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HOW TO DIFFERENTIATE INSTRUCTION FOR DEEPER LEARNING USING COGNITIVE TASK ANALYSIS

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ABSTRACT

This study aims to explore the requisite skills for Differentiated instruction (DI) implementation and to identify best practices across school levels. Differentiated instruction (DI) for deeper learning is essential for responding to students' diverse needs. Using 112 self-reported essays, interviews, videotaped practices, and experts meeting, this study employed Cognitive Task Analysis (CTA) to capture the knowledge experts use to carry out differentiation. The results revealed a 4:9:2 skill formula across the preparation, implementation, and evaluation phases. Notable differences across school levels emerged. In the preparation phase, primary and secondary school teachers prepared varied materials (34%) and grouping strategies (44%), whereas only a few kindergarten teachers (3%) employed these strategies. In the implementation phase, most primary (68%) and secondary (79%) teachers tailored materials to students' learning styles by offering content in multiple formats; however, only a small proportion of kindergarten teachers (26%) differentiated content, focusing instead on process differentiation and additional learning support. Despite the differing contexts, the study also identified cross-level similarities. Future research should investigate the long-term impacts of DI on student achievement and engagement, as well as examine DI practices in diverse educational settings.

Keywords: differentiation; cognitive task analysis; deeper learning; learning preferences; expert teachers

INTRODUCTION

Differentiated instruction (DI) for deeper learning is essential for teachers and schools seeking to address student diversity in contemporary educational practice (Parsons et al., 2018). DI is rooted in inclusive education, which aims to provide equitable learning access by tailoring instructional strategies, resources, and assessments to student needs (Bayram & Öztürk, 2021; Kapcia, 2024; Keppens et al., 2021). Students differ widely in learning preferences, readiness, and interests (Dijkstra et al., 2016; Goddard et al., 2015; Magableh & Abdullah, 2020; Tomlinson et al., 2003). As Tomlinson (2015) notes, teachers no longer have the option to ignore student diversity; the only question is how they will respond.

Multiple theories guide how teachers can address such diversity. Moore (2016) emphasizes differentiation in content, process, product, and learning environment. Content differentiation includes providing reading materials at varying difficulty levels or in different formats (e.g., articles, videos, podcasts). Process differentiation occurs when teachers design tasks at different levels of complexity based on student readiness. Product differentiation allows students to demonstrate learning through different formats, such as posters, slide presentations, videos, storybooks, or models.

Effective DI implementation requires teachers to consider differences across key areas: content aligned with students' prior knowledge, processes through which students engage with material, products that demonstrate learning, and the additional support students need. By adjusting these elements, teachers can create more inclusive and effective learning experiences.

Tomlinson et al. (2003) further emphasize varying content, process, and products according to students learning profiles, readiness, and interests, measured through diagnostic assessments. She also highlights the value of flexible grouping techniques to personalized learning.

Despite its advantages, DI poses significant challenges. A primary global challenge is the complexity of addressing varied learning profiles within a single classroom (Gaitas & Alves Martins, 2017; Suprayogi et al., 2017; van Geel et al., 2019). De Jager (2017) found that teachers cannot always provide assistance when students need it or allow them to work according to their preferences. Teachers must continuously observe and assess readiness, interests, and learning styles, and design instruction accordingly (Tomlinson, 2015). Nusser & Gehrer (2020) argue that teachers often lack the knowledge and skills needed to identify learners' barriers and adapt the curriculum. Teachers also feel overwhelmed by the wide variety of DI strategies, such as managing level-based or interest-based groups, supporting struggling learners, offering varied tasks, providing enrichment, encouraging slower learners, adjusting time allocations, and allowing independent or group work (Spencer-Waterman, 2014; Watts-Taffe et al., 2012). Additionally, insufficient professional development and resources further hinder consistent DI implementation (De Neve & Devos, 2017; Prast et al., 2018; Smets & Struyven, 2020).

Cognitive task analysis (CTA) has emerged as a method to address such challenges. CTA breaks down and analyzes the cognitive processes involved in performing complex tasks (Clark, 2014). By mapping DI processes, CTA offers insights into the operational strategies required for implementation. Prior studies demonstrate that CTA effectively captures DI complexity in real classroom settings (Meutstege et al., 2023; van Geel et al., 2019). CTA also facilitates peer learning by enabling teachers to share best practices, reflect on challenges, and collaboratively solve problems (Frerejean et al., 2021; van Geel et al., 2019). For example, high school teachers who meet weekly for CTA discussions share strategies such as tiered assignments, flexible grouping, and choice boards, collectively generating solutions to meet diverse learner needs.

The novelty of the present study lies in its application of CTA across multiple school levels—kindergarten, primary, and secondary. Previous research has typically focused on only one level (De Neve & Devos, 2017; Gheyssens et al., 2020; Prast et al., 2018; Smets & Struyven, 2020). This study uses CTA to provide a detailed analysis of DI practices by systematically breaking down the cognitive tasks performed by expert teachers. Its aim is to identify the requisite skills for DI implementation and construct a CTA model that other teachers can readily adopt.

Previous studies have applied CTA in the context of DI. Van Geel et al. (2019) applied CTA to DI with nine expert teachers and ten subject-matter experts in primary school. These participants were invited to collect preliminary knowledge and develop an inventory of real-life tasks and classroom situations requiring differentiation skills. In line with this work, Frerejean et al. (2021) examined how an interdisciplinary design team used CTA to design a professional development program (PDP) for primary school teachers implementing DI. The team employed the Four-Component Instructional Design (4C/ID) model, consisting of (a) designing learning tasks, (b) designing supportive information, (c) designing procedural information, and (d) designing part-task practice. Through this approach, the team successfully develop a PDP to support teachers' DI implementation. More recently, Meutstege et al. (2023) applied CTA through classroom observations and expert meetings. Their findings illuminated the skills required at the secondary school level and provided insights for developing PDPs for teachers.

Previous studies applying CTA to DI practices have contributed significantly to the development of effective teaching strategies. However, most have focused on a single school level (e.g. elementary or secondary), leaving a gap in understanding how CTA supports DI practices across all school levels. Bondie et al. (2019) reported that U.S.-based DI studies conducted between 2001 and 2015 were concentrated primarily in elementary schools (68%), followed by middle schools (25%), with only 7% spanning multiple grade levels—kindergarten, primary, and secondary. The use of CTA to break down the complexity of DI is also intended to make DI practices more adaptable and accessible for teachers.

Accordingly, this study is guided by the following research questions:

1. What skills are requisite for DI implementation?
2. What best practices can be identified from the use of CTA in the design and implementation of DI for deeper learning across various school levels?

RESEARCH METHODS

As noted above, CTA is a technique used to capture descriptions of the knowledge that experts employ to perform complex tasks through interviews and observations. DI has been identified as a highly complex instructional practice in classroom settings (Gaitas & Alves Martins, 2017; Suprayogi et al., 2017; van Geel et al., 2019). In this study, CTA was used to map DI processes and provide detailed insights into the operational steps and strategies required for effective DI implementation.

Table 1 CTA Steps

Five Steps of CTA	Steps in the Current Study
1. Collect preliminary knowledge	• Literature review • Self-reported STAR (Situation/Task, Action, Result) essays on classroom situations to identify required DI skills
2. Identify knowledge representations	Concept mapping of DI skills
3. Apply focused knowledge elicitation methods	• Classroom observation via video recording • Structured interviews • Meetings with experienced teachers
4. Analyze and verify data acquired	Coding to summarize, categorize, and synthesize data
5. Format results for intended application	DI implementation model applied in professional learning communities (PLCs)

Source: Clark et al., 2008

This current study used Clarks' CTA Framework (Clark, 2014; Clark et al., 2008), which consists of five steps: (1) collecting preliminary knowledge, (2) identifying knowledge representations, (3) applying focused knowledge elicitation methods, (4) analyzing and verifying acquired data, (5) formatting results for the intended application. In step 1, a literature review and self-reported essays were collected to obtain preliminary knowledge about real classroom situations. In Step 2, a concept map was developed to represent DI Skills, illustrating systematic steps from the preparation phase through evaluation. In Step 3, classroom observations via video recordings were conducted, followed by structured interviews and expert teacher meetings. In Step 4, data from videos, interviews, and expert meetings were coded, summarized, categorized, and synthesized. In the final step, the results were organized into a model intended for use in teacher professional development related to DI (see Table 1).

This study involved 112 teachers from 35 regencies/cities (Kabupaten/Kota) in Indonesia, each with at least one year of experience implementing DI during the 2023 –2024 academic year. This criterion ensured that all participants had prior exposure to DI. Representation across school levels was included to provide a comprehensive picture of DI implementation in classroom contexts. Demographic data—gender, educational background, and teaching experience—were collected to contextualize the findings and support more nuanced analysis. This diverse sample enabled the study to capture a wide range of insights into CTA-supported DI practices across kindergarten, primary, and secondary levels.

The research procedures began with a self-reported essay designed to capture teachers' experiences implementing DI (Figure 1). Essays followed the STAR format: Situation/Task described the instructional context, Action detailed the differentiation strategies used, and Result described outcomes or impacts. Teachers were not required to portray ideal DI practices but were encouraged to report their typical classroom approaches. This format is grounded in the theory of planned behavior (TPB), which has been widely used to explain and predict behavior across domains (Ajzen, 2020; Hagger et al., 2002).

Observation was another key data collection method. Indirect classroom observation through video recordings was used to minimize observer effects and capture authentic classroom practices. Video data allowed researchers to analyze DI implementation without the immediate presence of observers.

The common way to explore what people know is to ask them (Clark et al., 2008). This current study employed structured interview to find out deeper information about DI implementation in real life situation. In addition to these instruments, expert meetings were conducted to map out the DI skill required at each school level. Experienced teachers representing best practices at each level participated, contributing to a comprehensive understanding of DI skills across contexts.

The data corpus included self-reported essays, interview transcripts, and classroom observation videos. Data were coded into three main categories—preparation, implementation, and evaluation skills— with a fourth category capturing best practices across school levels. Following coding, data were summarized, categorized, and synthesized to construct a draft CTA model for DI skills.

RESEARCH FINDINGS

What Skills Are Requisite for DI Implementation?

To address the first research question, the researchers identified key differentiated instruction (DI) skills through an extensive literature review. This review encompassed previous empirical studies and theoretical frameworks related to DI and the Cognitive Task Analysis (CTA) technique. This step provided a foundational understanding of DI skills and best practices (Table 2).

In addition to the literature review, self-reported essays written by 112 teachers from 35 regencies/cities across school levels were analyzed to capture real-life classroom situations. Teachers were instructed to follow the STAR format—Situation/Task, Action, and Result. This structured approach, rooted in the Theory of Planned Behavior (TPB), was employed to explore teachers' past behaviors related to DI Implementation (Ajzen, 2020; Hagger et al., 2002; Petrea, 2001).

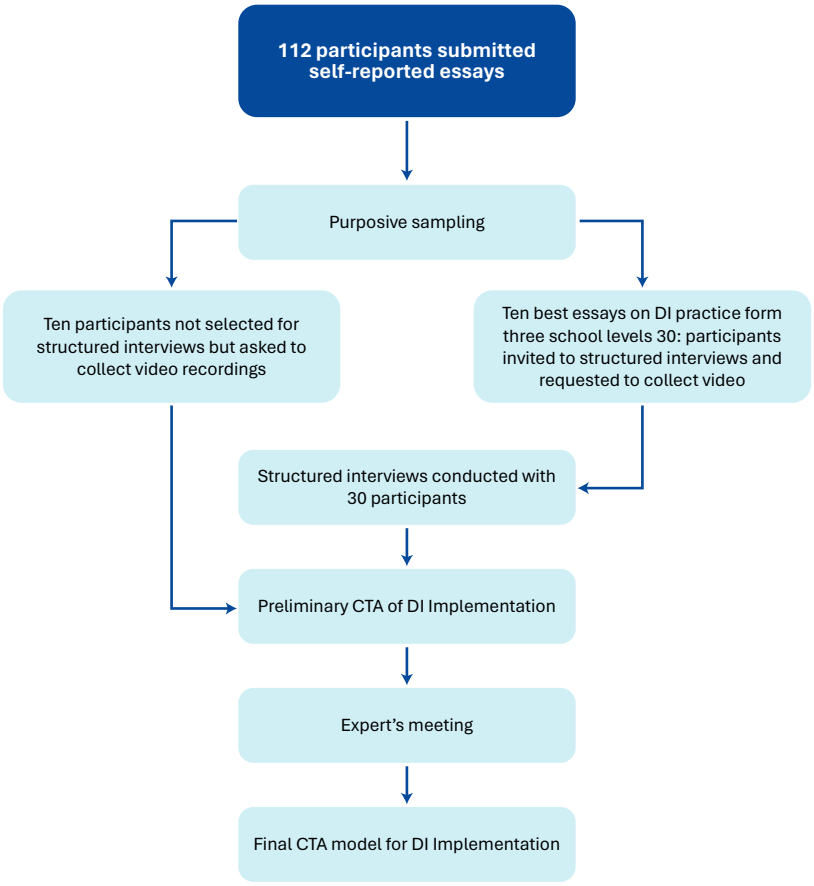

Figure 1 Procedures of Study
Source: Clark et al., 2008

Table 2 DI Skills Identified from the Literature

Phase	DI Skills Identified from the Literature	Key Sources
Preparation	a. Conduct pre-assessment b. Determine learning objectives based on pre-assessment c. Differentiating content	Moore, 2016; Tomlinson, 2003
	d. Differentiate process based on learning profile, readiness, and student interests	Hall et al., 2004; Prast et al., 2018
Implementation	e. Provide differentiated content (e.g., using different materials for struggling learners) f. Adapt activities based on interests	Moore, 2016; Tomlinson, 2003
	g. Organize flexible grouping (heterogeneous, homogeneous, individuals, pairs, small groups)	Hall et al., 2004
	h. Adapt instructional pace to the needs of students i. Provide additional support (e.g., classroom arrangement, IT)	Prast et al., 2018
Evaluation	j. Allow students to demonstrate understanding based on preferences k. Offer varied assessment options	Moore, 2016; Tomlinson, 2003

Source: Moore, 2016; Tomlinson, 2003; Hall et al., 2004; Prast et al., 2018

Examples of Self-Reported Essays:

Resp_P_43:

Situation/Task*: At the beginning of the last semester, I conducted a noncognitive diagnostic assessment for my 31 students. The results showed that 11 students were visual learners, 11 were kinesthetic learners, and 9 were auditory learners.*

Action*: Based on these results, I grouped the students into nine groups according to learning styles. I designed learning activities using available school resources, such as the literacy gazebo, classroom garden, fishpond, and school library.*

Result*: Students presented their learning outcomes in various formats, including worksheets, audio and video recordings, posters (using Canva), and Plant Magic Books, completed individually or in groups.*

Resp_S_81:

Situation/Task*: Teaching the reproductive system in science is challenging because the topic is considered taboo, making students feel uncomfortable. The material is theoretical, while students prefer practical activities.*

Action*: I initiated the GARDU application using a microsite that enabled students to learn and reflect on their learning outcomes. I also designed engaging materials, including educational games, videos, comics, animated PowerPoint presentations, and texts.*

Result*: Students' learning outcomes improved substantially. The highest score was 100, the lowest was 77, and the average was 87. All students submitted their project work on time and received high grades.*

Resp_K_01:

Situation/Task: *Initial observations in Class A showed limited social interaction, as students preferred to socialize with nearby friends.*

Action*: I introduced a hide-and-seek game, followed by differentiated tasks. Auditory learners arranged words using loose parts, visual learners colored pictures, and kinesthetic learners played the game. Students chose roles using hompimpah (a local decision-making game).*

Result*: Students became more socially inclusive and no longer chose friends selectively.*

Using the STAR format enabled a systematic exploration of teachers' DI experiences, documenting instructional rationale, strategies, and outcomes. This approach ensured consistency in the reporting process and yielded valuable insights into the practical application of DI across educational contexts.

What Best Practices Can Be Identified for DI in Deeper Learning Across School Levels?

Teachers' essays provided first-hand insights into DI implementation. From these, an inventory of classroom tasks and challenges was developed. The top 10 essays from each school level (kindergarten, primary, secondary) were selected through purposive sampling based on the effectiveness of DI strategies.

Authors of the selected essays were considered expert teachers and invited to participate in structured interviews and submit videotaped DI lessons. These data enabled deeper examination of challenges, instructional strategies, and observed outcomes, enriching the qualitative data (Figure 3).

Table 3 Alignment of DI skills in the Academic Literature & Best Practices

Phase	Literature Review	Best Practice	DI Skills Summary
Preparation	1. Conducting pre-assessment 2. Determining learning objectives based on pre-assessment	1. Setting goals 2. Determining grouping 3. Determining students' need 4. Selecting materials	1. Conducting pre-assessment 2. Determining learning objectives based on pre- assessment 3. Determining grouping 4. Selecting materials
Implementation	1. Providing difference in content and process 2. Assisting and allowing students to work in groups 3. Adapting the pace of instruction to the needs of the students 4. Providing additional support 5. Planning different questions to measure learners' understanding	1. Introducing goal 2. Activating prior knowledge 3. Providing adapted instruction 4. Providing grouping options 5. Providing varied materials 6. Giving explanation 7. Providing tiered questions 8. Providing additional support 9. Providing class time flexibility	1. Introducing goal 2. Activating prior knowledge 3. Providing adapted instruction 4. Providing grouping options 5. Providing varied materials 6. Giving explanation 7. Providing tiered questions 8. Providing additional support 9. Providing class time flexibility
Evaluation	1. Allowing students to show their understanding according to their own preferences 2. Providing varied assessment options	Providing varied assessment options	1. Allowing students to show their understanding according to their own preferences 2. Providing varied assessment options

Source: Moore, 2016; Tomlinson, 2003; Hall et al., 2004; Prast et al., 2018

In the preparation phase, all teachers conducted pre-assessments and set learning objectives accordingly (Figure 3). Teachers also identified students' learning preferences (visual, auditory, kinesthetic), consistent with findings by Zhang & Wink (2021) and Demirci-Ünal & Öztürk, (2024). Such information was essential for planning instruction that engaged and supported diverse learners.

However, teachers differed in how they responded to pre-assessment results. Approximately 34% prepared differentiated materials tailored to students' needs, while 44% implemented grouping strategies based on readiness or learning preferences (Figure 5). Most primary and secondary teachers adopted both approaches. In contrast, relatively few kindergarten teachers did so, likely due to the developmental emphasis on play-based and experimental learning (Baumgartner et al., 2020; Irvin, 2017).

Overall, the preparation phase involved assessing students' readiness and preferences, followed by differentiated instructional planning. These varied approaches demonstrate teachers' commitment to personalized instruction.

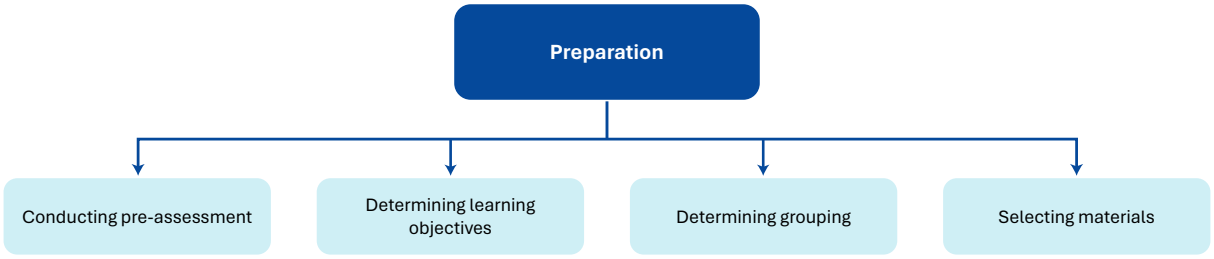

Figure 2 Skills in the Preparation Phase
Source: Moore, 2016; Tomlinson, 2003

Implementation is the phase in which teachers performed DI strategies. All teachers began by introducing learning objectives, and most activated students' prior knowledge (Figure 3). Teachers employed a range of instructional strategies, including learning/interest centers, RAFT, graphic organizer, learning contracts, tic-tac-toe activities, inquiry learning, project-based learning (PjBL), and problem-based learning (PBL). Learning/interest centers were the most frequently used strategy across school levels (60%).

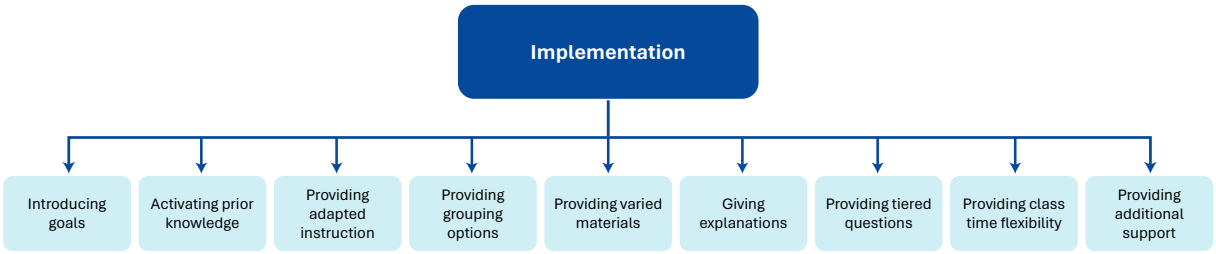

Figure 3 Skills in Implementation Phase
Source: Moore, 2016; Tomlinson, 2003; Prast et al., 2018

Regarding grouping techniques, approximately 65% of teachers employed homogeneous grouping, while 35% used heterogeneous, between-class, within-class, individual, paired, or small-group arrangements (Figure 5).

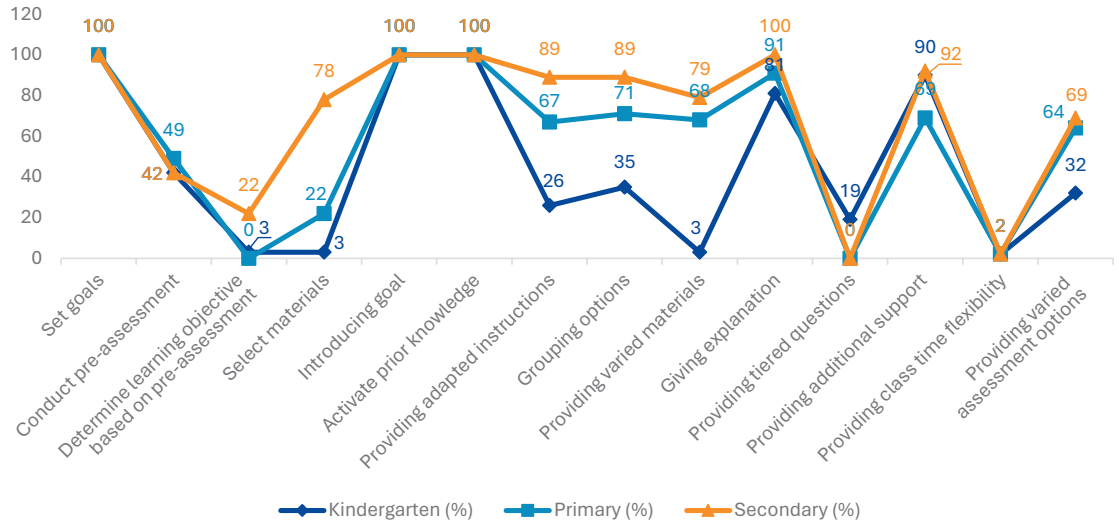

Figure 4 DI Best Practices Across School Level
Source: Research Primary Data

This finding aligns with the approach to providing varied materials. Most of primary (68%) and secondary (79%) teachers tailored their materials to students' learning styles by offering content in multiple formats, such as texts, videos, audios, and figures for subjects like the reproductive system. Only a few them provided tiered materials based on students' readiness or interests. For instance, only a small number of teachers offered different levels of content to cater to both fast and struggling learners. For kindergarten teachers, only few of them employed differentiation in contents/materials, as they focused more in process differentiation and additional learning support. Actually, kindergarten teachers can use strategies like flexible grouping, where students work together based on their skill levels, and varied activities that cater to different learning styles—visual, auditory, and kinesthetic. For example, visual learners might enjoy picture books, while kinesthetic learners thrive in hands-on activities (Tomlinson et al., 2015). Choice boards are also popular, allowing children to pick activities that interest them, which keeps them engaged (Hattie & Donoghue, 2016).

Table 4 DI Skill Practices Reported by 112 Teachers

DI Practices	Kindergarten (%)	Primary (%)	Secondary (%)	Average (%)
Giving explanation	80.65	91.11	100.00	90.59
Providing additional support	90.32	68.89	91.67	83.63
Setting goals	80.65	88.89	83.33	84.29
Providing adapted instruction	41.94	68.89	100.00	73.05
Grouping options	35.48	71.11	88.89	65.16

Source: Research Primary Data

Despite variation in grouping and materials, teachers across levels demonstrated strong instructional skills, particularly in providing clear explanations, whether addressing the whole class, small groups, or individual students (advanced or struggling student). This ability to communicate effectively ensured that students could understand the material regardless of the format it was presented in.

Additionally, all teachers were adept at providing additional support to enhance the learning environment. This included thoughtful classroom arrangements that facilitated learning, and the use of information technology to support and enrich instruction. Kindergarten teachers organized the classroom by integrating tables into different learning centers. They also designed furniture arrangement to ensure that teachers had an unobstructed view of all children at all times. While primary and secondary teachers prefer to use IT to support their instructions. Online text, videos, audios, online quiz, gamification or other IT support were used to address students' learning preferences.

Table 5 Most Frequently Used DI Practices

DI Practices	Kindergarten (%)	Primary (%)	Secondary (%)
Setting goals	100	100	100
Conducting pre-assessment	42	49	42
Determining learning objectives based on pre-assessment	3	0	22
Selecting materials	3	22	78
Introducing goal	100	100	100
Activating prior knowledge	100	100	100
Providing adapted instruction	26	67	89

DI Practices	Kindergarten (%)	Primary (%)	Secondary (%)
Grouping options	35	71	89
Providing varied materials	3	68	79
Giving explanation	81	91	100
Tiered questions	19	0	0
Additional support	90	69	92
Class time flexibility	2	2	2
Varied assessment options	32	64	69

Source: Research Primary Data

Table 5 shows that at least five differentiated instruction (DI) practices are frequently used across school levels. Providing explanations is a widely adopted practice, particularly at the secondary level, where all teachers (100%) reported using it. This practice is also highly prevalent among primary school teachers (91.11%) and kindergarten teachers (80.65%). Providing additional support is another dominant practice. At the kindergarten level, 90.32% of teachers reported offering additional support, followed by secondary school teachers (91.67%). In primary schools, this practice is less frequent, although still substantial (68.89%).

Setting learning objectives is also widely implemented across all educational levels. Among the three groups, primary school teachers reported the highest use of this practice (88.89%), followed by secondary school teachers (84.29%) and kindergarten teachers (80.65%). Providing adapted instruction shows a strong variation by school level. All secondary school teachers (100%) reported implementing adapted instruction, while this practice was used by 68.89% of primary school teachers and 41.94% of kindergarten teachers. Similarly, the use of grouping options is most prevalent at the secondary level (88.89%), followed by the primary level (71.11%). In contrast, only 35.48% of kindergarten teachers reported using grouping strategies.

In summary, all five DI practices are applied across educational levels; however, their frequency varies considerably. Secondary school teachers tend to emphasize explanation and adapted instruction, whereas kindergarten teachers are more strongly oriented toward providing additional support. These findings indicate that the use of differentiated instruction is shaped by the educational context. In early childhood settings, teachers often prioritize play-based learning, which may limit the application of more formal differentiation strategies (Berk & Winsler, 1995). Conversely, primary and secondary schools operate within more structured curricula that require differentiated instruction to address diverse student abilities, thereby encouraging practices such as flexible grouping (Smets & Struyven, 2020).

In the evaluation phase, all teachers allowed students to demonstrate learning through preferred formats, including oral presentations, videos, and infographics (Figure 6). Teachers used formative assessments to reflect on instructional effectiveness and student achievement. This process enabled teachers to identify instructional gaps and adjust future lessons accordingly.

Overall, the findings provide a comprehensive understanding of DI skills across preparation, implementation, and evaluation phases, illustrating how teachers adapt instruction to support deeper learning across school levels.

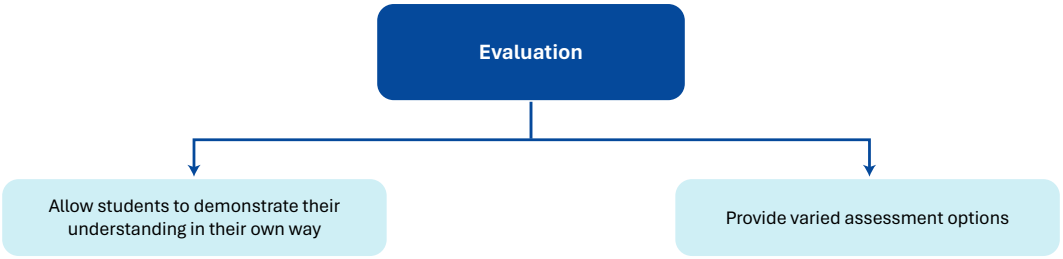

Figure 5 Skills in Evaluation Phase
Source: Moore, 2016; Tomlinson, 2003

DISCUSSION

This study aimed to explore requisite skills for differentiated instruction (DI) implementation and to identify best practices across various school levels. Data analysis revealed that DI requires four skills in the preparation phase, nine skills in the implementation phase, and two skills in the evaluation phase.

The results indicate that teachers require four essential skills during the preparation phase: (1) setting goals, (2) determining grouping strategies, (3) identifying students' needs, and (4) selecting appropriate materials. These findings align with Meutstege et al. (2023), who emphasize the importance of clearly articulated objectives in guiding instructional practices. Hattie (2008) further argues that specific and measurable learning objectives enhance student engagement and achievement by making the learning process more transparent and focused. Similarly, Haque (2022) highlights that clear learning intentions are fundamental to formative assessment, as they enable teachers to adjust instruction based on student feedback and performance. Setting explicit goals allows teachers to clarify intended learning outcomes and to monitor student progress more effectively.

Moreover, determining grouping strategies based on students' needs is vital for fostering an inclusive learning environment. The ability to identify students' learning preferences—visual, auditory, or kinesthetic—enables teachers to tailor instructional approaches more effectively. This finding supports Tomlinson's (2001) assertion that understanding students' strengths and needs is foundational to successful DI implementation.

The essays and interviews revealed that DI skills span all instructional phases, from preparation to evaluation. Van Geel et al. (2019) describe differentiation as a cyclical process consisting of interconnected stages. Teachers prepare lessons based on prior assessment and planning, implement differentiated strategies during instruction, and evaluate learning outcomes to inform subsequent instruction. Consistent with this framework, the present study identified four core skills in the preparation phase: setting goals, determining grouping strategies, identifying students' need, and selecting materials. This finding aligns with Meutstege et al. (2023), who identified lesson objectives as a key component of effective preparation. Similarly, Dávila Rubio (2017) and Wiggins & McTighe (2005) emphasize that clearly defined learning goals are essential for designing assessments that accurately measure student understanding. Content experts involved in this study underscored the importance of aligning learning goals with prior lessons and broader instructional objectives.

Based on the literature review, the implementation phase requires several core skills, including: (1) differentiating processes by adapting activities to students' interests (e.g., learning centers, RAFT, graphic organizers, learning contracts, tic-tac-toe); (2) organizing flexible grouping arrangements (homogeneous, heterogeneous, within-class, between-class, individual, pairs, or small groups); (3) differentiating content by using varied materials; (4) adapting instructional pace to students' needs; and (5) planning varied questions to assess student understanding. This phase is the most complex, as it involves multiple interrelated skills. For example, in content differentiation, most teachers tailored

materials to students' learning styles, while others adjusted materials based on students' readiness and interests (Eysink et al., 2017; Goddard et al., 2019; Tomlinson, 2015; Valiandes, 2015). Regarding grouping strategies, although homogeneous grouping was most commonly used, teachers also applied alternative grouping approaches (Bondie et al., 2019; Deunk et al., 2018).

Through CTA and analysis of teachers' best practices, four additional implementation-phase skills emerged: (1) Introducing learning goals, (2) activating prior knowledge, (3) providing additional support (e.g., classroom arrangement, technology, learning resources), and (4) providing flexibility in instructional time. Across all school levels, teachers introduced learning goals at the beginning of lessons and activated prior knowledge to enhance learning readiness. Teachers also utilized diverse resources—such as literacy gazebos, classroom gardens, and school libraries—to support different learning styles. Flexible instructional time was particularly effective in maintaining engagement among both advanced and struggling learners.

In the final phase—evaluation—teachers assessed whether students had achieved learning goals. Product-based assignments were designed to allow students, individually or collaboratively, to review, apply, and extend their learning over extended periods (e.g., a unit, semester, or academic year). This evaluation supports deeper understanding and meaningful demonstration of learning (Tomlinson, 2001; Tomlinson & McTighe, 2006).

The final CTA was developed by aligning academic literature with classroom practices across kindergarten, primary, and secondary school levels. Despite contextual differences, strong similarities emerged across instructional phases and required skills. This finding is consistent with Meutstege et al. (2023), who identified comparable DI processes across primary and secondary mathematics instruction. In early childhood context, DI often emphasizes holistic and experiential learning, which explains why kindergarten teachers prioritize play-based and exploratory activities during the preparation phase which can be particularly effective for young learners as it fosters creativity (Baumgartner et al. 2020).

Overall, the findings underscore the importance of systematically addressing student diversity through DI strategies. CTA supported teachers in identifying and applying effective DI strategies, such as flexible instructional time, grouping based on students' needs, and varied assessment approaches. The findings align with Tomlinson's (2001, 2015) framework, which emphasizes flexibility as a cornerstone of effective differentiation.

The practical implications of this study are significant for both teachers and professional development programs. Teachers can strengthen DI implementation by understanding students' learning profiles and creatively leveraging available resources. The best-practice examples identified in this study may inform the design of professional development programs that emphasize practical, context-sensitive DI strategies, thereby enhancing instructional quality and student outcomes.

This study has limitations. First, reliance on self-reported data may introduce bias, although this risk was mitigated through structured instruments and data triangulation. Second, although the sample included teachers from diverse regions, it was limited to 112 participants, which may constrain generalizability. Future research should include larger samples and data sources, such as systematic classroom observations and student achievement data.

Future studies should also examine the long-term impact of DI on student achievement and engagement, explore DI implementation in other educational contexts (e.g., special education and higher education), and investigate the role of educational technology in supporting differentiation.

This study contributes to the existing body of knowledge on DI by highlighting the effectiveness of CTA in identifying and implementing DI strategies across different educational levels. The findings emphasize the importance of context-specific approaches and provide practical insights for teachers and educators. By adopting these strategies, educators can better meet the diverse needs of their students, ultimately enhancing the overall learning experience.

CONCLUSION AND POLICY RECOMMENDATIONS

This study examined differentiated instruction for deeper learning across school levels using Cognitive Task Analysis. The findings revealed that DI implementation requires four skills in the preparation phase, nine skills in the implementation phase, and two skills in the evaluation phase. Despite contextual differences, substantial similarities in DI practices were observed across kindergarten, primary, and secondary levels. While teachers demonstrated strong instructional delivery and support skills, their use of advanced DI strategies—such as flexible grouping and tiered materials—remains limited. Most teachers relied on homogeneous grouping and learning-style-based materials, with fewer addressing differences in readiness or interests.

Although this study benefits from a comprehensive methodological approach and a diverse participant sample, its reliance on self-reported data may introduce bias. Nevertheless, structured instruments and triangulation strengthened data credibility.

Future research should investigate the long-term impacts of DI on student achievement and engagement and explore DI practices across varied educational contexts. Sustained professional development is essential to help teachers refine DI strategies and improve learning outcomes.

From a policy perspective, effective DI implementation requires comprehensive professional development programs that use CTA to guide teacher training. Policymakers should promote curriculum flexibility, enabling teachers to adapt content, processes, and assessments to students' readiness, interests, and learning profiles. Dedicated resources—including instructional materials and educational technologies—are necessary to support differentiation. Assessment policies should emphasize formative assessment and multiple ways of demonstrating learning, rather than relying solely on standardized testing. Collaborative teaching models and partnerships with parents and communities can further strengthen DI implementation.

Overall, this study highlights DI's potential to transform instructional practice and improve educational equity. By addressing existing gaps and building on current strengths, educators and policymakers can better meet the diverse needs of all learners.

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