved higher total SIFTER scores than those taught by non-trained teachers. The mean total score in the DT-trained group was 65.80 (SD = 4.29), compared to 53.47 (SD = 5.84) in the non-trained group, a difference of 12.33 points. The distributions underscore this gap. In the DT-trained group, nine of ten students scored at or above 61, with three students at or above 70. By contrast, in the non-trained group, six students scored 50 or below, five fell between 51 and 55, three between 56 and 60, and only three reached 61–65; no student in the non-trained group exceeded 65. The highest individual total in the DT-trained cohort was 72 (S6), while the lowest was 59 (S5). In the non-trained cohort, the highest total was 65 (S25) and the lowest was 45 (S27). These patterns indicate a right-shifted and more compressed distribution of totals for students taught by DT-trained teachers relative to the broader and left-shifted distribution in the non-trained group.

Domain-level comparisons mirror the total-score pattern.

In Pre-academics/Academics, the DT-trained group averaged 13.00 (SD = 1.15), whereas the non-trained group averaged 10.94 (SD = 1.39). Scores in the DT-trained group ranged from 11 to 15, with seven students at 13 or higher, suggesting that classroom access to core content and tasks was robust across the group. In the non-trained group, Pre-academics/Academics ranged from 9 to 13; three students were rated in the marginal band (scores of 8–9), and only five reached 12 or higher. The 2.06-point difference in means signals more consistent mastery of academic pre-requisites among students whose teachers had DT training.

Attention displayed a similar advantage for the DT-trained group, with a mean of 12.60 (SD = 0.84) compared to 10.71 (SD = 1.10) in the non-trained

group. In the DT-trained cohort, all students were rated in the pass range (10–15) for attention, and the interquartile spread was narrow, consistent with stable classroom engagement and on-task behavior. In the non-trained cohort, two students fell into the marginal band for attention and few exceeded a score of 12. The nearly two-point mean difference in this domain is consequential because sustained attention mediates access to instruction and learning opportunities across subjects.

The Communication domain showed one of the largest separations between groups. Students with DT-trained teachers averaged 13.10 (SD = 0.88), while their peers in the non-trained group averaged 10.12 (SD = 1.32), a Difference approaching three points. Within the DT-trained cohort, eight of ten students were rated at 13 or 14, indicating consistently strong expressive–receptive classroom communication relative to peers. In the non-trained cohort, six students were rated in the marginal band for communication and only two reached a score of 12. Given the centrality of classroom discourse for students with hearing impairment, this domain-level pattern is especially noteworthy.

Class Participation exhibited the tightest clustering and highest central tendency in the DT-trained cohort. The mean was 14.10 (SD = 0.88) with all students scoring 13–15, including four at the maximum of 15. This suggests uniformly strong engagement and contribution during lessons. In the non-trained cohort, the mean class participation score was 11.47 (SD = 1.18), with all students technically within the pass band (10–15) but concentrated at the lower end (10–12). Although the non-trained group did not show marginal ratings in this domain, the almost three-point separation in means indicates qualitative differences in the intensity and consistency of participation.

Behavior followed the same profile. Students taught by DT-trained teachers averaged 13.00 (SD = 1.15) with none rated marginal or failing. The non-trained group averaged 10.24 (SD = 1.30); five students were rated marginal for behavior (scores of 8–9) and only three reached 12 or higher. These findings are consistent with the view that DT-informed classroom management and task design, by aligning demands with readiness and providing clear pathways to success, can support positive behavioral regulation.

Inferential tests applied to continuous scores confirmed that differences were statistically significant and large in magnitude across the board. For the total score, Welch's t test indicated a significant group difference, $t(23.57) = 6.29$, $p < .001$, with a Hedges' g of 2.24. The 95% confidence interval (CI) for the mean difference in totals ranged from 8.28 to 16.38, which excludes trivial effects and aligns with the descriptive separation between the two distributions. Domain-specific contrasts were likewise significant: Pre-academics/Academics, $t(21.93) = 4.14$, $p < .001$, $g = 1.52$, 95% CI of the mean difference [1.03, 3.09]; Attention, $t(23.10) = 5.01$, $p < .001$, $g = 1.80$, 95% CI [1.11, 2.68]; Communication, $t(24.49) = 7.05$, $p < .001$, $g = 2.46$, 95% CI [2.11, 3.85]; Class Participation, $t(23.44) = 6.61$, $p < .001$, $g = 2.36$, 95% CI [1.81, 3.45]; Behavior, $t(20.90) = 5.73$, $p < .001$, $g = 2.14$, 95% CI [1.76, 3.77]. These inferential results

corroborate the descriptive evidence that the DT-trained group outperformed the non-trained group in each facet of classroom functioning assessed by SIFTER.

Within-group variability gives more comprehension of consistency of results. The DT trained group had domain scores that were not widely spread, with standard deviations running from 0.84 to 1.15, and totals likewise (SD = 4.29). This proves that the better performance was not because of a few high-achieving kids in the group but is a uniformly enhanced profile across the cohort. The non-trained cohort has its domain scores in a wider range (SDs between 1.10 and 1.32) with an even higher overall score SD at 5.84. This denotes an unstable classroom with a plethora of lower scores; individual profiles bear out this observation, too. The highest non-trained group's student score (total 65) comes very close to the mean for the DT-trained group, but most of his peers are by no less than 10 to 15 points below that level. Conversely, the DT trained group attained a sum, which is above by over five points compared to the mean of the untrained group. The least total was S5 at 59.

The categorical perspective supplied by SIFTER's pass/marginal bands, used here strictly as descriptive anchors, complements the continuous contrasts. In the DT-trained cohort, all students scored in the pass range (10-15) in every domain. In the non-trained cohort, marginal ratings were most common in Communication (six students), followed by Behavior (five students), Pre-academics/Academics (three students) and Attention (two students). No failing ratings occurred in either cohort. While categorical thresholds can obscure meaningful gradations within the pass band, the accumulation of marginal ratings in the non-trained group and particularly in communication-related functioning, aligns with the continuous score differences and with the observed concentration of totals in the mid-50s.

Taken together, the results reveal a coherent pattern. Across all domains and in the aggregate, students with hearing impairment who were taught by DT-trained teachers were rated as functioning at higher levels than peers taught by non-trained teachers. The advantage was most pronounced in Communication and Class Participation, domains that are especially sensitive to the accessibility of discourse and the structuring of interaction in mainstream classrooms. Differences in Attention and Behavior, though somewhat smaller, were still large in magnitude and suggest improved engagement and regulation. Academic readiness and performance, as reflected in the Pre-academics/Academics domain, were likewise stronger in the DT-trained cohort. The distributional evidence points not only to higher central tendency but also to greater consistency of positive outcomes when teachers had DT preparation. These findings, derived from a concise, teacher-completed screener with domain-specific sensitivity, provide convergent evidence that teacher training in differentiated teaching is associated with more favorable classroom functioning profiles for students with hearing impairment in mainstream settings.

Discussion

This study set out to examine whether teacher preparation in differentiated teaching (DT)is associated with differences in classroom functioning among students with hearing impairment (HI), as indexed by SIFTER domain and total scores. Across all five domains, pre-academics/academics, attention, communication, class participation, and behavior, the cohort taught by DT-trained teachers achieved higher ratings than peers whose teachers lacked DT training, with the largest separations observed in communication and class participation. The distributional pattern is notable: the DT-trained group displayed both higher central tendency and tighter dispersion, suggesting a cohort-wide elevation rather than a gain concentrated in a few high-scorers. In contrast, the non-trained group exhibited broader variability and a left-shifted distribution with multiple students clustering in the marginal range for communication and behavior. These findings, while derived from teacher report, are coherent with post-2015 evidence that DTwhen enacted as responsive adaptation of content, process, product, and environmentcan yield improvements in engagement and achievement under real classroom conditions (Smale-Jacobset al., 2019; van Geel et al., 2019).

Two theoretically grounded mechanisms likely underpin the pattern observed here. First, DT emphasizes continuous formative assessment to estimate learners' proximity to goals and to calibrate scaffolding and task demand accordingly. Studies since 2015 characterize actionable formative evidence as the engine of DT: it informs temporary, purpose-specific grouping; it signals when to raise or lower cognitive load; and it helps teachers align feedback with learners' current strategies (Smale-Jacobse et al., 2019; van Geel et al., 2019). For students with HI, whose access to classroom DTscourse can fluctuate with acoustics, seating, and talk speed—frequent checks for understanding and rapid adjustment of supports would be expected to stabilize attention and increase successful participation. The higher attention and behavior ratings in the DT-trained cohort are consistent with this account, suggesting that instruction felt appropriately demanding and predictably structured to students, reducing off-task behavior while maintaining pace.

Second, DT's commitment to maintaining the cognitive integrity of tasks while offering multiple access points may directly shape communication and participation. Empirical syntheses indicate that DT is most effective when teachers preserve disciplinary ideas and vary representation, modality, and response options, rather than simplifying content (Smale-Jacobse et al., 2019; Deunk et al., 2018). For learners with HI, this could translate into routines such as deliberate preview/review of key vocabulary, visual anchoring of discourse, and orchestrated opportunities to respond in small groups, practices that collectively raise opportunities for expressive and receptive language during lessons. The present data, with the largest between-group gaps in communication and class participation, align with this mechanism. They also converge with evidence that teachers' enactment of DT strengthens when they receive structured professional development that is iterative and subject-specific (Smets & Struyven, 2020), a

plausible explanation for the more homogeneous high performance observed in the trained-teacher cohort.

The results also speak to the professional and organizational conditions under which DT flourishes. Large-scale studies in the past decade have shown that teachers endorse DT but report constraints related to time, curricular pacing, and assessment regimes; where schools invest in sustained capacity building, the sophistication and consistency of DT increase (Pozas et al., 2020; Smets & Struyven, 2020). The tighter clustering of outcomes in the DT-trained cohort suggests not only improved average practice,but greater within-school coherence: students appear to have experienced reliably accessible lessons across topics and days, rather than sporadic differentiation. This interpretation resonates with the view that DT competence develops along a trajectory and can be measured and supported using validated instruments that capture teachers' beliefs and perceived efficacy (Coubergs et al., 2017; Letzel et al., 2020). In systems terms, DT training thus functions as both a knowledge intervention (strategies, routines, task design) and a belief intervention (confidence that diverse learners can meet common goals with the right supports), each necessary for durable change.

An important implication concerns classroom monitoring. Because DT depends on timely evidence, schools need brief, domain-sensitive tools that can be administered without disrupting instruction. The SIFTER, with its five domains central to classroom access, performed this role efficiently in the present project and has documented reliability and validity in translated versions (Khodaei et al., 2021). The tool's categorical bands (pass, marginal, fail) are coarse, but when combined with continuous domain scores they can help teachers and teams identify where to adjust practice. Here, the accumulation of marginal ratings for communication and behavior in the non-trained cohort would signal priorities for instructional redesign and environmental supports. Furthermore, repeated SIFTER administrations over a term could supply the formative trend data that DT requires, allowing schools to evaluate the effects of professional learning and of specific classroom routines.

The findings should be read alongside the broader post-2015 literature that clarifies DT's conceptual contours and its relationship to adjacent frameworks. Reviews emphasize that DT is conceptually multifaceted and sometimes conflated with static ability grouping; the more defensible understanding for inclusive aims is differentiation of teaching, not of students, within shared curricular goals (Eikeland & Ohna, 2022; Smale-Jacobse et al., 2019). Work at the intersection of Universal Design for Learning (UDL) and DT proposes a productive division of labor: UDL provides ex-ante design options to reduce barriers, while DT orchestrates ex-post adaptations as evidence accrues (Griful-Freixenet et al., 2020; Al-Azawei et al., 2016). The present pattern, meaning broad gains across domains with particularly strong effects in communicative participation, fits this synthesis: barrier-aware design likely made core content and discourse more reachable, and responsive adjustments during lessons sustained engagement for students with HI.

At the same time, caution is warranted. The cohorts were naturally occurring rather than randomly assigned, and audiological variables (degree/type of loss, device use, listening environment) were unavailable. Teacher expectancy effects cannot be excluded when outcomes are teacher-rated, although the magnitude and consistency of the differences across five domains make a purely expectancy-based account less likely. The mixed use of Primary and Secondary SIFTER forms required treating domain scores as continuous rather than comparing categorical risk designations across forms. Future designs should incorporate baseline covariates, independent achievement measures, and blinded raters where feasible, and they should follow students longitudinally to examine whether gains persist as academic demands increase.

Notwithstanding these caveats, the educational message is clear. In mainstream classrooms that include students with HI, DT training for teachers is associated with more favorable profiles of attention, communication, participation, behavior, and academic readiness/performance. Schools seeking to systematize these gains should consider multi-layered supports: coherent professional development focused on formative assessment, task design that preserves cognitive demand, and flexible grouping; classroom routines that stabilize acoustic and visual access; and routine use of brief screeners such as SIFTER to generate actionable evidence. Such a package aligns with the recent literature's portrayal of DT as an inclusive, evidence-seeking pedagogy that translates design principles into day-to-day decisions (Deunk et al., 2018; Griful-Freixenet et al., 2020; van Geel et al., 2019). The present findings add to that literature by providing domain-specific, classroom-proximal indicators that favor DT-trained teachers and by highlighting communication and participation as the domains most sensitive to DT-informed practice for learners with HI. Ultimately, the value of DT in this context is not only that it raises average outcomes, but also that it appears to make those outcomes more reliable across students, a defining feature of equitable instruction.

Limitations

Regarding the existing limitations, several of them qualify the inferences drawn from these data. First, the sample was small (N = 27) and non-random, with unequal group sizes, which reduces statistical power, inflates uncertainty around effect estimates, and limits generalizability. Another limitation that has to be mentioned is that students were nested within teachers, yet analyses did not model clustering or adjust for teacher- or school-level covariates; thus, observed differences may partly reflect unmeasured contextual factors. Apart from that, outcomes were teacher-reported SIFTER ratings rather than standardized achievement measures or blinded observations, introducing potential expectancy or rater biases. Something also notable is the mixed use of Primary and Secondary SIFTER forms necessitated treating domain scores as continuous and constrained categorical risk comparisons and reliability coefficients for the Greek adaptations were not reported here. In addition to the aforementioned, audiological, linguistic

and demographic variables (degree/type of hearing loss, device use, language background, SES, comorbidities) and classroom acoustic characteristics were unavailable, precluding adjustment for plausible confounders. Last but not least, the study compared existing cohorts cross-sectionally; without pre-training baselines, fidelity checks of DT implementation, or longitudinal follow-up, causal attribution and durability of effects cannot be established. Finally, the setting comprised mainstream Greek classrooms; transferability to other curricula, languages and teacher-education systems is uncertain. Future research should employ larger, multi-site, longitudinal designs with multilevel modelling and independent outcome measures.

Conclusion

This study examined SIFTER-based classroom functioning among mainstreamed students with hearing impairment (HI) taught by teachers with and without prior preparation in differentiated instruction (DT).Across all five SIFTER domains, pre-academics/academics, attention, communication, class participation, and behavior, students taught by DT-trained teachers demonstrated consistently higher ratings, with the largest advantages in communication and participation and a separation in total scores (65.8 vs 53.4). The distributional pattern further indicated not only a higher central tendency but also greater within-group consistency in the DT-trained cohort, suggesting that teacher preparation was associated with more uniformly accessible instruction.

Taken together, the results support three conclusions. First, teacher expertise in DT appears meaningfully associated with the quality of students' classroom functioning in mainstream settings, notably in domains sensitive to discourse access and task design for HI. Second, SIFTER proved a feasible, domain-sensitive instrument for monitoring educational risk and detecting differences aligned with instructional practice. Third, DT training is a practical lever for classroom improvement, with potential for scaling through targeted professional learning and coherent routines.

These conclusions are tempered by design constraints: small, non-random samples; reliance on teacher ratings; absence of audiological and contextual covariates; and cross-sectional comparison. Accordingly, the findings should be interpreted as strong associative evidence rather than as definitive proof of causality. Future work should incorporate baseline measures, fidelity checks of DT implementation, independent outcomes, multilevel modelling, and longitudinal follow-up to test durability and mechanisms.

Even though the described limitations cause some generalization issues, it is clear that by the current study actionable guidance is provided since schools serving students with HI can reasonably invest in DT-focused professional development, pair it with routine SIFTER screening, and organize instruction around responsive adjustments to content, process, product, and learning environment. Hence, with this strategy, not only higher average outcomes can be promised, but also more reliable participation and communication across students,

advancing equity and access within mainstream classrooms and sustained learning outcomes.

Declarations

Ethical compliance: The study used anonymized, teacher-reported screening data; no personal identifiers were collected. Conflict of interest: None declared. Funding: None. Author contribution: Sole author; design, analysis and writing. Data availability: Aggregated tables are available on request. Responsible use of AI: An AI tool (GPT-5) was used in few occasions for language editing and formatting; the author is solely responsible for the intellectual content.

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