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Desalegn Zerai

Towards Inclusive Education

Eritrean Elementary and Middle School Mathematics and Science Teachers' Views on and Implementation of Differentiated Instruction

UNIVERSITY OF JYVÄSKYLÄ
FACULTY OF EDUCATION AND PSYCHOLOGY

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ABSTRACT

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While abundant research has been conducted on differentiated instruction (DI), little is known about how teachers implement DI in educational contexts characterized by challenging circumstances, as in Eritrea. This doctoral dissertation aimed to investigate how Eritrean elementary and middle school teachers conceptualize and implement DI in mathematics and sciences classrooms and the challenges they face. The overall dataset consisted of narrative interviews with 18 mathematics and science teachers and 13 video-recorded lessons conducted by 10 teachers. The data were analysed qualitatively using different analytical approaches. Sub-study I explored the meanings of DI in Eritrean teachers' narratives through a narrative analysis of 18 teachers. The findings revealed that Eritrean teachers generally hold a positive attitude towards DI, while they hold both positive (72%) and negative meanings (28%). They also positioned themselves as positive agents of change. Sub-study II investigated the question modification strategies (QMS) of Eritrean mathematics and science teachers in differentiating classroom instruction through an interaction analysis of selected episodes of 10 video-recorded lessons. The findings showed that of the five different strategies they utilized, clarification, decomposition and code-switching supported differentiation in some way. Sub-study III explored the pedagogical tensions related to differentiation in Eritrean mathematics classrooms through a thematic analysis of both interview and video data (10 lessons) of eight mathematics teachers' classroom practice. The findings revealed that the teachers exhibited tensions between what they narrated and their actual classroom teaching. Even though the teachers indicated their positive attitudes towards student diversity and desire to accommodate differences, they experienced challenges that hindered their practices. This qualitative study followed a social constructivist approach. Overall, the research calls for strengthening teachers' potentialities and expertise through ongoing research-based in-service teacher training programmes to help them foster practices that address and respond to the diverse needs of all students.

Keywords: Differentiated instruction, differentiation, inclusive education, elementary and middle schools, mathematics and science classrooms, Eritrea.

TIIVISTELMÄ (ABSTRACT IN FINNISH)

Zerai, Desalegn
Kohti osallistavaa koulutusta: Eritrealaisten ala- ja yläasteen matematiikan ja luonnontieteiden opettajien eriyttämiselle antamat merkitykset ja eriyttämisen toteuttaminen
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Vaikka eriyttämistä on tutkittu paljon, tutkimustietoa ei ole juurikaan siitä, miten opettajat eriyttävät opetustaan resursseiltaan niukoissa kehittyvissä maissa, kuten Eritreassa. Tämän väitöskirjan tavoitteena oli tarkastella, millaisia merkityksiä eritrealaiset ala- ja yläkoulun matematiikan ja luonnontieteiden opettajat antavat eriyttämiselle, miten he eriyttävät opetusta tunneillaan sekä millaisia haasteita he kohtaavat opetusta eriyttäessään. Tutkimusaineisto koostui 18 matematiikan ja luonnontieteiden opettajan kerronnallisista haastatteluista sekä kymmenen opettajan yhteensä 13 oppitunnin videotallenteesta. Aineisto analysoitiin laadullisin tutkimusmenetelmin. Osatutkimuksessa I tarkasteltiin narratiivisen analyysin avulla, millaisia merkityksiä 18 opettajaa antoi eriyttämiselle. Tulokset paljastivat, että eritrealaiset opettajat suhtautuvat eriyttämiseen lähtökohtaisesti myönteisesti, vaikka 28 prosenttia heidän kertomistaan tarinoista oli kielteisiä. Opettajat asemoivat lisäksi itsensä positiivisiksi muutosagenteiksi. Osatutkimuksessa II tarkasteltiin vuorovaikutusanalyysin avulla sitä, miten eritrealaiset matematiikan ja luonnontieteiden opettajat muokkasivat oppitunneilla esittämiään kysymyksiä opetustaan eriyttääkseen. Analyysi pohjautui 10 oppitunnin videotallenteeseen. Tulokset osoittivat opettajien käyttävän viittä eri kysymysten muokkaustapaa: alkuperäisen kysymyksen toistaminen, uudelleenmuotoileminen, selkiyttäminen, pilkkominen osiin sekä koodinvaihto. Osatutkimuksessa III selvitettiin eriyttämiseen liittyviä pedagogisia jännitteitä kahdeksan eritrealaisen matematiikan opettajan haastattelu- ja videoaineiston (10 oppituntia) temaattisella analyysillä. Tulosten mukaan opettajat suhtautuivat myönteisesti oppilaiden moninaisuuteen, mutta liittivät opetuksen eriyttämiseen monia käytännön haasteita. Tutkimustulokset esittävät tarpeen vahvistaa opettajien asiantuntemusta tutkimusperustaisen täydennyskoulutuksen avulla, jotta opettajilla olisi paremmat valmiudet toteuttaa kaikkien oppilaiden osallisuutta edistäviä opetuskäytäntöjä.

Avainsanat: Eriyttäminen, inklusiivinen kasvatus, ala- ja yläkoulu, matematiikka ja luonnontieteet, opettaja, Eritrea.

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"Thus far the Lord has helped us" 1 Samuel, 7:12

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LIST OF PUBLICATIONS

This doctoral dissertation is based on three empirical sub-studies listed below.

Sub-study I	Zerai, D., Eskelä-Haapanen, S., Posti-Ahokas, H., & Vehkakoski, T. (2023). The meanings of differentiated instruction in the narratives of Eritrean teachers, *Pedagogy, Culture & Society, 31*(3), 419–437. https://doi.org/10.1080/14681366.2021.1914712
Sub-study II	Zerai, D., Eskelä-Haapanen, S., Posti-Ahokas, H., & Vehkakoski, T. (2023). The use of question modification strategies to differentiate instruction in Eritrean mathematics and science classrooms. *Education Sciences. 13,* 284 https://doi.org/10.3390/educsci13030284
Sub-study III	Zerai, D., Kontio, H., Eskelä-Haapanen, S., & Vehkakoski, T. (Manuscript under review). Differentiation-related tensions in the thinking and instruction of Eritrean elementary and middle school mathematics teachers.

The author of this thesis is the first author of all three articles. The first author was responsible for all phases of the study including planning, developing research questions, interviewing and video recording, analysis, interpretation and manuscript preparation. The three co-authors had a supervisory role in conceptualization, designing methodology, data analysis, interpretation of the findings and reviewing and editing all three manuscripts.

ABBREVIATIONS

DI	Differentiated Instruction
EDUFI	Finnish National Agency for Education
ELFA	Eritrea Learning for All
GPE	Global Partnership for Education
HEIs	Higher Education Institutions
IDD	Intellectual and Developmental Disabilities
IE	Inclusive Education
JYU	University of Jyväskylä
LCIP	Learner-Centred Interactive Pedagogy
MOE	Ministry of Education (Eritrea)
QMS	Question Modification Strategies
SNE	Special Needs Education
TENK	National Advisory Board on Research Integrity
UDL	Universal Design for Learning
UNICEF	United Nations Children's Fund
UNESCO	The United Nations Educational, Scientific and Cultural Organization

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ORIGINAL PAPERS

1 INTRODUCTION

Internationally, there is an increasing trend of including learners with disabilities and diverse learning needs in regular classrooms (Sharma et al., 2018). Inclusive education (IE) has gained momentum globally and is considered a "targeted agenda" in school systems (Lindner & Schwab, 2020). In relation to IE, differentiated instruction (DI) is a pedagogical framework that has gained popularity in the past 20 years. As part of inclusion efforts, many schools and teachers prefer DI to the traditional one-size-fit-all model of teaching, seeking to address the diverse needs of students in heterogenous classrooms (Tomlinson, 2014; Tomlinson et al., 2003). Previous research has also highlighted the benefits of DI, including its ability to improve students' achievement in mathematics and science (e.g., Russo et al., 2021) as well as in reading (Reis et al., 2011). Göransson and Nilholm (2014) also noted the benefits of DI in organizing classrooms. Teachers who differentiate their teaching provide specific alternatives for individuals to learn as deeply and quickly as possible, without assuming that a single learning roadmap fits all students (Tomlinson, 2014). In an empirical study, Kelly (2013) showed that there was a statistically significant difference between the performance of students who received DI in mathematics and those instructed through whole-class teaching, which supports the need for DI in some form.

Since I completed my master's degree in the field of educational psychology two decades ago, specifically focused on Special Needs Education (SNE) at the University of Western Cape, South Africa, I have been fascinated by the idea of IE to address the diverse educational needs of all students in mainstream classrooms. Accordingly, I have tried to incorporate the concepts of special needs, IE and accommodating diversity while raising awareness among college students and teachers in Eritrea, where I have had the opportunity to exert an influence. Thus, this research derives from my experience as a teacher educator in Higher Education Institutions (HEIs), which resulted from my passionate belief that DI, as a pedagogical framework, can be embraced by schools and teachers to promote inclusion and inclusive practices. When I was given the opportunity to pursue my PhD studies at the University of Jyväskylä (JYU) in

Finland, I decided to continue my research in the field of IE, with a specific focus on DI. Although DI has been studied extensively in many areas, I realized that there was a research gap in contexts like Eritrea, which have limited resources, large class sizes and poor educational infrastructure and educational systems. Hence, I felt it was worth studying the existing conditions of Eritrean teachers and the schools in relation to DI and IE. For the current research, selected mathematics and science teachers were interviewed and video-recorded. Mathematics and science were selected as subjects based on the belief that, in the Eritrean context, there is more classroom interaction and engagement in activities in these subjects than in other subjects.

As a signatory of the Salamanca agreement and the subsequent international conventions (The United Nations Educational, Scientific and Cultural Organization [UNESCO], 1994, 2000) that embrace the movement towards IE, Eritrea has taken some measures to advance IE. For instance, it requires the inclusion of all students with disabilities in mainstream classrooms, and it also established self-contained special classrooms inside some regular elementary schools in several cities around the country (Asefaw, 2016). However, no documented research is available about how DI practices and IE are advancing in Eritrea. Moreover, while there is abundant research on the impact of DI on IE worldwide (e.g., Lindner & Schwab, 2020; Porta, 2023), few studies have considered contexts in which teachers without specific training attempt to meet the diversity of students in their already large classes. Recent studies from Ethiopia (Ginja & Chen, 2020), and Tanzania (Milinga et al., 2023) have identified a lack of sufficient research on DI and teachers in Sub-Saharan Africa contexts. This represents an important research gap. Additionally, the complexity and vagueness of the concept of DI and the lack of knowledge about how it is understood by teachers in contexts like Eritrea — where an equivalent term for DI does not even exist in the local majority language (Tigrigna) — makes the need for research on this issue more pressing. Relatedly, teachers' understanding of IE is directly related to their attitudes, as those with more positive attitudes feel better prepared to implement inclusive practices, including DI (see Krischler et al., 2019). Moreover, there is a lack of understanding of how teachers in contexts completely different from the Western context in which DI originated (Tomlinson, 1999; Tomlinson et al., 2003) implement DI in practice and the challenges they face. This is particularly relevant, as Eritrea is characterized by large classrooms and under-resourced educational settings.

This research is situated within an IE context, where DI is seen as a pedagogical framework that can promote inclusion and inclusive practices. The study adopted a socio-constructionist approach (see Chapter 3). The purpose of the research was to investigate how Eritrean elementary and middle school mathematics and science teachers conceptualize DI and the strategies they utilize to implement it in their classrooms, along with the challenges they face when implementing DI. The study was based on three empirical sub-studies (see Chapter 4), whose research data consisted of narrative interviews with teachers

and video-recordings of their classroom instructions. The following research questions guided the study:

1. What kinds of meanings do Eritrean mathematics and science teachers give to DI?
2. What kinds of teaching strategies do Eritrean mathematics and science teachers use to differentiate their instruction in the classrooms?
3. What kinds of challenges do Eritrean mathematics and science teachers describe when implementing DI?

2 THEORETICAL FRAMEWORK

2.1 The Concept of Inclusive Education

IE is a contested, multifaced, complex and evolving concept, which is conceptualized in different ways in different parts of the world (Florian, 2014; Messiou, 2017). Thus, it can mean different things to different people in different contexts (Mahlo, 2017; Phasha et al., 2017). The variations are based on what aspects are given emphasis. The definitions may emphasize either the placement of students with disabilities (Buli-Holmberg et al., 2023; Florian, 2014), social rights, human rights and democracy issues (Buli-Holmberg et al., 2023; Mahlo, 2017; Phasha, 2016) or an organizational need for overall school improvement (Florian, 2014; Phasha et al., 2017). In addition, IE is perceived by its proponents as an approach that aims to transform repressive societies and educational systems by endorsing their foundational values of tolerance, respect, dignity and celebration of diversity (see Anthony, 2010; Phasha et al., 2017).

Phasha et al. (2017) argued that the basic idea of IE is addressing fundamental questions of power and equity and promoting the relationship between the diverse identities of students. A related African study indicates how inclusion is seen as a fight for freedom, yet developments of IE policies are largely dependent on models from the North (Pather, 2019). Studies by Phasha et al. (2017) indicated that different groups have different views on IE and "not every school, family, community or institutional setting can claim to have understood it" (Phasha et al., 2017, p. 1). According to these authors, one of the main challenges of IE in African context is "the conceptual understanding of inclusion which until quite recently was largely viewed as special education or the education of learners with physical disabilities" (Phasha et al., 2017, p. 2).

While the research on inclusion generally holds that inclusion concerns all students, real-world practices show that the focus is still on specific categories of students (Messiou, 2017). The attention has almost solely been paid to learners with disabilities and not widened to focus on a range of special needs which the marginalized and socially disadvantaged groups within communities might

have (Messiou, 2017; Pather, 2019; Phasha, 2016). This is based on the idea that some groups of students need more attention than others (Messiou, 2017). In relation to this, the meaning and definition of IE have been conflated with integration [1] and SNE. Pather (2019, p. 784) noted that the tension in conceptualizing IE in different countries might be based on "the contextual constraints and possibilities."

Despite the increasing awareness of and the rising interest in students with disabilities, the progress of IE has been slow (e.g., Geldenhuys & Wevers, 2013). Findings revealed that not all African countries mainstreamed IE in the general education system (Pather, 2019). One reason for this is that IE in Africa since Salamanca agreement had faced difficulties because of globalization and the heavy dependence on external funding to develop policies and practices, and to implement them locally (Pather, 2019).

Phasha et al. (2017) emphasize concepts of social differences, power, identity and culture as basis of thinking about IE in African contexts. Acknowledging differences as strengths rather than as challenges can create opportunities for education systems to transform by preparing educators to be ready for responding to all possible dimensions of student identities, including disabilities. Thus, the main values of IE include accepting and respecting differences, believing in multiple identities, and pluralism, and respecting and appreciating of ethno-cultural communities (Phasha et al., 2017). Thus, the western perspective of "universal learner" needs to be challenged by acknowledging social differences in teaching and learning processes. Other values for IE include mutual interdependence and the principle that everyone is responsible for students' learning (Phasha et al., 2017). A related study from an African context by Phasha (2016) showed how the principles of IE endorsed by the international movement towards IE endorsed since 1990 in Jomtien, are not new to African contexts, for example the values of IE are similar to the South African values of the Ubuntu philosophy (see also Akabor & Phasha, 2022).

For the purpose of this study, I lean on the following three definitions of IE and inclusive schooling. First, I am committed to the Salamanca Statement on Principles, Policy and Practice in Special Education (1994) which defines inclusive education (IE) as:

> *"The fundamental principle of the inclusive school is that all children should learn together, wherever possible, regardless of any difficulties or differences they may have. Inclusive schools must recognize and respond to the diverse needs of students, accommodating both different styles and rates of learning and ensuring quality education to all through appropriate curricula, organizational arrangements, teaching strategies, resource use and partnerships with their communities There should be a continuum of support and services to match the continuum of special needs encountered in every school"* (UNESCO, 1994, pp. 11–12).

[1] the concept involves allowing students with disabilities to attend schools in mainstream education alongside those without disabilities. However, integration does not guarantee full participation (see Phasha, 2016).

Second, my thoughts have been influenced by Ainscow et al. (2006) who developed a holistic view of inclusion, conceptualizing it in six ways: as a concern about disabled students and other categories of students with "special educational needs"; as a response to disciplinary exclusion; in relation to seeing all groups as vulnerable to exclusion; as developing the school for all; as "Education for All"; and as a principled approach to education and society (pp. 15–27). Based on this way of thinking, the authors defined inclusion as follows:

> [It is] "*an approach that is concerned with all learners and with overcoming barriers to all forms of marginalization, exclusion and underachievement*" (Ainscow et al., 2006, p. 5)

Third, I am inspired by an African study which defines IE as:

> "*A global agenda that aims to maximize educational access, participation and success or achievement for all learners, especially those who could have failed to qualify for admission into the school system or could have been placed in educational settings other than ordinary schools. Access goes beyond physical admission to schools: it includes active participation in the pedagogical content, process and product or assessment*" (Phasha, 2016, p. 4).

These three definitions of IE are interrelated as they all refer to recognizing diversity, placing of all students in mainstream schools, and pedagogical and curriculum adaptations. Besides, the definition by Phasha (2016) also specifically refers to the components of DI which helps me to link DI with IE. Both Salamanca's (UNESCO, 1994) and Ainscow's et al. (2006) definitions understand IE as a process of addressing and responding to the diverse needs of all learners through increasing participation in learning, cultures and communities while reducing exclusion from and within education (UNESCO, 2000). Carrying out IE involves changes and modifications in teaching content, approaches, structures, and strategies, based on a common idea that all students should be part of the regular (mainstream) education system (UNESCO, 1994). It also requires overcoming exclusionary pressures; that is, reducing exclusion involves finding ways to increase participation (Ainscow et al., 2006; Phasha, 2016).

2.2 The Concept of Differentiated Instruction

IE requires pedagogical models that aim to reach all students. Based on this understanding, DI, the focus of my research, has been found to support teachers in addressing the diverse educational and other needs of all learners in inclusive educational settings (Porta 2023; Tomlinson et al., 2003; Westwood, 2018). DI is an important aspect of IE that provides a means for achieving quality education for all students (Letzel et al., 2023; Lyons & Arthur-Kelly, 2014). As a result,

schools require teachers to create a stimulating learning environment by adapting their teaching through DI (Lindner & Schwab, 2020). However, the implementation of DI is not limited to inclusive classrooms. DI is generally understood as an academically responsive form of instruction in which teachers proactively modify curricular objectives, methods, learning activities and student products to address the diverse needs, interests and learning profiles of individual students (Tomlinson et al., 2003). According to Karten (2008), DI not only recognizes individual students' differences but also "gives merit to other learning spices and challenges" (p. 143).

DI is rooted in different educational theories, such as social constructivist theories, the principles of scaffolding and the zone of proximal development (Vygotsky, 1978), the theory of multiple intelligence (Gardner, 1983) and learning styles (Pritchard, 2009). In addition, DI is often confused with and linked to different concepts and terminologies. It has been likened to or used synonymously with the concepts of individualized learning (Landrum & McDuffie, 2010), personalized learning (e.g., Waxman et al., 2013), Learner-Centred Interactive Pedagogy (LCIP) (e.g., Tadesse et al., 2021) and adaptive learning (e.g., Wang & Lindvall, 1984). Lindner and Schwab (2020) also related DI to the transmission of didactic content through a participatory approach.

In addition, DI has been combined with universal design for learning (UDL). For example, Griful-Freixenet et al. (2020) reported that DI is linked to UDL in three different ways. First, due to the complementary interrelationships between DI and UDL, DI is considered a supporting approach for implementing UDL as an independent pedagogical model or framework. In turn, UDL is viewed as a practical guideline that aids in the implementation of DI, where DI is considered a proactive teaching approach. Second, in terms of their embedded interrelationship, some argue that DI is encompassed by UDL. From this view, DI is a practice of differentiating curriculum, whereas UDL is seen as a paradigm or philosophy (Griful-Freixenet et al., 2020). According to Lindner and Schwab (2020), DI is a teaching practice that reacts to the needs of students, while UDL is a proactive approach that ensures access for all students, irrespective of their educational needs (see also Griful-Freixenet et al., 2020).

Some researchers even use DI interchangeably with "curriculum differentiation" (e.g., Griful-Freixenet et al., 2020) or just "differentiation" (e.g., Lindner & Schwab, 2020), thus narrowing the concept of DI to an instructional strategy instead of a philosophy (see Griful-Freixenet et al., 2020) or a way of thinking (Tomlinson, 1999; 2014). This is contrary to the definition of Tomlinson (2014), who stated that the core philosophical values of DI embrace the following principles: diversity is normal and valuable; every learner has a hidden and extensive capacity to learn; it is the teacher's responsibility to be the engineer of students' success; and educators should be champions of every student who enters the schoolhouse doors (pp. 26–28). Further, some researchers have argued that the concept of DI is limited to teaching or instruction, whereas differentiation is a broader concept that also includes DI as well as the learning environment and material support (see Roiha & Polso, 2021).

My starting point is the belief that DI as a pedagogical framework creates opportunities for teachers to respond to all their learners with diverse backgrounds, thereby promoting the inclusion of all learners, not only those with disabilities or other special needs. DI has been shown to address learner diversity for specific individuals, groups or whole classes (Tomlinson et al., 2003). I believe it can be adopted flexibly to different contexts. Studies have shown that DI facilitates student learning (Smale-Jacobse et al., 2019) and has a positive effect on student achievement in educational settings (e.g., Deunk et al., 2018; Reis et al., 2011; Russo et al., 2021).

Theoretically, as the concept of DI is strongly linked to social constructivism, this thesis also draws upon a socio-constructivist approach to teaching and learning interactions. Social constructivism assumes the importance of culture and context in understanding what occurs in society and constructing knowledge (Packer & Goicoechea, 2000; Pritchard & Woollard, 2010; Rannikmäe et al., 2020; Vygotsky, 1978). It explains that learners actively construct their own knowledge through experience and interactions with others (Rannikmäe et al., 2020; Vygotsky, 1978). Thus, learning is not only limited to the individual, but it rather occurs meaningfully when individuals are engaged in social interactions (Kugelmass, 2007).

Social constructivism provides the rationale for the inclusion of all students in the general educational settings by focusing on the significance of context to learning (Kugelmass, 2007). Thus, the socio-constructivist perspective calls for organizing the classrooms and schools in ways that can meet the diverse needs of students by providing appropriate support services and modifications as well as creating a social, cultural and physical context that supports and promotes student friendly classroom environment (Kugelmass, 2007; Rannikmäe et al., 2020). As a meaning-making process, learning requires both teachers and students to actively participate in teaching-learning process (see Kugelmass, 2007; Rannikmäe et al., 2020). Thus, social constructivist teachers shift their role from being the provider of information to "an active mediator" of students learning (Kugelmass, 2007, p. 275). A teacher in an inclusive educational setting is proactive in responding to the diverse needs of the students, as well as in maintaining a positive, responsive, supportive classroom atmosphere, adapting instructional materials, arranging activities in different forms (DI being one approach), engaging students in problem-solving, and creating a common ground for communication, which are all aspects of the socio-constructivist approach.

2.3 Different Models of DI

The literature includes different theoretical and conceptual models of DI. Here, I review the models presented by Tomlinson (2014), Roiha and Polso (2021) and Reis and Renzulli (2018). First, in Tomlinson's (2014) model, DI consists of the following four dimensions: the content, process, product, and learning

environment. Content refers to what teachers want students to learn and the materials through which students access knowledge. Process refers to the activities and instructional strategies teachers devise to help students make sense of the learning contents, while product refers to the ways in which students demonstrate what they have learned (Tomlinson, 2014). Moreover, Tomlinson (2014) emphasized the importance of the learning environment for supporting DI and thus student success. This requires the provision of accepting, healthy and authentic learning environments that recognize and respect student diversity and support DI.

Second, Roiha and Polso (2021) developed a model of differentiation with five dimensions: teaching arrangements; learning environment; teaching methods; support materials; and assessment. Each dimension is directly related to how diversity is addressed in mainstream classrooms. The model emphasizes flexible grouping and co-teaching as teaching arrangements, the adaptation of physical and psychosocial environments to cater to diverse learners, the utilization of DI principles in teaching methods, the provision of individualized learning materials and additional support materials and the use of differentiated pre-evaluation and formative assessment approaches (Roiha & Polso, 2021).

Third, a related yet different model named "5 Dimensions of Differentiation" was proposed by Reis and Renzulli (2018), in which the three traditional components of successful DI are extended to five dimensions: differentiation of content; differentiation of instructional strategies; differentiation of the classroom; differentiation of the product; and the teacher. Content differentiation refers to tailoring the requirements and pacing of curricula, while instructional strategies involve catering lesson formats based on students' unique learning styles to facilitate engagement. The classroom dimension refers to organizing students into groups based on similar interests and strengths to facilitate collaboration, and the teachers are expected to make decisions and choices about how to differentiate the curriculum for a diverse group of students.

While differentiating teaching, the common dimensions of these three models are methods, assessment and the learning environment, which are explained in different ways. Roiha and Polso (2021) included "support materials" as an additional dimension, which I believe has a direct impact on the successful inclusion or accommodation of all students in mainstream classrooms. For example, the fourth dimension, "learning environment", in Tomlinson's and Roiha and Polso's models is called "classroom organization or management" by Reis and Renzulli. Thus, the three models are referring to a similar concept. Whereas the first two models focus on the fundamental role teachers play in differentiation, Renzulli's model incorporates the role of the teacher. In naming the fifth dimension "the teacher", Renzulli argued that teachers can differentiate themselves by "modelling" or assuming different roles in addition to the teaching role, both inside and outside the classroom (Reis & Renzulli, 2018, p. 89).

Since all these models involve the differentiation of content, process, product and learning environment, they have an impact on my study. However, for convenience, Tomlinson's (2014) model serves as the basis of this research. I

adopted this model because I believe it is one of the most widely and extensively utilized models in various educational contexts. Further, the investigation of my research questions was directly related to this model. In addition, in my experience as a teacher educator, I was more familiar with this model and had utilized it as a reference when I was teaching undergraduate students in my home institution. Finally, the focus of my research best fits the four main components of Tomlinson's model.

2.4 Teachers' Views on DI and Approaches to DI

DI is both a teaching practice and a philosophy that is believed to maximize students' learning opportunities (Gheyssens et al., 2022; Letzel et al., 2023). Tomlinson (1999, 2014) claims that the majority of effective teachers differentiate their instruction to some degree. Such teachers continuously learn to develop their own strategies and techniques to differentiate the contents, methods, processes, products of their teaching and learning environment (Reis & Renzulli, 2018). However, teachers perceive DI in different ways (Roiha, 2014). While some understand it as generally considering students' individuality, others regard DI as a somewhat separate issue that does not automatically belong to teaching (Roiha, 2014). As a result of differing views, teachers have different attitudes towards DI. For instance, several teachers perceive DI as a practice that can only be adopted sometimes, instead of considering it as a pedagogical framework that tends to maximize the creation of inclusive classrooms for all learners (Gheyssens et al., 2022). Besides, the failure of schools to utilize DI as a principal guideline or strategy is one of the main challenges that influence teachers' views on and approaches to DI negatively (Siam & Al-Natour, 2016).

In relation to training, several findings have shown that teachers do not feel prepared for differentiating classroom instruction for diverse students (e.g., Mengistie, 2020; Porta et al., 2022; Suprayogi et al., 2017). As a result, teachers think that they have limited knowledge of utilizing DI strategies and managing mixed ability groups as well as lack of adequate opportunities to plan DI, which in turn make teachers reluctance to implement DI (Mengistie, 2020, see also Porta et al., 2022). On the other hand, even if teachers value the utilization of DI, they perceive insufficient resources as a challenge to differentiate instruction (Letzel et al., 2023).

Teachers' approaches to and practice of DI vary in relation to teachers' teacher profile, gender, quality of pre-service training, teaching experience and exposure to diverse students including those with disabilities in their classrooms (e.g., Letzel et al., 2023; Peebles & Mendaglio, 2014; Saloviita, 2018). Thus, the mindset could positively or negatively impact the adaptation of teaching strategies through DI (Coubergs et al., 2017). For example, teachers who had previous training on DI displayed positive attitudes towards DI and they also carried out DI in classroom (Gülay & Altun, 2022). On the other hand, those without training perceive lack of familiarity with the instructional strategies that

support DI (Melesse, 2015). Teachers who do not recognize ways to differentiate or who do not feel capable of instructing different groups of students may struggle with differentiating instruction (Dixon et al., 2014), thus, their expectations of failure in successfully carrying out DI impacts their attitudes (Porta et al., 2022). Many teachers have also been reported to have poor attitudes towards supporting students with disabilities through DI due to the lack of a flexible curriculum and confusion about how to manage inclusive classrooms in mainstream schools (de Jager, 2017; Geldenhuys & Wevers, 2013).

Factors like time constraints, lack of resources, and voluminous curricular content have also a negative impact on teachers' attitudes toward DI (Porta et al., 2022; Siam & Al-Natour, 2016; Valiandes & Neophytou, 2018). In contrary, teachers' ability of utilizing different DI strategies in heterogenous classrooms positively predicts their use of DI (Coubergs et al., 2017). Teachers' self-efficacy beliefs and attitudes are important factors that predict their use of DI (Letzel et al., 2020; Porta et al., 2022; Savolainen et al., 2022; Suprayogi et al., 2017). This is especially true when teachers have positive attitudes towards DI, which results in strong self-efficacy in teaching in an inclusive classroom and confidence in differentiating their instruction (Dixon et al., 2014; Landrum & McDuffie, 2010; Malinen et al., 2013). Thus, teachers with strong efficacy tend to differentiate their instruction more often than teachers with low self-efficacy (Dixon et al. 2014; Suprayogi et al., 2017).

Variation was also found among primary and secondary school teachers' use of DI. Gheyssens (2022) noted that primary school teachers adopt DI more frequently than secondary school teachers, and DI practices are observed "regularly and spontaneously" in primary schools, but only "randomly" in secondary schools (p. 1395; see also Gülay & Altun, 2022; Letzel et al., 2020). The reasons behind these differences may require further study.

Teachers recognize the need to utilize DI in classroom, however, the use of DI by teachers is limited (Valiandes & Neophytou, 2018). Teachers' understanding of DI "in terms of its feasibility and its effectiveness" influences their attitudes and practices (Valiandes & Neophytou, 2018, p. 124). Teachers understanding of DI, however, may not always guarantee their use of DI in classrooms (Mengistie, 2020). Related findings revealed that although teachers understand the relevance of DI, they rarely practice it in classroom (Letzel et al., 2020, 2023). Porta et al., (2022) also found that even if teachers have an in-depth understanding of DI and its accompanying strategies, their knowledge is not related to their perception of DI implementation successfully. For example, if teachers perceive frustration towards DI, they tend to develop negative attitude towards implementing DI regardless of their understanding of DI (Porta et al., 2022). Hersi and Bal (2021) also noted the significant difference between teachers desire to utilize DI and their actual classroom practices. In addition, teachers' lack of agency also negatively affects teachers' adaptation of instruction through DI (Gheyssens et al., 2022).

Langelaan et al. (2024) reported that teachers' implementation of DI correlates with the outcomes of teacher education programmes, which prepare

teachers to effectively teach and model DI by modifying the curriculum as needed (see also Emam & Mohamed, 2011; Malinen et al., 2013; Peebles & Mendaglio, 2014). Peebles and Mendaglio (2014) further noted that spending more time in the direct instruction of students with special needs and less on observation and whole-class instruction will likely increase teachers' self-efficacy for inclusive teaching. This will allow teachers to understand how and why to differentiate instruction and make accommodations for exceptional learners.

2.5 The Research Context

2.5.1 Eritrean Education System and Overview of IE and DI Development

The Eritrean education system has been influenced by both the local and international contexts. It assumed its shape with the arrival of western missionaries and colonizers in the second half of the 19th century, similar to other parts of the African continent (Woldemichael, 1995). Education underwent further development during the British protectorate of Eritrea in the 1950s (Ministry of Education [MOE], 2002). During those periods, education was offered in Eritrean languages at the elementary school level, which was only accessible to some individuals. When Eritrea was absorbed by Ethiopia in the early 1960s (which led to the 30-year war for independence), the Eritrean education system was replaced by the Ethiopian one, and Amharic, an Ethiopian language, became the medium of instruction (Woldemichael, 1995).

When Eritrea was liberated in 1991, the provisional government drafted educational policy frameworks, aiming to extend educational opportunities to all citizens freely and equally and making elementary and middle school education compulsory (Woldemichael, 1995; MOE, 2011). Elementary education was provided for students of all Eritrean nationalities in their own languages, with flexible enrolment ages for students with special needs[2] including those with disabilities[3] (MOE, 2002, 2003).

Until recently, the Eritrean education system has maintained two separate services, the general and the special education systems. Only one public and two non-governmental special elementary schools cater to students with visual and hearing impairments respectively. However, the intake of these schools is very low, for example, between 2014/15 to 2018/19 they accepted 175 students per year on average, (See, MOE 2019a; United Nations Convention on the Rights of

[2] The terms special needs/special educational needs are used interchangeably in this dissertation. They refer to a range of educational needs of students that call for the attention of teachers and other responsible bodies to identify and address them by providing appropriate services. They concern students with disabilities or learning difficulties, those with marginalized, excluded minority background as well as ethnolinguistic groups, and at-risk students, and generally any form of educational needs that may arise in every school every day.

[3] include physical, sensory, intellectual and developmental impairments of students.

the Child [UNCRC], 2023). Students with other forms of disabilities were denied access to education until 2004 (Asefaw, 2016).

The Ministry of Education (MOE) developed a "policy and strategy on IE in Eritrea" in 2008 by drawing its guiding principles from several local and international policy documents and frameworks that share common commitments and goals in ensuring the rights of students with disabilities, the provision of SNE[4] and IE. The following are some of the local documents.

1. ***The Eritrean constitution***: even though its implementation is still withheld, Article 14 clearly states that no person should be discriminated against on the grounds of race, ethnic origin, language, colour, gender, disability, religion, age, political view, or social or economic status (Government of Eritrea [GOE], n.d.).
2. ***National disability polic***y: This policy promotes and protects the rights of persons with disability from a social justice point of view (MOE, 2008).
3. ***National Education Policy*** (MOE, 2003): declares that education is a fundamental human right of all citizens irrespective of their differences and makes making basic education all-inclusive equitable for all. It also noted the use of DI and UDL as means of curriculum adaptation to meet the needs of students with disabilities.
4. ***General guidelines of inclusive and SNE in the national curriculum*** (MOE, 2005): developed based on a three-year pilot project (2003 to 2005) on IE and SNE, it was meant to supplement LCIP in the national curriculum and serve as a means of implementing IE in every classroom in Eritrea. This document adopts the Salamanca 1994 definition of IE, noting that the target of SNE includes all students with diverse educational needs, not only those with disabilities (p. 26). This document acknowledges IE as a means of transforming the whole education system to respond to diversity, seeing diversity as "a challenge rather than a problem" (p. 4). The guideline also provides a list of strategies for creating a comfortable learning environment; for making learning more meaningful and enjoyable; and for addressing barriers[5] to learning.

The International conventions and frameworks that are guiding as well as binding tools, upon which the Eritrean IE policy draws its guidelines include the UNCRC (1989), the Jomtien World Education for All (1990), the Salamanca Statement and Framework for Action (1994), the Dakar Framework for Action (2000), and the UN Convention on the Rights of Persons with Disabilities (CRPD)

[4] refers to a range of educational and social services provided by the public school system and other educational institutions to school-aged individuals with disabilities and other needs. It is designed to ensure that students with disabilities and other needs are provided with an environment that allows them to be educated effectively.

[5] attitudinal, policy, institutional, cultural, traditional and social barriers within schools and the education system; educational assessment, educational planning in an IE setting; and parental involvement. They hinder the presence, participation and learning.

(2006) (see MOE, 2008, pp. 13–14). Eritrea had signed the Salamanca framework and CRC. Even though Eritrea has not signed nor ratified the CRPD, the IE policy utilized this convention as a reference.

The policy defines IE in terms of social justice, i.e. recognizing cultural diversity and equality of citizens. The principle of social justice requires teachers and schools to acknowledge pluralism and cultural diversity, thus, ensuring equal access to schooling for all learners, especially for those who have not had much schooling opportunities by minimizing variations in the quality of education (MOE, 2011), and practicing tolerance and equality (MOE, 2009). The IE policy aims to establish child-friendly schools that accommodate diverse students by enhancing participation and learning with special attention given to children and girls facing exclusion (MOE, 2008, 2013). Focusing on access and equity, quality and relevance, building capacity, and developing sound partnerships, the policy outlined eight policy objectives: (i) IE is institutionalized within the education sector, (ii) a range of diverse educational opportunities are provided, (iii) an educational support system is built, (iv) expertise in inclusive education is widened, (v) curriculum and assessment reflect the diversity of the learner population, (vi) education managers' and administrators' capacity in inclusive education is enhanced, (vii) school communities are empowered to address and respond to diverse learning needs, and (viii) IE is implemented through collaboration and coordinated actions (MOE, 2008, pp. 20–21).

To cater to the needs of students with Intellectual and Developmental Disabilities (IDD), the MOE has established 25 special classrooms[6] throughout the country since 2004 (UNESCO, 2021), 21 of which were built, furnished and continuously equipped by a European Union (EU) funded project (MOE, 2019b). These special classrooms are also referred to by the IE policy and other documents as inclusive classrooms (see MOE, 2005, 2008, 2019b). Teacher training for the special classrooms has been carried out by the MOE and other stakeholders under the direct supervision of the SNE panel of the MOE (MOE, 2008, 2019b). The MOE and the United Nations Children's Fund (UNICEF) are working together to provide resources to special schools and strengthen the SNE operational guidelines to enhance access to students with disabilities at all levels of education. To overcome the shortage of qualified teachers for students with special needs, the MOE planned to conduct training of trainers (on mother tongue education) for 150 teachers and increase the number of SNE teachers by 1000 in 2021 (MOE, 2019b; UNESCO, 2021). The MOE is progressively putting IE practice to the test by integrating it in many government and private schools. "The enrolment of students with IDD in regular schools increased from 255 in 8 schools in 2014 to 646 students in 19 schools in 2019" and Eritrea is considering signing the CRPD (UNCRC, 2023, pp. 23, 44).

Despite these efforts, the movement from SNE to full IE in Eritrea is slow and the quality of SNE provision in Eritrea remains poor. A formal teacher

[6] are self-contained educational settings located within mainstream elementary schools for students with IDD. They operate as part of the mainstream school with or without partial integration in the mainstream school programmes. Special classrooms have one or more special teachers that are specially trained to serve these students.

training scheme, trained teachers, modified or alternative curriculum and learning materials and support services are not available to fully address the special educational needs of students (MOE, 2019b). Local belief systems and attitudes, which stigmatize severely disabled children, are prevalent in Eritrean communities, forcing parents to hide their children and thus deny them educational opportunities (Asefaw, 2016; MOE, 2008). Additionally, the lack of recognized sign language training for education and vocational training for students completing elementary or middle school are significant challenges, reflecting the meagre service offerings for students with disabilities (MOE, 2019b). Limited and underfunded infrastructure as well as inadequate resources are other important challenges (see UNESCO, 2020).

Concerning DI, the IE policy document (MOE, 2008) and the national education policy (MOE, 2011) refer to the use of DI, UDL LCIP and learner-centred assessment as key aspects of advancing IE (MOE, 2005, 2011). However, there are no clear guidelines or procedures regarding how these educational strategies can be utilized at the classroom level. Additionally, the teacher education programmes in Eritrea are dominated by traditional teacher-centred practices, in which DI strategies are uncommon. Even though the IE policy sometimes uses the terms of integration and IE interchangeably (see MOE, 2008), what really happens in schools is not "full inclusion" but rather integration of students with sensory disabilities and IDD in the mainstream education only after they spend several years of elementary education in special schools or special classrooms respectively. These students are not considered part of mainstream education until they are believed to be fit to the system, which usually happens in middle school. In special classrooms the teachers are trained in SNE, the rooms are separate, and the teaching programs are different. However, the students with IDD have the opportunity for social integration with the mainstream students during the breaks, and even some mainstream teachers allow these students to attend classes alongside their peers.

Although opportunities are available for students with moderate and severe physical and IDD to continue their education in mainstream lower and upper secondary schools, little is known about the transition and survival rates of such students within mainstream schooling (MOE, 2016). Moreover, it remains unclear whether the MOE's inclusive policy guidelines are properly formulated to support implementation. This represents a gap that deserves research attention.

2.5.2 Eritrean Teachers' Socio-economic and Working Conditions

Recent studies indicated that many teachers in Eritrea do not choose the teaching profession themselves, mostly because of their low performance in secondary education leaving examinations they cannot join other colleges, hence, forcefully place in colleges of education (Demoz, 2017; Fessehatsion & Peng, 2021) Due to the shortage of teachers and their high attrition rate, college graduates from non-teaching fields are assigned to the teaching profession after obtaining a few days of training in teaching (see Fessehatsion & Peng, 2021; Posti-Ahokas et al., 2022;

Tadesse et al., 2021). The introduction of double-shift schooling at all levels, due to the shortage of teachers, increased the workload of teachers by forcing them to teach two groups of students in the morning and afternoon shifts (see Mengesha & Tesema, 2019).

A related study (Demoz, 2017) indicated that teachers' challenges are related to the lack of comprehensive policy of teacher management in Eritrea. including the living conditions, merit-based selection, the school setting, and initial and continuous professional education (Demoz, 2017). The bureaucratic and time-consuming process of mobilizing resources by district and regional authorities of the MOE also affects teachers' efforts to provide targeted services to disadvantaged students (Fessehation & Pai, 2019, p. 1153). The poor working and living conditions are worse in the countryside, placing a particular burden on teachers who stayed several years in remote areas without incentives or hardship compensation allowances (MOE, 2018). Due to the economic and the existing political situation of the country, most teachers are assigned to schools as national service members (without proper salary), hence, their working and living conditions are very low, they have no career advancement within their profession, and their profession does not have the status and respect it deserves (see Demoz, 2017). Moreover, the poor perception of the public on the value of the teaching profession, and the mismatch between the subjects they teach and their specialization undermines teachers' motivation and performance (see MOE, 2018).

Despite the MOE's policy commitment to empowering teachers, and enhancing teachers' status, morale, motivation, and professionalism (see MOE, 2011), little has been accomplished in realizing these. Even though the government has recently introduced a salary system corresponding to teachers' qualifications and years of experience, the effect of these and the political conditions of Eritrea on teachers' performance, retention, and quality of education is yet to be studied.

3 METHODOLOGY

In this qualitative research, I situated myself within a social constructionist perspective as a way of understanding and gathering the data, entailing that the meanings and experiences of the participants are constructed in different discourses within society (Burr, 2003; O'Leary, 2007; Patton, 2015). A constructionist approach aims to capture diverse understandings and multiple realities related to people's definitions, accounts and narrated experiences of the situation under study. Social constructionism assumes that people construct their world and reality, not just through language, but through their ongoing experiences and interactions with each other (Berger & Luckmann, 1966). Thus, a singular or universal explanation of DI is not the goal. Rather, constructionist qualitative inquiry honours the idea of multiple realities (see Burr, 2003; O'Leary, 2007), thus, it involves context-dependent inquiry and inductive data analysis (Creswell, 2013). The constructionist perspective aligns with this research as it positions me, as a researcher, to investigate how teachers' meaning-making is shaped not only by their knowledge, but also by their cultural understanding, classroom and school contexts, and interactions with their students (see Porta, 2023).

3.1 Research Data and Participants

The research data were collected through semi-structured interviews of Eritrean mathematics and science teachers as well as video recordings of their instruction. Eighteen teachers were recruited from six school sites in two of the largest cities of Eritrea with ethnolinguistically diverse communities. Details of the schools and the respective participants are presented in Table 1.

TABLE 1 General information about the schools

School	Type	Level	Participating teachers		total number of teachers at school		Number of students at school	
			M	F	M	F	M	F
1.	Public	Elementary & Middle	1	1	8	13	315	301
2.	Public	Elementary	2	2	6	13	388	342
3.	Private	Elementary & Middle	2	2	35	50	1544	1415
4.	Public	Elementary & Middle	2	1	19	15	613	597
5.	Public	Elementary	-	2	5	38	839	708
6.	Private	Elementary & Middle	2	1	39	22	794	887

M = Male; F = Female

Purposive sampling, which is typical of qualitative research, was utilized in recruiting participants for the study (Patton, 2015; Creswell, 2013). The purpose of qualitative research is to gain a detailed contextualized understanding of the phenomenon under study, which requires not only a small sample size so that issues can be explored in depth but also a flexible sampling process to capture diversity (Hennink et al., 2020). As a result, in this study, information-rich participants were recruited to gain an in-depth understanding of the issues under study. The research questions and objectives defined the target population for later recruitment as participants of the research, as they had the potential to provide rich information on the topic. The teachers were recruited based on the observations of the pedagogic heads and principals of the respective schools, who believed the teacher could generate optimum data for a study on DI. For the purpose of this study, two academic subjects, mathematics and science, were selected. This was based on the belief that there is more classroom interaction and engagement in different activities inside and outside the classroom in these subjects than in social studies or other subjects. As diversity is crucial for qualitative research, it was ensured deductively by including several schools (6 schools). Variations were more apparent between the public and private schools in terms of human and material resources and the types of short-term training that teachers receive.

Prior to recruiting the 16 participants, two participants were selected for piloting the interview questions, which helped to guide recruitment at later stages of the data collection process. In addition, consultations with my supervisors and meetings with the SNE panel at the MOE in Asmara, Eritrea, along with discussions with the pedagogic heads and principals of respective schools, guided the recruitment of the respective samples. The data collection process was circular, beginning deductively with defining the study population

and then using inductive leads from the collected data to refine or expand the sample of participants (Hennink et al., 2020). The selection was largely supported by the SNE panel that had a strong connection with several schools (the director helped to identify some of the schools). The panel is responsible for arranging and facilitating training and workshops for both special education and mainstream teachers on the topics of special needs and IE.

However, while I respected the suggestions offered by the SNE director, the selection of schools was not entirely based on his suggestions. I suggested and discussed my alternatives with him. For example, I chose one of the two cities because I was familiar with it, having worked as a high school teacher there for several years. I was fascinated by the cultural and ethnolinguistic diversity of the city and its schools. Thus, I decided to include that city in the sample (two schools belonged to the city). Discussions with school principals and pedagogic heads based on the criteria established prior to the data collection helped me to identify prospective participants in each school. However, this led to a risk of selection bias and potential coercion of participants. To overcome such bias, the six schools were selected randomly, and the teaching experience of the participating teachers varied greatly between three and 39. Thus, the teachers had diverse academic qualifications and teaching experience. Any teachers who did not wish to participate in the study after selection were able to withdraw from the data collection. Moreover, to the extent possible, I included an equal number of male and female teachers in the study. Permission to utilize the research sites was obtained from the responsible authorities, and signed informed consent letters were collected from all subjects (teachers and parents of the children) involved in the study (see Appendices 4 & 5). The details of the participating teachers are presented in Table 2.

TABLE 2 Description of the study participants

Pseudonym	**Teaching experience, years**	**Gender**	**Age**	**School type, public/ private**	**Teaching grade(s)**	**Educational background[1]**	**Subject**	**Number of students per class**	**Research data collected, Interview/video/both**
Aster	39	F	56	Public	4 & 5	C	Science	45	Interview
Rahel	27	F	46	Public	6 & 7	D	Science	55	Interview
Rezene	27	M	48	Public	5, 6 & 7	D	Math	50	Interview
Selim	27	M	46	Public	4 & 5	D	Math	55	Both
Mehari	25	M	52	Private	6	De	Science	60	Both
Martha	24	F	42	Public	5	C	Math	50	Both

Pseudonym	Teaching experience. vears	Gender	Age	School type, public/ private	Teaching grade(s)	Educational background[1]	Subject	Number of students per class	Research data collected, Interview/video/both
Kidane	24	M	51	Public	6, 7 & 8	D	Math	60	Interview
Eyob	23	M	45	Private	5	C	Math	70	Both
Adam	22	M	44	Public	6 & 7	C	Math	60	Both
Genet	17	F	40	Public	4	C	Math	80	Interview
Tsega	13	F	42	Private	4 & 5	C	Science	50	Both
Solomon	12	M	39	Private	4 & 5	D (12+3)	Math	50	Both
Fatuma	12	F	31	Private	4	C	Science	55	Interview
Miriam	7	F	26	Public	5	D	Math	55	Both
Natsnet	6	F	28	Private	6	De	Math	60	Both
Nahom	5	M	24	Public	3 & 4	C	Science	55	Interview
Bekita	4	F	23	Public	4	C	Math	50	Both
Aron	3	M	32	Private	4 & 5	C	Science	50	Interview

[1]C = Certificate, 1 year of college education; D = Diploma, 2–3 years of college education; De = Degree, 4 years of college education

3.2 Instruments and Data Collection Procedure

In this research, data were collected through semi-structured interviews and video-recordings of classroom instructions. This allowed me to explore the discourse and narratives of teachers obtained through the interviews and to further analyze the data by studying the video-recorded classroom teaching. The data collection followed the ethical guidelines of the University of Jyväskylä, Finland, as outlined in section 3.4.

The narrative interviews allowed me to understand the teachers' meanings and narrated experiences of the concept of DI in depth (see Hollway & Jefferson, 2008). The interview guide focused on the following main themes: 1) How would you describe students' diversity in your classroom? 2) How do you teach individually? 3) What does "responding to diverse learners" mean to you? Or how do you feel about it? 4) Would you please describe successful and unsuccessful stories about trying to modify or adapt your instruction? and 5) Do you have anything to add?

During classroom observation, the instruction of the 10 participating teachers was video-recorded while I was not present. The teachers performed

their normal day-to-day teaching inside their actual classrooms. For each session, a research assistant and I installed two video cameras in the front corners of the classroom, turned on the video cameras and left the classrooms, while the third research assistant sat in one corner of the classroom and recorded every possible movement of the teacher by zooming in and out with the camera. In addition, I attached an audio-recording device to the teachers' clothes/pockets to capture everything each teacher said during the lesson session. I asked each teacher to turn off the audio device when they finished their lesson.

A total of 11 lessons from 10 teachers were selected, which were recorded with the use of three video cameras. While most of the recordings were of one lesson, some were of two lessons. On three occasions, the video recording was spoiled for different reasons, for example, an external teacher banged on the door, causing the camera to fall. One teacher accidentally turned off one of the two front cameras. On another occasion, due to a strong wind blowing through the front window of the classroom, one video camera recorded a shaky video, which was difficult to view.

The classrooms were characterized by overcrowding, with large classes between 50 and 70 students and three students sitting at a single desk. The teachers usually stood in front of the classroom while teaching, occasionally moving around the classroom. During the classroom observations, the teachers engaged in whole-class teaching, placed students in mixed-ability groups and included group as well as individual blackboard work.

3.3 Data Analysis

Three analytical methods were utilized in this study: narrative analysis, interaction analysis and thematic analysis. Since I collected data through narrative interviews with teachers and video recordings of their classroom instruction, I found these analytical methods appropriate for treating the data. For example, the constructs of teachers' meanings of DI based on their life experiences were best suited for narrative analysis (see Gimenez, 2009; Patton, 2015). The teacher–student interactions based on the video data and the questioning episodes were best treated utilizing interaction analysis (see Erickson, 2006; Jordan & Henderson, 1995). Finally, when analyzing the large amount of data from both the interview and video recordings together, I found establishing themes and analyzing them using thematic analysis to be an appropriate choice (see Nowell et al., 2017). When utilizing all of these analysis methods, I also drew on the constructionist idea of the meanings constructed in people's language use and social interaction.

3.3.1 Narrative analysis

Narrative analysis was used as the basis for analyzing the interview data from the 18 teachers for sub-study I. The elicitation of interview narratives (life stories

or "key" episodes) as the leading qualitative method in social sciences has put big stories firmly on the map (Bamberg & Georgakopoulou, 2008). The central idea of narrative analysis is that stories offer especially translucent windows into cultural and social meanings, which are constructed as narratives and in narration. Thus, the representational functions of the narratives were the focus in this study (Gimenez, 2009; Patton, 2015).

Stories collected through interviews can be fodder for narrative analysis, as it focuses on stories and interpreting them and, more specifically, on the texts that tell the stories (Patton, 2015). Narrative analysis is used to examine people's construction of experiences, so each text is examined as a whole to retain the narrative flow, context and implicit meaning of the story (Esin, 2011; Herman, 2009). Therefore, the focus is on a single text at a time to understand the core narrative of that individual by focusing both on the structure (e.g., biographical details, chronology of events, turning points, the main plot and actors) and the content (e.g., identifying issues raised, threads of the story, categories of issues and the participant's own interpretation of the meaning of events or experiences) of the narrative text (Hennink et al., 2020). My interest was extended to analyzing the so-called small story events instead of only considering large life story narratives (Bamberg & Georgakopoulou, 2008). Accordingly, I used small stories as the basis for this study.

During the analysis process, while carefully reading through the entire interview data, I was intrigued by the narrative small stories of the teachers, in which they described how they carried out DI in practice. My focus was on the small stories the teachers produced, as I found them to be original and concrete in terms of presenting what the teachers had been doing or thinking. Their stories included real-life events or encounters that represented a social interaction between the participating teachers and one or more of their students at an identified time inside or outside the school. The stories were genuine expressions of reality from the teachers' perspectives and how they tended to perceive or define DI — or what DI meant to them in reality in relation to what they had done or were doing with their students. Overall, I identified 51 of these narratives (stories). After carefully studying them, I grouped them into five different categories and named them based on the narrative types and how the teachers understood and made meaning of the concept of DI. Thus, the study involved a combination of thematic and structural analyses of small story narratives (see Riessman, 2005).

3.3.2 Interaction analysis

Interaction analysis was utilized to analyze the video recordings of eight teachers' instruction (11 lessons) for sub-study II. Interaction analysis involves a fine-grained examination of the discourse patterns of teacher–student interaction (DeLiema, 2015). Through interaction analysis, it is possible to capture the details of naturally occurring everyday social interactions in time and space (Erickson, 2006; Jordan & Henderson, 1995). Hence, I was able to understand how the

participating teachers interpreted what they had been doing inside the classroom in order to modify their questioning.

I transcribed and translated the video data. Because questioning is the dominant way of carrying out instruction in Eritrean classrooms, it was important to examine QMS. Hence, the research questions that guided this sub-study focused on the teachers' use of QMS. This topic was selected because given the limited resources and alternatives Eritrean teachers have, teacher talk, and thus questioning, is the most prominent teaching practice in Eritrean classrooms.

I decided to select specific video episodes for transcription and translation, and thus the starting point of the analysis was identifying and selecting the episodes in which teachers modified their original question in whole or partly in an attempt to help students understand the concept under discussion. In total, 227 questioning episodes were identified, and 295 question modifications were found in 155 episodes, which were selected as the data source for analysis. The remaining 72 questioning episodes did not involve question modification, and either the teacher, the students or both simultaneously answered each question directly. The selected episodes were clustered into categories of QMS. Two criteria were used to classify and identify the question modification episodes: (1) a teacher presented two or more consecutive questions about the same topic, either in one turn or in a close-knit turn after a student response; (2) the reason for modifying an original question was related to the students' incorrect answer and misunderstanding or a failure to elicit responses from the students.

3.3.3 Thematic analysis

Thematic analysis was used as the primary method of analysis in sub-study III to analyze the data from the teacher interviews and the video recordings of classroom instruction. In thematic analysis, the theme is utilized as a concept to organize a group of repeating ideas or patterns that run throughout the data. Hence, the prevalence of the items under study is very important (Braun & Clarke, 2006, 2022). Through thematic analysis, it is possible to study underlying meanings, which are implicitly discovered at the interpretive level, as well as elements of the participants' subjective understandings. Thematic analysis enables researchers to raise the participants' perspectives to an abstract level of conceptualization and reveal the underlying meanings in the participants' words. According to Nowell et al. (2017), thematic analysis is helpful when analyzing large quantities of data. It also provides flexible approaches, enabling a rich and detailed yet complex account of the data to emerge (Braun & Clarke, 2006). Thematic analysis is also useful for examining the perspectives of different research participants, including their similarities, differences and insights, as well as summarizing the key features of a large data set. As thematic analysis is not directly related to any pre-existing theoretical framework, it can be utilized flexibly within different theoretical frameworks. However, the theoretical position of the researcher should be clearly stated. In this study, the analysis involved the following six steps described by Braun and Clarke (2006, 2022):

(1) Familiarizing oneself with the data: I began by reading the transcribed and translated data interview data and observing the extensive video recordings of the classroom lessons of 10 teachers. This helped to familiarize me with the dataset. Throughout this phase, I noted initial ideas (Braun & Clarke, 2006), that is, the various contrasting and conflicting discourses between the participant teachers' narratives obtained from the interviews and the classroom instructions recorded in the videos.
(2) Coding: In this phase, I inductively coded the interesting features of the data that were related to DI in a systematic way across the entire data set. The codes were generated as they appeared in the data without attempting to fit the emerging codes into the context of existing themes in the literature. In this process, the data relevant to each code were collated. The codes emerged from both the interviews and the video data. A total of 26 codes were generated from the interview data, and eight teachers reported that they carried out different activities that could fall under each of these codes. The teachers' activities were sometimes related, while at other times they were different or even opposing. For example, teachers mentioned "providing several questions", "offering peer support", "providing individual activities", "code-switching", "changing sitting arrangements", "making groups and providing group work", "punishment/reinforcement", "pace of learning", etc.
(3) Generating initial themes (=tensions): This involved collating codes into potential themes, gathering all the data relevant to each potential theme. At this stage, the codes were condensed by organizing them into categories that could potentially form themes. Generating the themes took more time when refinement was necessary for the data to fit into the generated themes. The interview and video data were reread and re-observed carefully to identify patterns that persisted throughout the data set, resulting in the identification of several potential themes. (The video data extracts were observed that supplemented, complemented or contrasted the activities of the teachers indicated during the interviews.)
(4) Developing and reviewing themes: This phase involved checking whether the generated themes worked in relation to the initial codes and the entire data set (steps 1 and 2) and generating a thematic analysis "map". At this stage, I attempted to bring the two data sets together to develop potential themes that could be analysed in their entirety with the help of the available data set. Ultimately, 6 themes were selected to represent all of the interview and video data.
(5) Refining, defining and naming themes: This involved an ongoing process of refining the specifics of each theme and the overall story they told, generating clear definitions and names for each theme. At this stage, I identified five pedagogic tensions (themes) and decided on their final naming. The pedagogical tensions were identified based on the teachers' thinking regarding DI and how they understood the concept. The teachers produced exhibited differences in their thinking and actions in the

actual classroom instruction. I defined these inconsistencies in thoughts and actions as pedagogical tensions. As a result, each tension represented a theme (see Braun & Clarke, 2022). The final naming of the tensions was based on previous literature and theory-driven thinking about DI.

(6) Producing the report: In this final step, I selected extracts that were representative of the entire data set and respective themes and analysed them in relation to the research questions and against the existing literature to produce a scholarly report of the analysis.

3.4 Research Ethics

Researchers need to insure the integrity of their research, avoid any misconduct and also protect their participants (Creswell & Creswell, 2018). In this study, I followed the principles and rules of research ethics established by the Finnish National Advisory Board on Research Integrity [TENK] (2012, 2023). Since my study did not meet any of the criteria mentioned in the TENK guidelines regarding the need for an ethical review, the Ethics Committee of the University of Jyväskylä did not perform an ethical review of this study. Section 3.1 describes in detail the ethical principles that were followed during the data collection process. Local approval and informed consent were sought from the district school authorities, school principals, teachers and parents of all the students who participated in video recordings of classroom instruction. I prepared a parent consent form that explained the general aims of the study and the purposes of the data collection. The consent form also explained that there were no risks related to their children's participation in the study. Further, the consent form stated that "it is the right of the child to participate in the video-recordings or not" and that "the child has the right to interrupt their participation in the data collection at any moment". The consent form was prepared and sent to the parents with the anticipation that, each parent would discuss participation with their children.

Recently, it has also been emphasized that the informed consent of children is crucial. For example, if they do not want to be part of a video recording, then they should be given a chance to opt out of it (see Einarsdóttir, 2007; Peters et al., 2021). One way to ensure this is to add the following kind of sentence to the parental consent form: "I have discussed this research with my child, and (s)he understands what participation means and (s)he wants to participate". However, I did not include such a clause. Moreover, the children were not provided with a simple consent form. These may be considered limitations regarding consent. Thus, it was important to observe the reactions of the children during the research. During a pilot video recording, no student appeared to be bothered by the video recordings. As the front two cameras were stand-alone ones, the students' attention was not diverted or disturbed by the video recording. However, in situations when a research assistant video-recorded the teacher's

movements using a tablet (half of the cases), some of the students who were sitting close to them were distracted by what they saw on the screen (some were even seen giggling). However, on average, only five to six students out of 50–70 students were occasionally distracted by the video-recording in each classroom. Otherwise, the video recordings did not appear to elicit anxiety or stress in the students. On the other hand, however, the participant teachers' consciousness of being recorded by multiple cameras might have caused pressure to appear as an especially good and effective teacher.

The topic of my research was evolving throughout the PhD project period before it settled into its final shape. This was guided by the data I collected from Eritrea and the analytical angles I chose when recording my findings. While reporting the results, I was not focused on individual teachers' attitudes and their personalities but rather on the cultural meanings given to DI. Hence, while paying close attention to classroom practices in Eritrea and obtaining critical data, care was taken to report the findings in a modest way without criticizing or attacking the individual teachers' actions or non-actions. While some practices that diverged from common ones were observed, I do not believe that individual teachers could change everything on their own. What they were doing was based on culture-related practices in Eritrea, which clearly influenced the individual teachers' thinking and behaviour. I secured all data personally, with access only given to my three supervisors.

4 OVERVIEW OF THE ORIGINAL STUDIES

My dissertation consisted of three sub-studies. The aims, research questions, data and the analysis methods of each sub-study are presented in Table 3.

TABLE 3 Overview of the original studies

	Sub-study I	**Sub-study II**	**Sub-study III**
Title	The meanings of differentiated instruction in the narratives of Eritrean teachers	The use of question modification strategies to differentiate instruction in Eritrean mathematics and science classrooms	Differentiation-related tensions in the thinking and instruction of Eritrean elementary and middle school mathematics teachers
Aim	To investigate the meanings of DI constructed by Eritrean elementary and middle school mathematics and science teachers	To examine the question modification strategies Eritrean elementary and middle school teachers used to differentiate their instruction	To explore the pedagogical tensions related to differentiation in Eritrean elementary and middle school mathematics teachers' thinking and instructional practices

	Sub-study I	Sub-study II	Sub-study III
Research questions	1) What kinds of narratives do Eritrean mathematics and science teachers tell about differentiating instruction? 2) How do teachers position themselves and students within these narratives?	1) What kinds of question modification strategies do teachers use in mathematics and science classrooms to differentiate their instruction? 2) What kinds of functions do various question modification strategies serve in differentiating classroom interaction?	1) What kinds of tensions related to DI exist in Eritrean elementary and middle school mathematics teachers' thinking and instruction?
Participants and data	Narrative interviews with 18 teachers	Video recordings of 10 mathematics and science teachers (13 lessons)	Both interview and video recordings of 8 mathematics teachers (10 lessons)
Data analysis	Narrative analysis	Interaction analysis	Data-driven inductive thematic analysis

4.1 Sub-study I: The Meanings of Differentiated Instruction in the Narratives of Eritrean Teachers

This narrative study aimed to investigate the meanings Eritrean elementary and middle school teachers constructed regarding DI and the positions in which they located themselves and their students in relation to implementing DI. The study was based on narrative interview data obtained from 18 Eritrean mathematics and science teachers. In their interviews, the teachers recounted 51 small stories, in which they described their real-life experiences of meeting students' individual needs through differentiation during teaching.

The findings indicated that the teachers produced five different meanings of DI in their narratives. The first three were positive, while the last two were negative: DI as a caring orientation; DI as a flexible pedagogic approach; DI as a

self-reflective process; DI as a failed attempt; and DI as a demanding approach. In the three positive narrative types (72% of the small stories), the teachers constructed strong agency related to implementing DI in their classrooms by positioning themselves as attentive and understanding caregivers, flexible and innovative experts or reflective learners. Correspondingly, the teachers positioned their students as respected human beings, diverse learners or facilitators of teachers' learning. In contrast, in the negative narrative types (28% of the small stories), the teachers positioned themselves as responsible individuals with limited possibilities to influence students or unsuccessful teachers with scarce resources. The students were positioned as individuals with severe challenges or victims of weak instruction.

The findings revealed that implementing DI is also possible, at least to some extent, in countries with scarce resources and large class sizes like in Eritrea. Thus, the study offers promising future prospects in relation to supporting teachers to adopt evidence-based DI practices through different forms of formal and informal training. The negative narratives also indicated some of the major challenges Eritrean teachers face when teaching in today's large, heterogeneous, inclusive classrooms, which are poorly resourced. In addition, they highlighted future reforms that could be taken by the MOE, schools and teacher education institutions in Eritrea.

4.2 Sub-study II: The Use of Question Modification Strategies to Differentiate Instruction in Eritrean Mathematics and Science Classrooms

In sub-study II, I examined how Eritrean elementary and middle school teachers utilized question modification strategies (QMS) to differentiate their instruction with the aim of addressing student diversity in the classroom as well as the functions these strategies served in classroom interactions. The study was based on 11 videotaped recordings of classroom lessons conducted by eight mathematics and science teachers. Interaction analysis was utilized as an analytical method.

The findings revealed that the QMS represented a reactive, not proactive, response of teachers to students' learning needs. The QMS were also found to help engage students in classroom discussions in oversized but mixed-ability learning groups. Further, the QMS helped teachers provide students with optimal access to knowledge by responding to their situational learning needs. Of the five QMS identified from the data, repetition was the most frequently utilized by the teachers. However, apart from providing opportunities for slow-responding students to engage in the questioning process, its support of DI was limited. Thus, its contribution to DI was related to slowing the pace of instruction for some students. The effective use of rephrasing as a QMS strategy serves DI by helping teachers respond to the misunderstandings of students. Clarification

and decomposition were found to be the most highly developed strategies, and the teachers were observed to utilize both flexibly. Decomposition aligned with students' learning readiness by lowering the cognitive level of the questions. Both clarification and decomposition were found to enhance differentiation by modifying the learning content and process of teaching. Code-switching was found to be a holistic example of DI by differentiating the content, product and the learning environment. It was also found to specifically help linguistic-minority students, thus meeting the students' learning profiles. The most complex and abstract higher-order questions called for clarification and decomposition QMS, while simply closed-ended questions that required the recall of factual information were answered easily when teachers utilized repetition.

The overall findings indicate that QMS are indispensable, dominant elements of classroom interactions and one of the most powerful forms of pedagogic talk in teacher-led and poorly resourced classrooms, like those in Eritrea. Understanding the role of the different strategies in supporting students' learning can help teachers further develop their teaching practices. Thus, these findings call for strengthening teachers' potentialities and expertise through ongoing in-service teacher training programmes, leaning on research-based teaching practices.

4.3 Sub-study III: Differentiation-related Tensions in the Thinking and Instruction of Eritrean Elementary and Middle School Mathematics Teachers

In this thematic analysis, I explored the pedagogical tensions related to differentiation in Eritrean elementary and middle school mathematics teachers' thinking and instruction practices. Interviews and video recordings (10 lessons) of eight teachers were used as data in this study. The findings revealed three major tensions: adapting instruction to students' individual needs versus carrying out whole-class frontal teaching; providing individual tasks versus abstract content-laden teaching; and utilizing peer learning versus emphasizing individual-oriented competition. The findings further showed that mathematics teachers mainly differentiated the content and the process of their instruction, while there was no evidence of differentiating the product. They adapted their instruction to meet students' individual needs by differentiating the content, while they differentiated the learning environment through the use of mixed-group peer learning. The study revealed that these teachers face the same dilemma as teachers elsewhere regarding whether to adapt their instruction to the individual needs of their students or stick to the requirements of the current curriculum, which requires traditional whole-class frontal teaching. Moreover, the study yielded culture-specific findings, including teachers' emphasis on individual-oriented competition, the dominant use of summative assessment as

well as the utilization of punishment as a motivating factor, all of which were contrary to previous findings. Although the teachers claimed that competition motivates students and makes the classroom more enjoyable, the widespread use of competition may be due to the teachers' limited understanding of student-friendly classroom management.

The major challenges the teachers faced in differentiating their instruction included a lack of DI experience in their pre-service and in-service training, a lack of human and material resources and large class sizes. Moreover, it appeared that some tensions related to DI may be linked to the teachers' misunderstandings about the nature and conception of DI.

While the Eritrean teachers' activities were dominated by whole-class frontal and abstract content-laden teaching, they were found to intuitively vary their instructional approaches in ways that foster DI, indicating future possibilities of strengthening the use of DI in Eritrean schools. There were abundant examples of the teachers adapting their instruction to the individual needs of their students, providing individualized tasks and utilizing peer learning in the form of mixed small groups. The teachers also held positive attitudes towards implementing DI. However, the findings showed that there is still a need to increase Eritrean teachers' awareness of the contradictory discourses surrounding classroom practices. Finally, teachers need both material and human support and training on research-based DI practices to foster the inclusion of all students.

5 DISCUSSION

In this doctoral study, I sought to contribute to research and the understanding of DI and its practices by providing knowledge on the issue in the context of developing countries. Specifically, I aimed to investigate the meaning making of Eritrean teachers (sub-studies I and III), ways of implementing DI (mainly sub-studies II and III) and the challenges teachers encounter in relation to carrying out DI practices in classrooms (sub-studies I, II and III). The findings revealed that the teachers understood DI differently and generally held positive attitudes towards both DI and IE. At the same time, the findings indicated that due to the various challenges the teachers encounter, they often fail to implement DI effectively and thus have reservations to fully embracing it. Moreover, the teachers exhibited inconsistencies in the ways in which they implemented DI, which were rooted in both their narrated experiences and other extraneous factors beyond the teachers.

Overall, this research work has broadened the understanding of DI and inclusive practices by providing empirical insights in the context of developing countries with limited resources and overcrowded and heterogenous educational settings with large class sizes. The findings also suggest directions of future research as well as intervention strategies.

5.1 Meanings of DI

One of the key findings of the study was that the teachers in this study understood and approached DI in different ways. These views can be conceptualized as holistic, pragmatic and skeptical approaches to DI. These three main meanings were generated from the findings across all three sub-studies.

The *holistic approach* reflected teachers' strong desire, readiness and positive attitude to support all students in the classroom as well as to become personally and emotionally attached to students. For example, a caring approach was identified in sub-study, as the teachers went beyond the role of a teacher and

personally addressed individual students' needs in the same way as parents look after their children. This was evident in their tendency to provide psycho-emotional support to help alleviate stressful situations (e.g., living on the street) students encountered because of various family and extraneous factors. In addition, the teachers narrated their efforts to extend their support outside of school hours and during the weekend. This is a practice that differs from typical teacher roles in western countries and is missing from western studies on DI. The findings of sub-study II also revealed that teachers were holistically and crucially attentive to their students' ethnolinguistic diversity, code-switching between three languages (English, Tigrigna & Bilen) to meet the individual needs of ethnic minority groups in Tigrigna-dominated classrooms. Likewise, the findings from sub-study III highlighted teachers' attempts to differentiate the learning environment to accommodate students with diverse mathematics skills and abilities. Taken together, the findings of sub-studies I and III revealed that teachers sometimes proactively responded to the educational needs of individual students. The holistic approach to DI thus reflected teachers' deep attitudinal attachment to the principles of DI and can be considered teachers' ideal understanding of the philosophical values of DI (Tomlinson, 2014; Tomlinson & Imbeau, 2010).

In addition to the holistic approach to DI, the *pragmatic approach* was also identified throughout the three sub-studies. For example, teachers' understanding of DI as a flexible pedagogical approach, which was observed in sub-study I, indicated that the teachers understood DI as a variety of concrete acts (e.g., modifying direct teaching by providing questions at students' levels and utilizing peer teaching) to make their teaching more accessible for all students and to facilitate learners' meaningful presence, participation and learning in the classroom. This has also been found to be a cornerstone of DI from the perspective of teachers in previous studies (King, 2016; Stollman et al., 2019). Additionally, both sub-studies II and III showed that the participating teachers utilized a wide range of instructional strategies that facilitated differentiation, including making changes to the classroom arrangement, utilizing peer learning and modifying teacher questions through clarification and decomposition. However, this reflected the teachers' reactive response to students' learning needs (Lindner & Schwab, 2020; Tomlinson et al., 2003) rather than a proactive response, unlike the holistic approach. Further, the teachers also viewed DI practices as opportunities to challenge and reflect on their own teaching practices and acknowledge their limitations, emphasizing the need to make appropriate adjustments to their practices, as seen in sub-study I.

The third meaning given to DI In three sub-studies was the *skeptical approach* to DI. In sub-study I, the teachers' narratives of DI as a "failed" and "demanding" approach reflected the skeptical approach to DI. Although the teachers were aware of the principles and requirements of DI, they did not believe that its implementation would be possible in Eritrea because of various external factors, such as a lack of training, large class sizes and a lack of clarity or unfamiliarity with the actual DI strategies. Thus, some teachers were reluctant

and resistant towards DI and displayed attitudinal ambivalence towards implementing it. As a result of these challenges, which have also been mentioned in other studies, (Cambridge-Johnson et al., 2014; Gaitas & Martins, 2017; Goddard & Kim, 2018; Malinen et al., 2013; Porta, 2023; Rodriguez, 2012; Smit & Humpert, 2012), the teachers carried out practices that were contrary to the core values of DI, which in turn hindered the realization of IE. For example, sub-study II showed that teachers utilized traditional teacher-led whole-class teaching and low-level questions. Similarly, sub-study III revealed that teachers sometimes punished their students for misconduct or failure to comply with or meet their demands or labelled their students because of their disabilities and behavioural variances.

These three meanings given to DI reflect the teachers' readiness to recognize and accommodate their students' diversity. However, at the same time, they were caught in dilemmas or uncertain about what they should do. Thus, generally, the teachers' meaning making related to their positive attitudes towards DI and diversity, and the ambivalence observed in meanings was usually the result of extraneous rather than internal factors. Thus, interventions that target these challenges could help to alleviate the teachers' skeptical form of meaning making.

5.2 Strategies of Implementing DI

The research findings offer diverse yet contrasting insights into Eritrean teachers' use of DI strategies and their commitment to implementing them. First, the teaching strategies of the study participants were mainly dominated by the traditional teacher-centred or teacher-dominated activities (Tadesse et al., 2021, 2023). The teachers had primarily assumed the role of providing or transmitting knowledge, whereas the students had the role of receiving that knowledge (sub-studies II & III). Additionally, the findings of sub-study III revealed the inconsistencies in the teachers' thinking and instruction. On the one hand, teachers advocated and verbalized the need for differentiating instruction, regarding it as an integral and essential part of the teaching and learning process, not simply an alternative. On the other hand, their classrooms were dominated by content-laden abstract learning, summative assessment practices and the substantial use of the blackboard — the typical way of teaching in Eritrean classrooms. Neither of these teaching strategies support the effective implementation of DI as intended (Tomlinson, 2014; Tomlinson & Moon, 2013).

In the worst scenarios, the teachers utilized individual-oriented competitions, labelled students according to their abilities or behaviours and even resorted to corporal punishment (sub-study III). These practices jeopardize the real essence of the principles of IE and DI. For instance, while earlier studies (Buchs et al., 2021; Lindner et al., 2021; Vu et al., 2021) have shown that peer learning and inter-class competition partly promote differentiation but that teachers in differentiated classrooms should ensure that students compete with

themselves and not one another (Tomlinson, 2014), the Eritrean teachers expressed a belief that individual-oriented competition facilitates DI (sub-study III). This might be due to the widespread culture-specific belief that competition is both acceptable and constructive in Eritrean society.

Notably, in both sub-studies II and III, the teachers worked as lone practitioners, while collegiality in the form of team teaching or co-teaching was non-existent. Furthermore, the teachers' narratives in sub-study I revealed the teachers' individual autonomy. This finding is surprising, as the Eritrean culture is generally collective, collaborative and communal rather than individualistic. A recent study in Eritrea (Fessehation & Pai, 2019) also indicated that teacher readiness for collaborative teamwork is low. This emphasis on teacher autonomy is contrary to the recommendations in the Eritrean curriculum and MOE documents (MOE, 2009, 2018), which advocate for collaboration and collegiality. It is also inconsistent with previous studies arguing that teacher collaboration is necessary to successfully implement DI (Goddard & Kim, 2018; King, 2016; Smit & Humpert, 2012). The lack of focus on DI and IE and continuous school-based in-service training could be one of the reasons behind this finding. Earlier studies from Eritrea confirmed lack of in-service training (Elias et al., 2023; Tadesse et al., 2021). Moreover, teachers' overloaded schedules, which include teaching two groups of students during the day in opposite shifts, represent a huge responsibility. They must accommodate large numbers of students, which could cause them to become pre-occupied with their own responsibilities instead of focusing on supporting each other.

Although the study did not reveal any systematically organized and guided use of DI strategies as recommended in previous studies (e.g., Goddard & Kim, 2018), there were still positive examples of the individual teachers being conscious of DI and intuitively taking the initiative to implement a variety of tangible instructional strategies to meet individual students' learning needs in the classroom. These classroom practices reflected some aspects of the models of Tomlinson (2014), Roiha and Polso (2021) and Renzulli (Reis & Renzulli, 2018). This included differentiating teaching materials and methods (Roiha & Polso, 2021; Tomlinson, 2014) and some aspects of modifying the learning environment (Reis & Renzulli, 2018; Roiha & Polso, 2021; Tomlinson, 2014).

The study provides evidence showing that even though Eritrean teachers had several challenges related to DI (which shall be discussed in more detail in sub-section 5.3), they were able to utilize diverse pedagogical and psycho-emotional strategies to implement DI. Thus, the Eritrean teachers did not differ from committed teachers in other cultural contexts in terms of supporting students by taking the initiative to incorporate diverse instructional strategies creatively and innovatively in their teaching as a way of differentiating their instruction (UNESCO, 2020). Instead, the research findings indicated that the teachers managed to carry out DI despite scarce resources and large class sizes. While the teachers struggled to accommodate their students' diverse needs in large classes with a demanding curriculum, they turned this difficult situation into an opportunity to maximize their students' learning. They accomplished this

through the formation of mixed-ability groups, purposefully placing at least one high-achieving student in each peer group, or through engaging as many students as possible in individual as well as blackboard work. In addition, the teachers also utilized their cultural and traditional value-laden practices, such as showing tenderness through comforting touch and hugging. This helped them create a positive and student-friendly learning environment and increase their students' participation in class. These findings are in line with those of earlier studies showing that such activities are common ways of creating a positive learning environment (Mäkelä, 2018; Roiha & Polso, 2021). For example, Mäkelä (2018) stated that activities that enhance social relations in turn enhance students' sense of belonging by creating meaningful connections with the school.

Despite the positive finding of teachers utilizing different strategies to promote DI, not everything was carried out smoothly and perfectly. The teachers also used a wide range of traditional teacher-centred strategies, which neither supported the differentiation of content, process, and product nor promoted a positive learning environment (sub-studies I, II and III). For example, the teachers placed the blame for their inability to differentiate their instruction on students' reluctance and specific behaviours, positioning them as challenging or problematic students (sub-studies I and III). In addition, the teachers carried out summative forms of assessment more frequently than formative assessments and implemented teacher-led instruction predominantly (sub-studies II and III).

The opposing tensions between the teachers' narrations of what they did and what they actually did in reality indicate that further work needs to be done to help teachers improve their understanding of the best practices for implementing DI. The same kind of ambivalence between teachers' actions and thinking has also been found in previous studies (e.g., King, 2016). In line with this, it has been reported that carrying out DI in practice is challenging (Cambridge-Johnson et al., 2014; Gaitas & Martins, 2017; Goddard & Kim, 2018; Malinen et al., 2013; Porta, 2023; Rodriguez, 2012; Smit & Humpert, 2012). Accordingly, it is crucial to enhance teachers' positive attitudes towards DI since, as King (2016) noted, teachers with positive attitudes towards implementing DI tend to utilize DI as often as possible in practice.

5.3 Challenges of Implementing DI

While none of the three sub-studies directly addressed teachers' challenges in implementing DI, such challenges became evident throughout the sub-studies. Thus, the third research question focused on the factors that caused challenges for teachers seeking to implement DI in their classrooms. Understanding these challenges has implications for further research as well as for recommendations concerning education policy and teaching practices in schools.

The challenges reported by the teachers in this study can be divided into four main types: student-related factors (student behaviour and diversity), curriculum-related factors (voluminous, content laden and inflexible curriculum),

organizational factors (large class sizes, lack of training and professional development, lack of resources and school support, poor infrastructure) and external factors (parent–teacher relationships). These challenges partly align with teachers' general problem talk found in previous studies conducted in different contexts and countries (Cambridge-Johnson et al., 2014; Gaitas & Martins, 2017; Goddard & Kim, 2018; Malinen et al., 2013; Porta, 2023). For example, Gaitas and Martins (2017) reported that teachers face challenges in implementing DI in five areas: activities and materials, assessment, management, planning and preparation and the classroom environment. In addition, teachers' challenges have been linked to the contextual characteristics of the schools at the system level, the school level, the teacher or class level and the individual student level (Courtney, 2021; Lunsford, 2017).

Organizational factors like large class sizes were observed to be one of the main challenges experienced by teachers in all three sub-studies. DI is considered a time-consuming and challenging approach to teaching (Goddard & Kim, 2018), and this is especially true in school contexts like Eritrea, where class sizes are typically quite large (50 to 70 students). In this study, teachers highlighted this issue in their comments: "*Class size is the main challenge. We have classes as large as 50–60 students, and we cannot identify individual students' needs properly*" and "*Because of the large class size, I could not carry out authentic activities as often as possible*". The situation was exacerbated when the schools were also in highly impoverished contexts. Indeed, poor infrastructure and a scarcity of material resources were evident in all the schools in this study.

A notable challenge related to implementing DI, which was identified throughout the three sub-studies, was a lack of both pre-service and in-service professional development courses on DI and IE. This limited the teachers' pedagogical expertise and ability to identify and address the diverse needs of their students, to flexibly and frequently adapt the curriculum and to select and utilize strategies that promote DI in more systematic and organized ways. For example, the teachers proudly reported the frequent multi-purpose use of blackboards as one of the best ways of accommodating student diversity and applying student-friendly teaching methods (sub-study III). In addition, several teachers said that a lack of professional development opportunities was one of the main causes for their skepticism towards DI (sub-study I) and the reason for their confusion and tensions in carrying out DI strategies (sub-study III). Gaitas and Martins (2017) implied that such teachers' challenges are linked to the lack of professional development training on DI in higher education programmes. Several studies on DI have also emphasized that a lack of educational support is a main challenge in DI implementation (e.g., Gaitas & Martins, 2017; King, 2016; Porta, 2023).

Besides organizational factors, the teachers in this study also stated that the overloaded curriculum content was another challenge for carrying out DI (sub-studies I & III). Further, the classroom observation data from sub-study II revealed that the teachers struggled with covering large portions of lesson contents within the 40 minutes lesson time. Overall, the findings across the three

sub-studies indicated that the teachers were faced with the difficult situation of fulfilling the requirements of the overly bloated school curriculum. Thus, they were often forced to resort to traditional teacher-dominated, content-laden, abstract, whole-class teaching instead of DI (e.g., sub-study III). In their narratives in both sub-studies I and III, the teachers related this challenge to large class sizes. As a result of these challenges, they were not able to frequently utilize student-centred instructional strategies.

Moreover, teachers often had difficulty recognizing positive student characteristics, traits and behaviours and instead blamed them for the failures of teaching. A lack of teachers' professional skills and school-based support were evident in both sub-study I and III, in which the teachers highlighted the challenges they faced in identifying and supporting their diverse students' individual needs. Eritrean schools are not equipped with support personnel, including specially trained teachers and support teachers. Hence, it requires commitment and dedication on the part of individual teachers to take the initiative in attempting to identify their students' special needs and address them in ways they consider appropriate. A lack of collaboration and teamwork made it even more difficult for individual teachers to accommodate student diversity on their own. Accordingly, it is crucial for teachers to hold positive attitudes toward student diversity and have the willingness and ability to acknowledge and support the individual needs of their students (see Cambridge-Johnson et al., 2014; Dixon et al., 2014).

Finally, the participating teachers expressed their deep concern about the lack of or limited parent–teacher relationships and parents' lack of commitment to supporting their children's education (sub-studies I and III). As a result of this challenge, the teachers reported that they sometime felt helpless and did not know what to do to support struggling students. This challenge has also been found in previous studies (Courtney, 2021; Siam & Al-Natour, 2016). Earlier study in Eritrea also reported similar findings (see Belay et al., 2017).

5.4 Strengths and Limitations

The trustworthiness of the study was strengthened in different ways. The notable and classic work of Lincoln and Guba (1985) describes the concept of trustworthiness of qualitative research in terms of credibility, dependability, transferability and confirmability (see also Loh, 2013; Patton, 2015), which are alternative quantitative assessment criteria for validity and reliability (Nowell et al., 2017).

To strengthen the credibility of this study, I collected rich interview and video data, which complemented each other and provided a multi-sided view of DI. The video recordings represent authentic and naturally occurring data that would have existed without my presence as a researcher (Lincoln & Guba, 1985; Patton, 2015). The interviews also provided the opportunity to capture the teachers' individual viewpoints, emotions, experiences and interpretations. The

use of both data sets in sub-study III enabled data triangulation, enhancing the credibility of the research findings. I also made repeated visits to the sites and spoke with the school governing bodies as well as the participating teachers to establish rapport, gaining their trust for the interviews and video recordings. I also shared the recorded videos with teachers who wanted to observe their own activities. Thus, I spent a considerable amount of time in the field during the data collection process, which helped me develop an in-depth understanding of the phenomenon under study (see Creswell & Creswell, 2018; Nowell et al., 2017). This also allowed me to develop a trusting relationship with the participants, helping to ensure that they provided information frankly (see Lincoln & Guba, 1985). Further, I utilized different analytical methods in each sub-study, thereby improving the credibility of the findings.

The direct observations and video recordings of classroom instruction and teacher interviews provided important insights into how teachers understand and implement DI in their classrooms. However, a key limitation of the observation data was the lack of recordings of what happened when students were working in groups due to the quality of the recording devices and poor classroom lighting. Hence, the students' voices during the group work were missing, especially when the respective teacher was not physically close to the groups of students. Thus, supplementing this research with students' voices on their experiences with DI could offer further insights on the efficiency and usefulness of the DI strategies from a student perspective. In addition, the teachers involved in this study were considered the best by the pedagogic heads and the school directors of each school, so selection bias is a possible limitation. If the participants had been more diverse, including both those nominated by the school governing bodies and others who desired to participate in the study, I would have been able to collect richer data, and the findings might have been different. Accordingly, future studies should include teachers across all grade levels, with diverse teaching backgrounds and from all school types throughout Eritrea.

Another important limitation of the study was the lack of member checking, which involves presenting the final report of the study or specific descriptions or themes to the participants (see Creswell & Creswell, 2018) or creating opportunities for them to provide context and alternative explanations (Patton, 2015, p. 967). Moreover, inter-coder reliability was not checked.

The dependability (parallel reliability) of a study is related to ensuring that the research process was logical, traceable and documented (Lincoln & Guba, 1986). In this study, the use of triangulation strengthened the dependability of the research. Three different analytical methods were used in examining the research data: namely narrative analysis (interviews), interaction analysis (video-recorded data) and thematic analysis (both interview and video data). Thus, both the interview and video-recorded data were examined using at least two analytical methods. Moreover, when collecting the data, I personally interviewed the 18 teachers at a convenient time and location, and I personally installed the video-recording devices in the respective schools with the help of research

assistants. When framing the research questions and the interview questions, dichotomous questions were avoided. The selection of four to five general questions helped me obtained detailed information from the interviews. Further, the questions were treated as beginning points, and when necessary, they evolved in a way that allowed the participants to request clarifications. The entire analysis and discussion were based solely on these two data sources, which were collected in 2019.

Transferability refers to the "potential for extrapolation" (Elo et al., 2014). It is related to how the findings of a study can be generalized or transferred to other settings. This can be achieved through the provision of thick descriptions and experiential accounts of the participants (see Creswell & Creswell, 2018; Nowell et al., 2017). It is the responsibility of the researcher to provide thick descriptions so that external readers can judge the transferability themselves (Lincoln & Guba, 1986). Purposeful sampling strengthens the transferability of study results by providing in-depth descriptions of participants' views and experiences in a range of contexts and times (see Patton, 2015). I utilized small but carefully selected information-rich cases in this research, which helped me recognize and understand the large variety of meanings the Eritrean mathematics and science teachers gave to DI.

Confirmability refers to establishing that the accuracy of the interpretations and findings of a study are based on the data collected (see Elo et al., 2014; Nowell et al., 2017). According to Lincoln and Guba (1986), confirmability is achieved by ensuring credibility, transferability and dependability. With some limitations, the trustworthiness of these aspects was maintained in my research. Confirmability of the results was ensured by carrying out a systematic and unbiased analysis of both the interview and video-recorded data. Throughout the three sub-studies, I did not omit any relevant knowledge or data when answering the research questions, even though the findings sometimes differed from what I expected. Additionally, I have presented negative or discrepant information to provide the different perspectives of the participants and discussed contrary information in the findings (see Creswell & Creswell, 2018; Nowell et al., 2017). While it was not possible to provide inter-coder reliability, the constructive challenges, comments, criticisms and continuous discussion with my three supervisors helped me develop the perspective, thickness and strength of my data description and interpretations. This in turn served the purpose of researcher triangulation and added to the confirmability of the findings.

However, despite these strengths, the data were obtained from a relatively small sample of mathematics and science teachers. Thus, future work involving a large-scale study is needed to gain a deeper understanding of the field and to ascertain the transferability of the findings to other contexts.

5.5 Conclusions and Practical Implications

This study showed that even though the Eritrean mathematics and science teachers tried their best to meet their students' individual needs, they still experienced confusion or a lack of clarity regarding the meanings and definitions of the concepts of IE, DI and LCIP. They were also unclear about the use of non-offensive or non-biased terminology and labels. This might be due to the vague and unclear IE policy statements of the MOE (2008, 2009) and the lack of specific guidelines and directions concerning how to implement DI and IE at the school level. Indeed, the lack of a conceptual focus on IE and DI in practice is one of the challenges to realizing IE through DI. Thus, the guiding principles need to be embedded in policy documents as well as in school curricula and HIEs themselves. Further research is also needed to study these policy documents and suggest appropriate recommendations on how they could be harmonized with the school curricula at different levels.

The study also highlighted the need to improve the quality of Eritrean classroom instruction by supporting teachers in classrooms and developing the teacher education practices in HEIs by incorporating DI elements in teacher preparation programmes. The findings revealed the need to improve teachers' pedagogical expertise through training and other forms of personnel and material support. For example, in the three sub-studies, the teachers were found to alternate unevenly between traditional teacher-centred and student-centred strategies, regardless of the policy and guidelines of the national curriculum, which advocate the use of interactive student-centred methodologies. In addition, teachers might produce negative narratives about DI and express fears and uncertainties regarding DI and addressing diversity in mainstream classrooms. Providing mechanisms to increase awareness as well as research-based tailored training could improve teachers' understanding of DI and maximize their pedagogical competence, helping to alleviate their fears and uncertainties. As Gaitas and Martins (2017) noted, teachers need to be given opportunities to reflect on their own practices and critically evaluate their teaching (see also Tomlinson, 2014). They also need material and personnel support to improve their practices to effectively deal with diverse students. When teachers are supported through continuous professional development, their attitudes towards and understandings of DI are positively influenced, thereby increasing their confidence and self-efficacy to implement DI strategies (see Gaitas et al., 2022; Porta et al., 2022; Savolainen et al., 2022).

Currently, the MOE is preparing to carry out a nationwide foundational literacy and numeracy (FLN) and Teaching at the Right Level (TaRL) intervention programmes with support from UNICEF and the Global Partnership for Education (GPE) (UNICEF, 2023). Such in-service programmes intend to train teachers in the strategies to improve the foundational literacy and numeracy of elementary school students (GPE, 2024). Since the core elements of TaRL are similar with the components of DI the MOE can implement the TaRL

and future teacher-related training programmes using DI strategies and concepts of IE.

As much as inclusion is about addressing and responding to the diverse needs of students, it is also about increasing participation by reducing exclusion. Adopting the concepts of DI and IE into everyday classroom helps to minimize some barriers to learning within the school and the curriculum. Thus, some of the strategies listed by MOE (2005) including creating positive learning environment, strengthening school-family relationships, helping teachers understand that every student in their classroom is their responsibility, and helping teachers and students to accept and celebrate all forms of differences (pp. 18–19) can be further refined into practical measures. Findings from this study and from other related contexts on DI can be utilized by the SNE panel, and teacher education institutions as reflective tools when planning supportive mechanisms for teachers to utilize collaborative learning and peer teaching to create more positive learning environments.

The findings also showed that collaboration and coordinated work between the teachers, the schools and the MOE were lacking. Thus, future research should focus on ways of bringing these three actors together. I hope that such studies will reveal the types of measures that could be taken by each party to improve such collaboration. Smit and Humpert (2012) reported a strong relationship between teachers' use of DI and team collaboration and DI culture, including sharing and discussing ideas about DI with their colleagues (see also Goddard & Kim, 2018). In addition, Goddard and Kim (2018) emphasized the importance of providing sufficient time and logistical support for teachers to collaborate with each other.

As a channel between the MOE and schools, school principals and pedagogic heads (school governing body) need to be well versed in school-based DI and IE policies, practices and in-service training. School leaders need to have knowledge of DI and be DI leaders, training teachers and offering continuous support to help them plan and implement successful DI strategies and evaluate their progress (see Lunsford, 2017; Özdemir et al., 2022; Smit & Humpert, 2012). Such coaching and modelling by principals encourage teacher autonomy, one of the positive aspects of curriculum differentiation (see Özdemir et al., 2022). School district leaders, policymakers from the MOE as well as HEIs should all understand the types of support that teachers require to successfully implement DI strategies in their classrooms on a regular basis, not just as an occasional option.

In this study, several examples of teachers' resourcefulness and their creativity to work within challenging conditions were found. This proves that there is a lot of unutilized potential in the teachers as professionals. Hence, teachers should be heard as part of the discussions around policy improvement. Including experienced teachers who know how to consider the needs of individual teachers in planning would greatly help to bridge the gap between policy and practice.

The three interrelated sub-studies helped me to understand the viewpoints of the Eritrean mathematics and science teachers on DI and IE by providing in-depth information on how they gave meanings to DI, and how they put genuine effort in utilizing a variety of instructional strategies regardless of their challenges. The sub-studies also revealed to me that in the midst of their challenging life circumstances and working conditions, the selected teachers remained devoted to their profession. The research also presented a novel perspective by examining DI in developing countries, focusing on teachers' holistic approaches to and understandings of DI, with an emphasis on the caring approach that dominates Eritrean teachers' practices. These factors have not been examined in previous studies. Thus, the study provides novel findings for the international community.

YHTEENVETO (SUMMARY IN FINNISH)

Opetuksen eriyttäminen on yhä ajankohtaisempaa inklusiivisessa kasvatuksessa, jossa eriyttäminen on keskeinen pedagoginen keino varmistaa jokaisen oppilaan oikeus hyvään opetukseen. Eriyttämisellä vastataan oppilaiden erilaisiin oppimisvalmiuksiin, opiskelunopeuteen, kiinnostuksen kohteisiin ja taitoihin heidän tarpeisiinsa vastaavilla yksilöllisillä opetusratkaisuilla sen sijaan, että opetus suunniteltaisiin samanlaiseksi kaikille oppilaille (Tomlinson, 2014; Tomlinson ym., 2003). Eriyttämistä voidaan toteuttaa eri tavoin. Tomlinson (2014) jakaa sen joko sisällön, prosessin tai tuotoksen eriyttämiseen. Roiha ja Polso (2021) ovat puolestaan kuvanneet eriyttämistä 5D-mallissaan opetusjärjestelyjen, oppimisympäristöjen, opetusmenetelmien, oppimisen tukimateriaalien tai oppimisen arvioinnin eriyttämisenä. Oppilaiden on todettu hyötyvän opetuksen eriyttämisestä, sillä sen on havaittu olevan yhteydessä oppilaiden parempiin oppimistuloksiin esimerkiksi lukemisessa (Reis ym., 2011), matematiikassa ja luonnontieteissä (Kelly, 2013; Russo ym., 2021).

Tämän väitöstutkimuksen tavoitteena oli tarkastella matematiikan ja luonnontieteiden opettajien eriyttämiselle antamia merkityksiä ja tapoja toteuttaa eriyttämistä. Tutkimuksen aineistonkeruu toteutettiin vähemmälle huomiolle jääneessä tutkimuskontekstissa, Afrikan sarven maihin kuuluvassa Eritreassa. Eritrea edustaa niin sanottua globaalia etelää ja kehittyviä maita, joissa niukat koulutuksen järjestämisen taloudelliset resurssit, koululuokkien suuret oppilasmäärät, opettajien matala koulutustaso sekä yhteiskunnan infrastruktuuri asettavat haasteita opetuksen järjestämiselle ja eriyttämisen toteuttamiselle. Vaikka Eritrea on sitoutunut Unescon Salamancan sopimukseen (1994) ja inklusiivisen kasvatuksen edistämiseen (2000), inklusiivisen kasvatuksen toteutumisesta tai opetuksen eriyttämisestä käytännössä ei ole juurikaan tutkimusta. Eriyttämisen käsitteelle ei ole myöskään suoraa vastinetta paikallisessa enemmistökielessä tigrinjassa.

Väitöskirjan ensimmäisen osatutkimuksen tavoitteena oli tarkastella kahdeksantoista eritrealaisen ala- ja yläkoulun matematiikan ja luonnontieteiden opettajien eriyttämiselle antamia merkityksiä. Aineiston muodostivat opettajien kerronnalliset haastattelut ja niissä tuotetut 51 pientä kertomusta arjen eriyttämiskokemuksista. Kertomuksista tunnistettiin narratiivisen analyysin avulla kolme eri tarinatyyppiä, joissa eriyttäminen merkityksellistettiin myönteisesti: eriyttäminen huolenpitämisenä, eriyttäminen joustavana pedagogisena lähestymistapana sekä eriyttäminen itsereflektiivisyyttä edellyttävänä prosessina. Näissä tarinatyypeissä opettajat asemoivat itsensä eriyttämistä toteuttaessaan joko sensitiivisiksi ja ymmärtäväisiksi huolenpitäjiksi, joustaviksi ja uudistuksellisiksi asiantuntijoiksi tai reflektiivisiksi oppijoiksi. Kahdessa tarinatyypissä eriyttäminen merkityksellistettiin kielteisesti joko epäonnistumiseen tuomittavana yrityksenä tai vaativana lähestymistapana. Näissä kielteisissä tarinatyypeissä opettajat asemoivat itsensä joko rajalliset vaikutusmahdollisuudet omaaviksi, mutta kuitenkin vastuunalaisiksi yksilöiksi, tai niukkojen resurssien takia epäonnistuviksi opettajiksi.

Toisessa osatutkimuksessa tarkasteltiin eritrealaisten ala- ja yläkoulun matematiikan ja luonnontieteiden opettajien esittämiä kysymyksiä. Tutkimus keskittyi opettajien tapaan muokata esittämiään kysymyksiä tilanteissa, joissa oppilaat jättivät vastaamatta alkuperäiseen kysymykseen tai vastasivat siihen väärin. Tutkimuksen aineiston muodostivat kahdeksan opettajan oppituntien (n=11) videotallenteet. Oppituntien kysymysjaksot analysoitiin vuorovaikutusanalyysin avulla. Tulokset osoittivat opettajien käyttävän joko pelkästään tai vaihdellen seuraavia kysymyksen muokkaamistapoja: toistaminen, uudelleenmuotoilu, selventäminen, pilkkominen osiin sekä koodinvaihto. Vaikka alkuperäisen kysymyksen toistaminen oli käytetyistä kysymyksen muokkaamisen tavoista käytetyin, se ei varsinaisesti auttanut opettajia eriyttämään opetustaan. Kysymyksen uudelleenmuotoilun tehokkuus riippui puolestaan siitä, miten tarkasti opettaja kykeni havaitsemaan oppilaiden väärinymmärryksen syyn ja muotoilemaan sen pohjalta kysymystään uudelleen. Kaikki opettajien esittämät kysymysten muokkaamisen tavat edustivat reaktiivista vastaamista oppilaiden oppimishaasteisiin. Alkuperäisen kysymyksen selventäminen tai pilkkominen osiin sekä koodinvaihto edustivat eriyttämisen näkökulmasta kehittyneimpiä kysymysten muokkaamisen tapoja. Koodinvaihto virallisesta opetuskielestä (englanti) paikallisiin kieliin on tunnistettu yleiseksi, joskin virallisen politiikan vastaiseksi käytännöksi myös muissa vastaavissa konteksteissa.

Kolmannen osatutkimuksen tarkoituksena oli selvittää eritrealaisten ala- ja yläkoulun matematiikan opettajien eriyttämiseen liittyviä pedagogisia jännitteitä heidän haastattelupuheessaan ja opetuskäytännöissään. Tutkimusaineiston muodostivat kahdeksan opettajan kerronnalliset haastattelut sekä videotallenteet heidän pitämiltään oppitunneilta (n=10). Aineistosta tunnistettiin temaattisen analyysin perusteella kolme eri eriyttämisen toteuttamiseen liittyvää jännitettä: opetuksen suunnittelu oppilaiden tarpeiden mukaisesti vastaan suurryhmäopetuksen toteuttaminen; yksilöllisten oppimistehtävien tarjoaminen vastaan abstraktien opetussuunnitelman sisältöjen opettaminen sekä vertaisoppimisen hyödyntäminen vastaan yksilöiden välisen kilpailun korostaminen. Osa jännitteistä edustaa globaaleja, useimmissa aikaisemmissakin tutkimuksissa havaittuja eriyttämisen esteitä. Osassa jännitteistä tuli esiin Eritrean kulttuuriympäristön erityispiirteet, kuten summatiivisen arvioinnin hallitsevuus tai kilpailun korostaminen.

Väitöstutkimuksen tulokset havainnollistavat, miten opettajien näkemykset eriyttämisestä edustivat joko holistista, pragmaattista tai skeptistä suhtautumista eriyttämiseen. Tulokset olivat rohkaisevia osoittaessaan, että eriyttämistä voidaan ainakin jossain määrin toteuttaa konteksteissa, joissa käytettävissä olevat taloudelliset resurssit ovat niukat ja opetusryhmien koot ovat suuria. Vaikka tutkimusaineistossa opettajajohtoinen opetustapa oli hallitseva, eritrealaiset opettajat osoittivat herkkyyttä oppilaiden moninaisille oppimistarpeille ja pyrkivät vastaamaan niihin kekseliäästi ja luovasti. Eriyttämisen toteuttamisen haastavimmat esteet olivat opettajien näkemyksissä oppilaisiin liittyvät tekijät (esim. käyttäytyminen ja oppilaiden taustatekijät), opetussuunnitelmaan liittyvät vaatimukset (esim. vähäiset jouston mahdollisuudet sisällöissä), organisatoriset te-

kijät (esim. opettajien koulutuksen puute ja heikko infrastruktuuri) sekä ulkoiset tekijät (esim. ristiriidat kodin ja koulun yhteistyössä). Tämä väitöstutkimus nostaa esiin tarpeen tukea eritrealaisia opettajia niin materiaalisesti kuin koulutuksellisesti inklusiivisen kasvatuksen ja eriyttävän opetuksen toteuttajina. Lisäksi onnistuneeseen eriyttämisen ja inklusiivisen kasvatuksen toteuttamiseen tarvitaan selkeämpiä paikallisia ohjeistuksia, rehtorien sitoutumista inklusiivisen kasvatuksen toteuttamiseen sekä opettajien rohkaisemista yhteis- ja tiimiopettajuuteen. Opettajien kokonaisvaltainen huolenpito oppilaista aikaan tai paikkaan katsomatta näyttäytyy puolestaan eritrealaisen opetus- ja koulukulttuurin vahvuutena.

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APPENDICES

Appendix 1 Interview questions

The question used in the teachers' interview in this study are as follows:

1) How would you describe students' diversity in your classroom?

2) How do you teach individually?

3) What does, responding to diverse learners mean to you? Or how do you feel about it?

4) Would you please describe successful and unsuccessful stories about trying to modify or adapt your instruction?

5) Do you have anything to add?

Appendix 2 Information Letter (Tigrigna Version)

ዩኒቨርሲቲ ይሻዕስኪላ

1. **ስምን ንውሓት ጊዜን መጽናዕቲ**

ኣርእስቲ እዚ መጽናዕቲ "ብዙሕነት ተመሃሮ ዘማእከለ ኣመሃህራ ኣብ መባእታን ማእከላይን ደረጃ ኣብያተ ትምህርቲ ኤርትራ" እዩ። ዕላማ እዚ መጽናዕቲ መማህራን መባእታን ማእከላይን ደረጃ ኣብያተ ትምህርቲ ኤርትራ ብዛዕባ ብዙሕነት ተመሃሮ ዘማእከለ ኣመሃህራ ዘለዎም ርድኢትን ኣተሓሳስባን ትጽቢትን ተመኩሮን ከምኡውን ብድሆታትን ምጽናዕ እዩ። እዚ መጽናዕቲ እዚ ኣብ ነሓሰ 2018 ዝጀመረ ኮይኑ ኣብ ሰነ 2022 ክዛዘም ትጽቢት ይግበር።

2. **ሕጋዊ ባይታ ሓበሬታ ምእካብን መጽናዕቲ ምክያድን**

☒ ትሕዝቶ ናይ ሓበሬታ ደብዳበ ካብ ምሕባር ብተወሳኺ ካልእ ቀጥታዊ ስምምዕ ብተሳተፍቲ እዚ መጽናዕቲ ክምላእ እዩ።

3. **ተቐጻጻርን፡ ሓላፍነት እተዋህቦ ተመራማርን ተጸዋዕን**

ተቐጻጻሪ
University of Jyväskylä, Department of Education, Seminaarinkatu 15, P.O. Box 35, 40014. Switchboard (014) 260 1211, Business ID 0245894-7. Data protection officer of the University of Jyväskylä: tietosuoja@jyu.fi, tel. 040 805 3297.

ሓላፍነት እዚ መጽናዕቲ እተዋህቦም ተመራመርቲ
ደሳለኝ ዘርኣይ ገብረመድህን፡ ኢ-መይል desieht@gmail.com, **ቁ. ቴሌፎን** +2917126499
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ተጸዋዒ
ደሳለኝ ዘርኣይ ገብረመድህን፡ ኢ-መይል desieht@gmail.com, **ቁ. ቴሌፎን** +2917126499፣ **ኣሰመራ ኮሌጅ ትምህርቲ**

ኣተግበርቲ እዚ መጽናዕቲ፡ ዉልቃዊ ሓበሬታ ዝቐበሉን ዝምሰርሑን
ደሳለኝ ዘርኣይ ገብረመድህን፡ ኢ-መይል desieht@gmail.com, **ቁ. ቴሌፎን** +2917126499
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ፕሮፌሰር ሲርፓ ኢስከላ-ሃፓነን, ኢ-መይል sirpa.eskela-haapanen@jyu.fi, ቁ. ቴሌፎን +358408054956
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ዶ/ር ዮናስ መስፍን ኣስፍሃ, ኢ-መይል ymasfaha@gmail.com, ቁ. ቴሌፎን +2917155149

4. ድሕረ ባይታን ዕላማን መጽናዕቲ

ቀንዲ ዕላማ ናይዚ መጽናዕቲ ብዙሕነት ተመሃሮ ዘማእከለ ኣመሃህራ ኣብ መባእታን ማእከላይን ደረጃ ኣብያተ ትምህርቲ ኤርትራ ንምጽናዕ እዩ። ብተወሳኺ እዚ መጽናዕቲ መማህራን መባእታን ማእከላይን ደረጃ ኣብያተ ትምህርቲ ኤርትራ ብዙሕነት ተመሃሮ ዘማእከለ ኣመሃህራ ብኽመይ ይርድኡዎ፡ እንታይ ትርጉም ይህብዎ፡ ኣብ መምህሪ ክፍሊ ብኽመይ የተግብርዎን፡ ነዚ ኣብ ምትግባር ዘጋጥሞም ብድሆታትን ከጽንዕ እዩ።

5. ግብራዊ ትግባረ መጽናዕቲ

እዚ መጽናዕቲ ካብ ነሓሰ 2018 ክሳብ ሰነ 2022 እዩ ዝካየድ ዘሎ። ሓበሬታ ካብ ናይ ሰነ ፍልጠትን ቁጽርን መምህራን 4ይን 5ይን ክፍሊ ከምኡውን 6ይ ክሳብ 8ይ ክፍሊ ተመሃሮ መባእታን ማእከላይን ደረጃ ኣብያተ ትምህርቲ ኤርትራ ብመልክዕ ቃለ መሕትትን (12 መምህራን ነፍሲ ወከፎም ናይ ኣስታት ሓደ ሰዓት ቃለ መሕትት) ካብ ታሕሳስ 2018 ክሳብ ጥሪ 2019፡ ከምኡ ድማ ካብ 6 መምህራን ኣብ ውሽጢ ክፍሊ እናመሃሩ ብቪድዮ እናተቐድሐ (ነፍሲ ወከፎም ከክልተ ክፍለ ጊዚ) ካብ ጥሪ ክሳብ ለካቲት 2019 ክእከብ እዩ። ቀዳማይ ክፋል ምእካብ ሓበሬታ ብገምጋም ካብ 6 ክሳብ 8 ሰሙናት ክወስድ እዩ። ካልኣይ ክፋል ተወሳኺ ቃለ መሕትት ምስ መምህራን ድማ ኣብ 2020 ክካየድ እዩ።

ኣብ ነፍሲ ወከፍ ቤት ትምህርቲ ምብጻሕን ምስ ሓላፊ ቤት ትምህርትን ብምልዛብ ኣብ ቃለ መሕትትን ምምላእ ቪድዮን ዝሳተፉ መማህራን ይርቁሑ። ንነፍሲ ወከፍ መምህር ሓፈሻውን ዝርዝራውን ሓበሬታ ብዛዕባ እዚ መጽናዕቲ ይወሃብ፡ ናይ መምህራን ግደውን ይዝተየሉ። ክሓትዎ ዝንደልዩ ሕቶታት ንጹር ሓበሬታ ይወሃብን ምቹእ ባይታ ንምእካብ ሓበሬታ ይዳሎ።

6. ኣብዚ መጽናዕቲ ምስታፍ ክህልዎ ዝኽእል ጠቕምን ኣሉታዊ ሳዕቤንን

ጠቕሚ፡ ተሳተፍቲ እዚ መጽናዕቲ ዝኾኑ መምህራንን ኣብያተ ትምህርትን ዉጽኢት ናይዚ መጽናዕቲ ምስዝግለጸሎም ኣገባብ ኣመሃህራኦም ዘንጎፎም ጸገማትን ብሳይንሳዊ መርትዖ ዝተሰነየ መግለጺ ስለዝወሃቦም ኣገባብ ኣመሃህራኦም ኣብ ምምሕያሽ ዕዙዝ ተራ ክጻወት ይኽእል እዩ።

ኣሉታዊ ሳዕቤን፡ ኣብ ውሽጢ ክፍሊ ንጥፈታት መምህር ተመሃሮን ብሰለስተ ካሜራታት ስለዝቕዳሕ ጸቕጢ ይፈጥር ይኸውን። ከምኡውን መንነት መምህራንን ተመሃሮን ካብ ቪዲዮ ምሉእ ብምሉእ ክትሰውሮ ስለዘይከኣል እዚ ከም ኣሉታዊ ሳዕቤን ክጥቀስ ይከኣል።

ውሕስነት ዉልቃዊ ሓበሬታ ምርግጋጽ

ኣብ እዋን መጽናዕቲ ዝእከብ ኩሉ ሓበሬታን ውጽኢት መጽናዕትን ንምዕቃብ ምስ ዝምልከት ሕጋዊ ዓንቀጻት ብዝሰማማዕ ኣገባብ ብስቱር ይዕቀብን ይምስራሕን። ኣብ ምምስራሕን ምግላጽ ውጽኢትን ኣስማት ናይ መምህራንን ኣብያተ ትምህርትን ስለ ዘይግለጽ ኣሉታዊ ሳዕቤን ኣዝዩ ትሑት እዩ። ዝተኣከበ ሓበሬታ ብጀካ ተመራማራይን ተሳተፍቲ እዚ መጽናዕትን ዝኾነ ካልእ ኣካል፡ ሓለፍቲ ኣብያተ ትምህርትን ካልኦት ኣብያተ ጽሕፈት ፈጺሞም ክረኽቡዎ ኣይኽእሉን። ንጥፈታት መማህራንን ሓበሬታን ንዋላ ሓደ ሰብ ኣይግለጽን፡ ኣብ ኢንተርኔት ኮነ ኣብ ካልእ መራኸቢ ብዙሓን ኣይዝርጋሕን።

7. ውጽኢት መጽናዕቲ

እዚ መጽናዕቲ ዓለምለኻዊ ተፈላጥነት ኣብ ዘለዎም ጆርናላት ክሕተምን፡ ውጽኢትን መጠቓለልን መጽናዕታዊ ጽሑፍን ኣብ ኮንፈረንሳት፡ ሃገራዊ ኣኼባታትን ናይ ኮሌጅ ኣኼባታትን ክቐርብ እዩ። ውጽኢት መጽናዕቲ ንተሳተፍቲ እዚ መጽናዕቲ ብውልቂ ክሕበሮም እዩ።

8. ወጻኢታት ናይዚ መጽናዕትን ፋይናንሳዊ መብርህን

እዚ መጽናዕቲ ብ Eritrea Learning for All (ELFA II) ፕሮጀትክን መሻርኽቱ ዝኾኑ ኮሌጅ ትምህርቲ፡ ሚኒስትሪ ትምህርትን መንግስቲ ፊንላንድን እዩ ዝምወል። ተሳተፍቲ ዝኾነ ይኹን ዘውጽኣዎ ወጻኢታት የብሉዎምን።

9. መሰል ተሳተፍቲ እዚ መጽናዕትን ተሳትፎ ምቁራጽን

ተሳተፍቲ እዚ መጽናዕቲ ኣብዚ መጽናዕቲ ንምስታፍ ዝኣተዉዎ ስምምዕ ናይ ምስራዝን ተሳትፎ ናይ ምቁራጽን መሰል ኣለዎም።

10. ምዕቃብ ውልቃዊ ሓበሬታ

ሓበሬታ ብስቱር ብቃል-ምስጢር ኣብ ውልቃዊ ኮምፕዩተር ይዕቀብ

11. ትግባረ መሰል ተሳተፍቲ እዚ መጽናዕቲ ምርግጋጽ

ነፍሰ ወከፍ ተሳታፊ በዚ ዝስዕብ ሓበሬታ ንዓይ ክረኽበኒ ይኽእል።
ደሳለኝ ዘርኣይ ገብረመድህን, ኢ-መይል desieht@gmail.com, **ቁ. ቴሌፎን** +2917126499

Appendix 3 Information Letter
UNIVERSITY OF JYVÄSKYLÄ

1. NAME AND DURATION OF THE RESEARCH

The research is titled "The implementation of differentiated instruction in Eritrean elementary schools". The research aims to investigate the mind sets, expectations and attitudes of Eritrean elementary school teachers towards differentiated instruction; the actual implementation practices in classrooms; and the challenges they face in implementing differentiated instruction. The study is conducted from August 2018 and is expected to be completed in June 2022.

2. LEGAL BASIS FOR THE PROCESSING OF PERSONAL DATA

☒ A separate template is prepared to request explicit consent of the research subjects in addition to notifying them about this information letter. The templates will be signed by teachers and parents.

3. CONTROLLER, SCIENTIST-IN-CHARGE AND CONTACT PERSON

University of Jyväskylä, Department of Education, Seminaarinkatu 15, P.O. Box 35, 40014. Switchboard (014) 260 1211, Business ID 0245894-7**.** Data protection officer of the University of Jyväskylä: **tietosuoja@jyu.fi**, tel. 040 805 3297.

Scientist in charge of the research:
Desalegn Zerai Ghebremedhin, desieht@gmail.com, telephone +2917126499
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Yonas Mesfun Asfaha, ymasfaha@gmail.com, tel +2917155149

4. BACKGROUND AND PURPOSE OF THE RESEARCH

The purpose of this research is to clarify the implementation of differentiated instruction in Eritrean elementary schools. In addition, the purpose is to clarify how the Eritrean elementary school teachers conceptualize and give meanings to differentiated instruction and position themselves in relation to its principles; what Eritrean elementary school teachers do in implementing differentiated instruction in their classrooms and the challenges they face in implementing differentiated instruction.

5. PRACTICAL IMPLEMENTATION OF THE RESEARCH

The research is conducted between September 2018 and June 2022. Data will be collected from 12 elementary school teachers through audio recording of interviews (each 1 hour long) from December 2018 to January 2019. Grades 4 and 5, science and mathematics subjects are specifically selected for data collection. Video recordings of the actual classroom instructions of 6 teachers (each two lessons) will be conducted from January to February 2019. It takes about 4 weeks to participate in this first phase of data collection for this research.

The research is implemented in that first visits will be made to the respective schools. In consultation with the directors subjects will be selected for interviews and classroom observations. Clarifications will be given to the respective subjects about the research and their respective roles in participating through this research.

6. POTENTIAL BENEFITS AND DISADVANTAGES TO SUBJECTS

Benefits for the subjects: the research product will benefit the subjects and the schools as the results will be presented to them, this may help them improve their teaching practice.

Risks of being video recorded: being recorded in classroom with three video cameras may overwhelm the subjects. Besides it is impossible to remove the direct identifiers for the video recordings.

7. PROTECTION OF PERSONAL DATA

The data collected during the research and the research results are processed confidentially in compliance with the data protection legislation. It will not be possible to identify you from the research results, clarifications or publications.

During data analysis and results only citations of subjects will be used while the names of the schools and the subjects are kept anonymous, there is minor risk. Data will not be accessible to anybody other than the researchers and the subjects, not to the directors nor to any authorities or offices.
Teachers' activities will not be reported to anybody

The following have been considered when designing the research:
Safeguards selected to protect personal data
☒ The use of the personal data file is based on an appropriate research plan
☒ There is a designated person or a group of persons responsible for the research;
☒ The personal data file is used only for purposes of historical or scientific research and the procedure followed is also otherwise such that
☒ The data pertaining to a given individual are not disclosed to outsiders
☒ After the personal data are no longer required for the research or for the verification of the results achieved, the personal data file is destroyed or transferred into an archive, or the data in it are altered so that the data subjects can no longer be identified;
☒ Actions to improve the competence of employees who process personal data (training, instructions)
☒ Internal actions of the controller and the processor in order to prevent unauthorised access to personal data
☒ Pseudonymisation of personal data
☒ Codes used to protect secretly and safely
☒ Data secured working environments (systems) and services related
☒ Other technical measures
☒ Other organisational measures (e.g. training and agreements with research assistants)

Processing of direct identifiers
☒ Direct identifiers are removed in the analysis phase but the code key is retained (**for interview data/this is not possible for the video**
☒ Direct identifiers are not erased in the analysis phase because in the research results and other documents, the only reference to you is an

identification code. The identification code key that enables connecting your personal data to the identification code is held securely and will be disposed after the publication of the research results.
The research data is stored in accordance with the University of Jyväskylä's data security practices for processing research data.

8. RESEARCH RESULTS

The research will result in publication of articles in international journals while the summary and dissertation are presented in conferences, national seminars and college meetings. Research results will be informed of the results personally.

9. RESEARCH COSTS AND FINANCIAL CLARIFICATIONS

The research is funded by Eritrea Learning for All (ELFA II) project and the parties, College of Education/ Ministry of Education/ Finnish Government.

10. RIGHTS OF THE RESEARCH SUBJECT AND DEVIATION FROM THEM

The research subject has the right to cancel his/her consent if the processing of personal data is based on consent.

11. STORAGE AND ARCHIVAL OF PERSONAL DATA

Storage
Data is stored in protected PCs with passwords

12. IMPLEMENTING THE RIGHTS OF DATA SUBJECTS

Subjects can contact me
Desalegn Zerai Ghebremedhin, desieht@gmail.com, telephone +2917126499,

Appendix 4 **Consent Form for Teachers**

CONSENT FOR SCIENTIFIC RESEARCH

I have been requested to participate in the following study: ***The implementation of differentiated instruction in Eritrean elementary and middle schools.***

I have read the information letter and have received sufficient information on the study and its implementation. The content of the study has also been explained to me verbally and I have received proper answers to all my questions concerning the study. The clarifications were provided by Desalegn Zerai. I have had sufficient time to consider participating in the study.

I understand that it is voluntary to participate in the study. I have the right to interrupt my participation or cancel my consent at any time and without explanation during the study. Interruption of participation or cancellation of consent for the study have no negative consequences for me.

By signing the consent document, I accept that my information is used for the research described in the information letter. I also allow that the citations of my interviews/classroom interaction can be added to the research articles/research report. Although all the data will be pseudonymised, there is always a risk that I can be identified from the research results.

☐ Yes

With my signature, I confirm my participation in the study and permit the matters mentioned above.

_____ _____

Signature *Date*

_____

Printed name

Consent received

Signature of the consent recipient _____

Date

_____

Desalegn Zerai

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ነዚ ፍሉይ መጽናዕቲ ዝተገብረ ሰምምዕ

እነ ኣብዚ “ብዙሕነት ተመሃሮ ዘማእከለ ኣገባብ ኣመሃህራ ኣብ መባእታን ማእከላይን ኣብያተ ትምህርቲ ኤርትራ” ዘርእስቱ መጽናዕቲ ከሳተፍ ተሓቲተ ኣሎኹ።

ናይ ሓበሬታ ደብዳቤ ኣንቢቦን ብዛዕባ እዚ መጽናዕቲ እዝን ትግባረኡን እኹል ሓበሬታ ተዋሂቡኒ ኣሎ። ትሕዝቶ ናይዚ መጽናዕቲ እዚ መግለጺ ብኣቶ ደሳለኝ ዘርኣይ ብቓል ተዋሂቡኒን ብዛዕባ እዚ መጽናዕቲ ክሓቶ ዝደልዮ ኩሉ ሕቶታት ተመሊሱለይን ኣሎ። ። ኣብዚ መጽናዕቲ እዚ ንኽሳተፍ ክሓስበሉውን እኹል ጊዜ ረኺበ እየ።

ኣብዚ መጽናዕቲ ምስታፈይ ብወለንታይ ምኳኑ ይርድኣኒ እዩ። ተሳትፎይ ኣብ ዝኾነ ጊዜ ብዘይ ዝኾነ መግለጺ ከቋርጽ ምሉእ መሰለ ኣሎኒ። ተሳትፎይ ምቁራጸይ ኮነ ስምምዕ ምስራዘይ ዘምጽኣለይ ዝኾነ ኣሉታዊ ሳዕቤን የብሉን።

ዝህቦ ሓበሬታ ኣብ ናይ ሓበሬታ ደብዳበ ንዝተገልጸ ዕላማ ናይዚ መጽናዕቲ ክጥቀሙሉ ከም ዝኽእሉ እዚ ናይ ስምምዕ ወረቐት ብምፍራም ምቕባለይ ኣረጋግጽ። ከምኡውን ምሳይ ዝተገብረ ቃለ መሕትትን/ብቪድዮ እተቐድሐ ናይ ውሽጢ ክፍሊ ንጥፈታትን ኣብቲ ዝዳሎ መጽናዕታዊ ጽሑፍን ጸብጻብን መጽናዕትን ክኣቱ ኣፍቅድ ኣሎኹ። ዋላ'ኳ እቲ ዝህቦ ሓበሬታ ብዘይፍለጥ ልብ ወለዳዊ ስም እተተሰወረ ካብ ውድኢት ናይቲ መጽናዕቲ መንነተይ ክፍለጥ ሒደት ተኽእሎ ኣሎ።

☐ እወ

ኣብዚ መጽናዕቲ ክሳተፍ ምኳነይን ኣብ ላዕሊ ዝተገልጹ ጉዳይ ፍቓደይ ምሃበይ ብኽታመይ ኣረጋግጽ።

_____ _____

ክታም *ዕለት*

_____

ምሉእ ስም

ስምምዕ ተረካቢ

_____

ክታም ስምምዕ እተረከበ ሰብ _____

ዕለት

_____

ደሳለኝ ዘርኣይ

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Tel:
(014) 260 1211
Fax:
(014) 260 1021

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Appendix 5 Consent Form for Parents

ናይ ስምምዕ ቅጥዒ

ሓፈሻዊ ሓበሬታ ብዛዕባ እዚ መጽናዕቲ

ኣነ ደሳለኝ ዘርኣይ ገብረመድህን፥ ናይ ዶክትሬት ዲግሪ ተመሃራይ ኣብ ዩኒቨርሲቲ ይቫዕስኪላ (ፊንላንድ) ዝኾንኩ "ብዙሕነት/ፍሉይነት ተመሃሮ ዘማእከለ ኣገባብ ኣመሃህራ ኣብ መባእታን ማእከላይን ደረጃ ኣብያተ ትምህርቲ ኤርትራ" ዘርእስቱ መጽናዕቲ የካይድ ኣሎኹ። ዕላማ እዚ መጽናዕቲ መማህራን መባእታ ኣብያተ ትምህርቲ ኤርትራ ኣብዚ ኣርእስቲ ዘለዎም ርድኢትን ኣተሓሳስባን ትጽቢትን ተመኩሮን ከምኡውን ብድሆታትን ምጽናዕ እዩ። ሓበሬታ ንምእካብ መማህራን ኣብ መስርሕ ምምሃር ከለዉ ኣብ ክፍሊ ምስ ተመሃሮኦም ብሽድዮ ክቕድሑ እዮም። ቅኑዕ ስነ-ምግባር ምእካብ ሓበሬታ ከካይድ ስለዝግብኣኒ ንስኹም ከም ወላዲ ዉላድኩም ብሽድዮ ክቕዳሕ ከሎ ክትፈልጡን ፍቓድኩም ክትሕተቱን ስለዝግባእ እዚ ናይ ስምምዕ ቅጥዒ ኣዳልየ ፍቓድኩም እሓትት ኣሎኹ።

እዚ መጽናዕቲ ብኣፍልጦ ኮሌጅ ትምህርቲ ኣስመራን፥ ሚኒስትሪ ትምህርቲ ዞባ ማእከልን ንኡሳን ዞባታትን፥ ዉላድኩም ዝመሃረሉ/ትመሃረሉ ቤት ትምህርትን እዩ ዝካየድ ዘሎ። ዝእከብ ሓበሬታ ንመጽናዕቲ ጥራይ የገልግል። ኣስማት ተሳተፍቲ ተመሃሮን መምህራንን ቤት ትምህርትን ስቱር እዩ፥ ኣይግለጽን። ዉላድኩም ኣብዚ መጽናዕቲ ናይ ዘይምስታፍ መሰሉ/ላ ዝተሓለወ እዩ። ኣድላዩ ዝበልኩምዎ ሓበሬታ ክትሓቱን ዉላድኩምውን ኣብ መንን መጽናዕቲ ኣቋሪጹ ክወጽእ ይኽእል እዩ።

ስምምዕ

ኣነ ዕላማ ናይዚ መጽናዕትን ትሕዝቶኡን፥ ዝእከብ ሓበሬታ ንመጽናዕቲ ጥራይ ከምዝገልግልን ኣብዚ መጽናዕቲ ምስታፍ ዘስዕቦ ጸገም ከምዘይብሉን ተረዲአ ኣሎኹ። ኣብ ዝደለኹሉ እዋን ዉላደይ ተሳትፎኡ/ኣ ከቋርጽ/ከተቋርጽ ይኽእል/ትኽእል። ዝእከብ ሓበሬታ ኣብ ምድላው ናይ ዶክትሬት ዲግሪ መጽናዕታዊ ጽሑፍ ክትጥቀሙሉ ከም ትኽእሉ ብኽታመይ የረጋግጽ።

_____

ክታም ወላዲ **ዕለት** _____

_____

ስም ወላዲ

ሰምምዕ ተረካቢ፥

_____ ***ዕለት*** _____

ክታም

_____

ምሉእ ስም

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ORIGINAL PAPERS

I

THE MEANINGS OF DIFFERENTIATED INSTRUCTION IN THE NARRATIVES OF ERITREAN TEACHERS

by

Zerai, D., Eskelä-Haapanen, S., Posti-Ahokas, H., & Vehkakoski, T. 2023

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Routledge
Taylor & Francis Group

The meanings of differentiated instruction in the narratives of Eritrean teachers

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ABSTRACT

The principles of inclusive education largely accepted by governments of different countries require differentiated classroom instruction to meet the diverse needs of individual students. Despite this, teachers have differing experiences and understandings about implementing differentiated instruction (DI) and heterogeneous classrooms. This narrative study aimed at exploring the meanings of DI in the Eritrean context, where teachers are not explicitly familiar with the concept, although their teaching practices reflect some level of differentiation. The research data consisted of 17 narrative interviews with Eritrean mathematics and science teachers. The results of the narrative analysis showed that the teachers constructed five meanings of DI in their narratives: as a caring orientation, as a flexible pedagogic approach, as a self-reflective process, as a failed attempt and as a demanding approach. The majority of the narratives were found to produce positive meanings of DI, and the teachers constructed strong agency towards carrying out DI. These examples of sophisticated DI practices in the teachers' positive narratives could be utilised to implement DI, even in situations where teachers have limited resources and training and in contexts with large class sizes.

KEYWORDS

Differentiated instruction; individualisation; inclusive education; teacher; narrative analysis; Eritrea

Introduction

Differentiated instruction (DI) is pivotal in advancing inclusive education (Tomlinson 2014; Westwood 2018). It has been found to improve students' learning results (Nurmi et al. 2012) and strengthen their engagement in schooling (Little, McCoach, and Reis 2014). Although inclusive education is understood as a process of transforming schools to serve all children (Cambridge-Johnson, Hunter-Johnson, and Newton 2014; Hanafin, Shevlin, and Flynn 2002), many teachers have poor attitudes towards including students with special needs in mainstream classrooms (Geldenhuys and Wevers 2013; Šuc et al. 2016). One reason for this is teachers' confusion about how to manage inclusive classrooms in practice (Newton, Carbridg, and Hunter-Johnson 2014). Conversely, teachers' strong self-

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efficacy in differentiating their instruction is related to their positive attitudes towards inclusive education (Dixon et al. 2014; Malinen et al. 2013; Saloviita 2018).

This study focuses on the meanings of DI constructed by Eritrean elementary and middle school mathematics and science teachers. Eritrea exemplifies countries where poverty is widespread and human and material resources for education are limited (Rena 2009). Despite this, as a signatory of international conventions advocating inclusive education (UNESCO 1994, 2000), the Government of Eritrea is committed to addressing the diverse needs of all learners regardless of their backgrounds. In this challenging context, common to many countries in the Third World, it is important to listen to Eritrean teachers' accounts of inclusive education and the ways in which they position themselves in relation to the principles of DI. By presenting teachers' insights, the study responds to the need for additional research concerning realisable and efficacious DI practices (see Göransson and Nilholm 2014) to help teachers make educational environments more inclusive. Two research questions were formulated based on the research data: 1) What kinds of narratives do Eritrean mathematics and science teachers tell about DI? 2) How do teachers position themselves and students within these narratives?

Defining DI

The concept of DI is linked to a range of other terms, such as adaptive instruction (e.g. Wang and Lindvall 1984), student-centred approach (e.g. Fox and Hoffman 2011; Tzanni 2018) and personalised learning (e.g. Waxman, Alford, and Brown 2013). Some researchers separate the concepts of DI and individualised instruction, and emphasise that the latter term means adapting learning goals and content to the abilities of individual children with special needs by creating separate individualised education programmes (IEP) for them (Landrum and McDuffie 2010), whereas DI is considered an academically responsive approach that creates opportunities for all children to learn (see Raveaud 2005; Stollman et al. 2019; Tomlinson 2014). Others view these concepts as identical, and some consider differentiation as a narrower concept within individualisation (Kratochvílová and Havel 2013; Landrum and McDuffie 2010). In this study, DI is understood as a general concept, covering teachers' positive understanding of diversity and belief in all students' potential as well as their commitment to certain pedagogical principles, such as community building, flexible curricula, teaching up, varying group practices and ongoing assessment. Instead, differentiation as a sub-concept of DI refers to teachers' concrete proactive responses and the use of a variety of instructional strategies that can also be applied in mainstream classrooms (e.g. Tomlinson 2014).

The theoretical roots of DI are linked to research on individual learning differences and the need for developing innovative teaching methodologies to make schools responsive to students with disabilities (Wang and Lindvall 1984). Subsequently, it has been inspired by a wide range of educational theories, including social constructivist theories, such as Vygotsky's Zone of Proximal Development (ZPD) (Subban 2006), the theory of multiple intelligences (Gardner 1983) and learning style theories (Pritchard 2009). Tomlinson (2014) defined DI as a pedagogical approach in which teachers modify curriculum objectives, content, methods, classroom activities and assessment to respond to the diverse needs of all learners and maximise their learning opportunities (see also Raveaud 2005; Stollman et al. 2019; Tomlinson et al. 2003). Differentiation can be carried

out on three levels: what a student is to learn (content), how the student will learn (process) and how the student is to display what has been learned (product) (Tomlinson et al. 2003).

In sum, successful DI provides a wide range of experiences different from the norm (Fox and Hoffman 2011), deviating from traditional instruction, which leans on the assumption that 'one size fits all' (Fox and Hoffman 2011, 7; Suprayogi, Valcke, and Godwin 2017). DI is not only an instructional technique but also a way of thinking, where teachers view learning from the students' perspectives without categorising them based on their learning readiness (Tomlinson 2014) or giving fewer activities to struggling learners than advanced ones (Tomlinson and McTighe 2006). Therefore, DI is closely related to the ideology of inclusive education, and it can also be considered an expression of educational philosophy and a political statement concerning how classrooms should be organised (Göransson and Nilholm 2014).

Teachers' experiences and understandings of DI

Teachers' understandings of DI vary greatly (Cambridge-Johnson, Hunter-Johnson, and Newton 2014). These different beliefs stem from teachers' values, working conditions, education and/or encounters with different students. Many teachers do not like the idea of including students with disabilities in mainstream classrooms, mainly because they have insufficient knowledge about how to manage inclusive classrooms in practice (Dixon et al. 2014; Geldenhuys and Wevers 2013). Teachers may also be reluctant to carry out DI because they feel uncomfortable with its principles (Rodriguez 2012) and lack familiarity with the best implementation strategies (Cambridge-Johnson, Hunter-Johnson, and Newton 2014; Dixon et al. 2014). Other reasons for negative attitudes include insufficient time for preparation (Rodriguez 2012, 77; Tzanni 2018) or fear of having no assistance from colleagues (Smit and Humpert 2012). Some teachers complain about teaching a large number of students who experience barriers to learning due to learning difficulties or poor home circumstances (Pieterse 2010). Others also believe that differentiation damages the cohesion of the group and leads to 'social inequalities' among students (Raveaud 2005).

Teachers' attitudes towards differentiation also seem to be associated with teacher category (Saloviita 2018; Schwab, Sharma, and Hoffmann 2019), the length and nature of their work experience (Nurmi et al. 2012) and the types of schools in which they work (Siam and Al-Natour 2016). Special education and classroom teachers seem to use differentiation more frequently than subject teachers (Saloviita 2018; see also Schwab, Sharma, and Hoffmann 2019). In addition, teachers in private schools appear more likely to implement DI than teachers in public schools (Siam and Al-Natour 2016). This might be because private school teachers receive more school-based training and resources than public school teachers do (see e.g. Admas 2019; MOE (Ministry of Education, Eritrea) 2016). Regarding work experience, it has been reported that, although novice teachers seem to be reluctant to include students with special needs in their classrooms (Peebles and Mendaglio 2014; Šuc et al. 2016), they are more likely than their experienced colleagues to differentiate their instruction according to their students' performance levels (Nurmi et al. 2012). Peebles and Mendaglio (2014) showed that spending more time on direct instruction with students with special needs and less time on observation and whole-class

instruction is likely to increase teachers' self-efficacy for inclusive teaching. In addition, high-quality teacher education programmes are associated with teachers' implementation of DI (Nazzal 2011; Peebles and Mendaglio 2014) by providing teachers with the practical skills and theoretical knowledge necessary to flexibly modify their instruction.

There is also a concern regarding teachers' varied understandings about differentiation (Thakur 2014). While some understand it as considering each student's individuality in general, others regard differentiation as a special approach that does not have to involve all students (Raveaud 2005; Rytivaara and Vehkakoski 2015). Furthermore, regarding the bases for differentiating instruction, some teachers focus more on their students' readiness and less on their learning profiles (Stollman et al. 2019), whereas others focus more on students' interests and learning profiles (Tzanni 2018). Additionally, previous studies have highlighted the gap between teachers' understanding of differentiation and its actual implementation (Suprayogi, Valcke, and Godwin 2017; Whipple 2012) as well as the gap between individualisation in theory and in practice (Rytivaara and Vehkakoski 2015, 13).

Materials and methods

Study context

The research context of this study is Eritrea, which is situated in the Horn of Africa. The Eritrean education system consists of three tiers: compulsory basic education (elementary school, grades 1–5, and middle school, grades 6–8), secondary education (grades 9–12) and further and higher education (MOE (Ministry of Education, Eritrea) 2011). From age 4 onwards, children can attend preschool for two years before enrolling in elementary school at age 6 or 7. Eritrean teachers with high school plus one year of college education are assigned to elementary schools, those with two years of college education to middle schools and those with four years of college education to high schools. Some elementary school teachers are upgraded to the middle school level through in-service training.

Eritrea can be defined as a unitary one-party state. For decades, Eritrean children have missed out on schooling due to war and conflict, although Eritrea was liberated in 1991. A recent study conducted in the capital city, Asmara, by Yikealo et al. (2017) verified the correlation between pupils' learning outcomes and their families' socioeconomic statuses. Parental lack of awareness of education in rural and geographically remote areas coupled with prevailing social norms place children with disabilities and working children at risk of exclusion. The general level of learning achievement is declining, and paramount literacy and numeracy problems have been observed in elementary schools (Asfaha et al. 2017), with only 25.4% of grade 5 students achieving the minimum mastery level (MOE (Ministry of Education, Eritrea) 2015). Dropout rates in elementary and middle schools reached 6.1% and 7.5%, respectively (MOE (Ministry of Education, Eritrea) 2016).

Eritrean classrooms are typically heterogeneous, and the class sizes are large (average 50 to 70). Inclusive education has been understood in Eritrea as the integration of children with physical and sensory disabilities into regular school programmes. Children with intellectual disabilities were denied access to education until 2004, when Eritrea started offering special classes inside some regular elementary schools (Asefaw 2016). Two- to three-time repeaters in school are considered children with learning difficulties and are

encouraged to attend special classes within regular schools, from which they can progress to regular classrooms, depending on their performance (Asefaw 2016). However, special education teachers in mainstream schools are not involved in regular classroom teaching. In addition, Eritrea has a relatively large number of unqualified teachers in regular schools, and many teachers lack the pedagogical competence to meet students' diverse needs (see Idris, Asfaha, and Ibrahim 2017). Therefore, the policy emphasis on implementing learner-centred pedagogy at all levels of the education system remains distant in relation to classroom practices (Idris, Asfaha, and Ibrahim 2017; MOE (Ministry of Education, Eritrea) 2011; Posti-Ahokas, Meriläinen, and Westman 2018). Although Eritrean teachers have been found to have positive attitudes towards inclusive education (Habtom, Franciscah, and Mazrui 2019), a conceptual focus on inclusion in school practices and challenges in implementing differentiation in practice is still lacking (Asefaw 2016; Habtom, Franciscah, and Mazrui 2019).

Data and participants

In this qualitative study, a total of 18 Eritrean elementary and middle school mathematics and science teachers were interviewed. For these two subjects in the Eritrean context, teachers typically apply diverse teaching methods and provide various activities to engage students; meanwhile, in some other subjects, such as social studies and citizenship, instruction is generally more teacher-led. The teachers came from six schools in two cities. Schools were selected purposively, after discussions with officials from the Ministry of Education, with the aim of obtaining rich data from diverse backgrounds and school types. Criteria for selection was their ethnic, cultural, religious and socioeconomic diversity, and the school sizes in the two cities. Four schools were public while two were private. The participants taught grades 4 to 7, and their teaching experience varied from 3 to 39 years (M = 17.6 years). Nine of the participants were males and nine were females. All participants had one to four years of college education. Nine teachers reported that they had attended several in-service training courses on teaching students with diverse needs, while the remaining nine had not participated in any such training (see Table 1).

The first author contacted the directors of the respective schools with official letters from the college and the Ministry of Education. He discussed with the school principals to identify teachers who were effective in their teaching and seemed to care for their students. However, some teachers were also selected because they were the only qualified teachers in those schools due to staff shortages. The interviewer (first author) discussed the purpose of the study with each candidate and how they would be interviewed. Participants were given information about the study and their rights in both the Eritrean national language, Tigrigna, and in English prior to providing their written informed consent.

Sixteen teachers' interviews were carried out from January to March 2019. Before this, a pilot was conducted, which involved joint interviews with two teachers. The pilot was included in the data analysed for the present study. The interview durations ranged from 8 to 45 minutes, and they were carried out at the schools. The interviewing language was Tigrigna. One of the teachers was interviewed twice, first in Amharic (it was thought she would feel comfortable being interviewed in her first language) and then in Tigrigna (to maintain consistency between all the interviews).

Table 1. Backgrounds of the participating teachers.

Pseudonym	Gender	School type	Teaching experience in years	Educational background*	In-service training	Subject specialisation
Abraham	M	Public	27	Diploma	None	Math
Alem	F	Public	39	Certificate	None	Science
Amare	M	Public	24	Diploma	Limited	Math
Barnabas	M	Public	5	Certificate	None	Science
Berhe	M	Private	12	Diploma (12+3)	Frequent	Math
Biniam	M	Private	25	Degree	Limited	Science
Hana	F	Public	7	Diploma	None	Math
Helen	F	Public	24	Certificate	Intensive	Math
Kebron	M	Public	22	Certificate	None	Math
Mehari	M	Public	27	Diploma	None	Math
Melat	F	Public	4	Certificate	Limited	Math
Mohammed	M	Private	3	Certificate	Frequent	Science
Natnael	M	Private	23	Certificate	Limited	Math
Saba	F	Public	27	Diploma	None	Science
Selam	F	Private	12	Certificate	Frequent	Science
Tigisti	F	Private	13	Certificate	Frequent	Science
Tsega	F	Public	17	Certificate	None	Math
Zebib	F	Private	6	Degree	None	Math

*Certificate = 1 year of college education; Diploma = 2–3 years of college education; Degree = 4 years of college education.

The interviews were narrative with the aim of inviting participants to give meanings to their experiences through narration (see Hollway and Jefferson 2008). In accordance with the principles of narrative interviewing, the interviews consisted of only a few general questions to encourage the participants to produce high-quality stories as spontaneously as possible without the researcher leading their narration. The definition of DI (Tomlinson 2014) and its two main dimensions – teachers' understanding of student diversity and pedagogy in heterogeneous classrooms – determined the choice of interview questions. In addition, since an equivalent term for DI does not exist in Tigrigna, the first author tried to use understandable and ordinary words in the interviews to convey the concept, and described it to the teachers using several related and synonymous terms referring to diversity, adaptation and addressing individual needs. Therefore, the interviews consisted of the following four broad questions: 1. How would you describe students' diversity in your classroom? 2. How do you teach individually? 3. What does responding to diverse learners mean to you? Or How do you feel about it? 4. Would you please describe successful and unsuccessful stories about trying to modify or adapt your instruction? The first question was an easy warm-up question, whereas the purpose of the third question was to prompt the teachers to discuss their values and beliefs. The second and fourth questions directed the teachers to freely elaborate how they implement DI in practice. The specific aim of the fourth question was to locate the teachers' narration in their memory of their real-life teaching experiences.

The interviews were transcribed and translated into English by two senior experts from the fields of special education and applied linguistics. The translated data were verified against the transcribed Tigrigna version by the first author and the expert from applied linguistics. The total English interview data comprised 142 pages (Times New Roman, point size 12, line spacing 1.5).

Analysis

Narrative analysis was employed in the analysis of the interview data. As is common to the qualitative research approaches developed after the linguistic turn, the main idea of narrative theory is that through storytelling, people not only retrospectively describe their life events, but they categorise, reconstruct and give meaning to them. Therefore, the narrative analysis seeks to understand what participants do with the narratives and how they organise their experiences and make sense of them through storytelling (Esin 2011; Herman 2009). Our own way of doing narrative analysis has been mainly influenced by the functional analysis of narrative, which focuses on the representational functions that the narratives could serve (Gimenez 2009).

The analysis began with a careful reading of the transcribed interview data. During this phase, we noticed that teachers provided several concrete examples of how they carry out DI in practice, and describing these real-life teaching experiences seemed to be a relevant way for the participants to offer their own meanings to DI without being forced to provide socially desirable textbook definitions. Therefore, we decided to focus on these small stories about ongoing or past events and everyday occurrences, which are typical and not necessarily particularly special (Bamberg and Georgakopoulou 2008). The criteria for identifying the stories for analysis were as follows: 1) teachers gave authentic examples of the events where they encountered one or more students (characters) and tried to support them through differentiation (actions), and 2) the stories were situated in a specific time expressed through such temporal words as 'last year' or 'one day' (temporal). The authenticity of the stories meant that teachers' general descriptions of how 'I usually act' were omitted from the analysis, which only focused on the concrete descriptions of the individual events described through the use of specific qualifiers, such as students' names, places or other details or through paraphrasing their interaction with a particular student. After deciding collaboratively on these criteria, the first author identified 52 small stories from the data. All but one of the teachers produced small stories in the interviews.

After identifying the small stories, the authors began to group them into different narrative types based on the similarities and differences between their contents, form and the positions of the teachers and their students in the stories (see Table 2). The contents of the small stories referred to the events and experiences described by the teachers, whereas the form of the stories denoted the ways in which the teachers organised them as a certain storyline, e.g. narrative reversals and plotting experiences as positive or negative (see e.g. Sandelowski 1991). In addition, the discursive positions were key to understanding how teachers locate themselves and their students in the stories and create certain images by assigning different roles, characteristics, rights or duties to them (Davies and Harré 2001; Esin 2011). Based on these three dimensions, we identified five different narrative types as presented in the next section. Although some narrative types were more marginal in the data than others, we wanted to describe all variations present in the small stories; thus, no narrative type was omitted from the results.

Results

The findings are presented through five different narrative types, representing teachers' different ways of constructing meanings of DI: 1) as a caring orientation, 2) as a flexible

Table 2. Teachers' different ways of constructing meanings of DI.

	Positive narratives			Negative narratives	
Narrative type	DI as a caring orientation	DI as a flexible pedagogical approach	DI as a self-reflective process	DI as a failed attempt	DI as a demanding approach
Main content	Stressing one's commitment to creating warm relationships with students and providing them with emotional and extra instructional support	Reporting differentiating content, language, method and assessment	Emphasising the need to change one's teaching style	Describing pedagogically infeasible cases	Blaming lack of knowledge and skills for failures
Form of the story	Change story	Story about opportunity	Growth story	Tragedy story	Stagnation story
Positioning themselves as teachers	Attentive and understanding caregivers	Flexible and innovative experts	Reflective learners	Responsible teachers with limited possibilities to influence	Unsuccessful teachers with scarce resources
Positioning students	Respected human beings	Diverse learners	Facilitators of teachers' learning to teach	Students with severe challenges	Victims of weak instruction
Number of stories	23	14	3	9	2
Percentage of small stories	45%	27%	6%	18%	4%

pedagogical approach, 3) as a self-reflective process, 4) as a failed attempt and 5) as a demanding approach (see Table 1). The first three narrative types represent stories where implementing DI led to positive consequences, while the latter two create a negative image of the possibilities of DI. Pseudonyms are used for both the teachers and students in the extracts.

DI as a caring orientation

The first narrative type is composed of stories where DI is constructed as a caring orientation. In this narrative, the teachers position themselves as attentive and understanding caregivers, like parents, who build a strong reciprocal relationship with their students. The context of these emotionally laden stories is the children's challenging home circumstances: 'the child is not clean and is very fearful'; 'he could not fit in with our students because he was a street child' and 'his father was martyred'. The plot progression of these stories resembles change stories, starting with a teacher who recognises a child's poor circumstances as reflected in schooling. Finally, the teachers describe how they perceive positive changes in students' lives and schooling as a result of creating a trusting relationship with children through verbal encouragement, expressions of affection and physical intimacy: 'after studying his "background" and the like, I decided that I had to make him my friend'. Abraham gives a detailed small story of one student:

> At one time, a student (Meron) in grade 7 failed, failed twice. But his parents begged me. [. . .] They asked even during summertime for one hour a week or something like that. Finally, I agreed and started helping the child. [. . .] Now, Meron unexpectedly developed personal interest, developed 'interest' towards me. When I approached to help him, he would be prepared and waiting for me. He received me with affection, whether he understood the lesson or not. [. . .] then he told me the secret story I told you before. He told me: 'I observed you one day doing such and such. I saw you pick up that girl who had fallen [down, tripped]. I understood then that you do care very much about us. Now, you know there will be no one except you who can understand me.' That way he understood; things were made clearer. At that moment, what was the student passing through? You ask the student three times three and he says 'six', but then he begins to ask, 'teacher, how are these stars able to stand (not fall) in the sky?' Now, you can imagine, this student has a 'capacity' even though that was not opened up or developed, and this will be revealed to him with time. He was able to study the stars, but not 'three times three' nor did he know. (Abraham, Diploma, 27 years of experience)

As shown in this extract, the caring orientation appears in both the intensity and quality of the caring. The teacher transcends distant professionality by providing extra instructional support to one of his students, Meron, during his leisure time, e.g. 'even during summertime for one hour a week', and helping the girl who had tripped and fallen over. In addition, he emphasises the quality of the caring by discussing the emotional attachment of his student: 'he developed personal interest towards me'.

What is striking about this narrative type is that it does not emphasise the academic benefits of DI; instead, the students are primarily positioned as human beings who deserve recognition despite their learning outcomes. For instance, Meron is said to be attached to his teacher whether 'he understood the lesson or not'. At the end of the story, Meron's weak mathematics knowledge is counterpointed by his ability to ask creative questions about the stars. This impacts the teacher: 'Now, you can imagine, this student has a capacity' (although it does not show in the formal lessons). Thus, in this narrative

type, students' individual needs are not only academic but also extensive and complex, demanding the teachers' wide-ranging personal investment in the students. The relationships also arouse deep fulfilment in the teachers regarding their work: 'when I observed the big changes in them and the experience I shared with them, I can never forget for the rest of my life'.

DI as a flexible pedagogical approach

In the second narrative type, teachers describe how they have tailored their instruction to students' individual needs. Compared to the previous narrative type, these stories are short and focus mainly on students' academic challenges. Hopeful future prospects for students are created by the teachers' descriptions of the timely and high-quality support they provided. The repertoire of various instructional methods mentioned by the teachers is large, including organising the physical learning environment, e.g. 'giving children with eye problems the front seats', modifying direct teaching, e.g. 'I give them the questions at their level', utilising peer learning, e.g. 'I start with a smart student, who does the question and explains the process to the other students, so that it becomes an example', and code switching, e.g. 'I had to at least mix in some Tigrigna, then only after this, did the children start to understand the words'. Recognising students' opportunities is said to be positively reflected in students' current learning outcomes or in their later academic success.

> Last year, a child in section 4-D (Daniel) was not able to recognise the alphabet. Therefore, I always asked the child letter recognition questions. [. . .] He was not able to score good marks in the two tests, amounting to 10 marks each in the quarter tests. But honestly, he scored 32 out of 40 in the final exams. When I observed such a difference, I was very happy. [. . .] I was improvising; thus, how I could help the child by myself. As I told you before, I just prepared a workbook for him by myself. I made him work in class on the blackboard always; I gave him the priority to answer classroom questions. [. . .] There were others as well in other classrooms. There were students exhibiting indolence in writing. You ask them why they are exhibiting such laziness; sometimes they spill the ink of the pen and give this as a reason. They lose the pen, or they spill the ink. I always keep two pens, one for me and the other in the box. I always carry two tools. Sometimes, the students claim that they lost a writing material, such as an eraser or pencil. I tell them not to worry and give them a replacement pencil or eraser. They can borrow from me. (Selam, Certificate, 12 years of experience)

In this extract, the teacher narrates two different small stories. The first is about Daniel, who has difficulties recognising the alphabet. The teacher highlights her sole, strong and continuous responsibility for the student and his learning: 'I always asked the child', 'I was improvising; thus, how I could help the child by myself' and 'I just prepared a workbook for him by myself'. She also expresses her emotional rewards from helping Daniel when he shows progress. The teacher positions Daniel as someone with special needs who needed to be addressed accordingly, but whose performance could improve with such adaptive support.

In the second small story, the same teacher describes a group of students who not only experience reading and writing difficulties but also have poor school attendance. Instead of criticising the students, the teacher anticipates their needs by bringing extra materials to class. She describes how she regularly 'carr(ies) two pens', and whenever she notices a student who has lost one, she 'give(s) them a replacement pencil or eraser'. In this story,

the teacher shows situational flexibility when students have not behaved according to the classroom norms. In both small stories, the teacher positions herself as an innovative and sensitive expert, treating her students competently to involve them in meaningful learning.

DI as a self-reflective process

The third narrative type focuses on a turning point in a teacher's professional growth, which has arisen either through encounters with students with special needs or through attending training. These growth stories consist of teachers' self-criticisms as well as descriptions of increasing professional understanding and responsibility. Then, the teachers disengage themselves from what they previously believed and begin to obtain a new outsider's perspective on their work: e.g. 'sometimes, the problems that we state as problems are not only created by the students, but also by us – the teachers. The problem that is mainly created by the teachers is neglecting the weak students.' Consequently, the teachers understand some dimensions of teaching more deeply than before and are motivated to change their teaching style to better address their students' individual needs.

> Sometimes, when I attend new workshops, I sense that 'I am lost, and hence, I have to change my teaching methods'. Therefore, you start pondering 'what if I change this, what if I do that'. [. . .] Whenever they provide a workshop, you learn new approaches and then reflect: 'What? Aren't we doing harm to our students?' I mean, you start to change. [. . .] Additionally, for instance, at a workshop one time, he asked us who could remember the previous day's session of the workshop, but we could not remember most of it. Now, in relation to memorising, I learned from the workshop that 'criticising a student for not memorising, decrying the students for failing to remember what is taught yesterday', it has its own problems. That our ability – I mean, there is what is called 'short-term memory' and 'long-term memory'. Therefore, I learned from the workshop that repetitive actions enable the child to remember. Therefore, sometimes we should not get angry whenever students fail to remember. I was able to remember that we teachers are in such courses as well. If I could not remember when I was asked to recall back what I learned before, on the same token, how could the child remember? (Natnael, Certificate, 23 years of experience)

In this extract, the teacher positions himself as a reflective learner who attended a workshop where he realised the difficulty of memorising. This incident gives him insight into the students' situation. He takes strong responsibility for his own instruction and its weaknesses by emphasising his need for development as a teacher, referring to 'change' and saying 'I sense that I am lost, and hence, I have to change my teaching methods', 'what if I change this, what if I do that' and 'you start to change'. These word choices reveal that, although the teacher recognises his own shortcomings as a teacher, the story is still forward-looking and future-oriented. While in this story, the students' position is not explicit and the teacher talks about them only indirectly, the students are the focus, positioned as the motivating force behind the teachers' desire to learn to teach better.

DI as a failed attempt

In the fourth narrative type, teachers construct DI as a failed attempt and position themselves as having limited opportunities to influence the students. The common

feature in these tragic stories is that the failures are attributed to outside factors and children's internal problems, such as impairments, e.g. 'These slow-learning students, whatever you do or prod, even with the efforts of all teachers, you cannot improve or change their condition', poor home conditions, e.g. 'due to problems in his upbringing, he can't understand us', or unchangeable cultural habits, e.g. 'there are some females, though they are excellent students at school, they are married off at young age. [. . .] we tried: "Please, don't destroy her future. Let her study," we told these people, but we didn't succeed'. Thus, although teachers report giving their best efforts to support the children's learning, the learning aims have not been achieved due to factors beyond their control or because the goals would require impossible sacrifices from the teachers.

> There are times you cannot succeed. There were students—there is no need to mention their names—but these students, I would sit with them and make them work. When they asked me things, I'd answer; when I was doing all these things, they were interested, but they could not make it. [. . .] However, to the best of my ability, I have tried. There were five of them; you'd ask them to just get into class and you'd make them work, but when they returned the next day, they'd forgotten everything. They had memory problems. Again, I think something had happened in their life. Oh, if you don't have a father and a mother, it is a bit difficult. Therefore, I have tried in all ways. They could not accept me. This is in teaching. In other things, it is different, but in lessons, they couldn't do it. They just couldn't. This angers you. However, feeling uncomfortable, you have to let it go. (Hana, Diploma, 7 years of experience)

In this extract, the teacher repeatedly mentions that she has made strong efforts to help some of the students, but those efforts have been unsuccessful: 'I was doing all these things', 'to the best of my ability I have tried' and 'I have tried in all ways'. However, she does not blame herself for the students' failure; rather, she attributes it to the students' internal characteristics, e.g. 'they had memory problems', or their home environments, e.g. 'if you don't have a father and a mother, it is a bit difficult'. Thus, the students are portrayed as having their own challenges, which hinder them from benefitting from DI. The hopelessness of the situation is also expressed through emotional words that illustrate the teacher's sense of powerlessness: 'this angers you' and 'feeling uncomfortable'. Finally, the teacher explains that she has had to accept the situation and give up. The story shows the contradiction between the teacher's reported attempts to help students in different ways and the repeated trials that ended in failure.

DI as a demanding approach

The fifth narrative type represents another group of unsuccessful stories. These stagnation stories create pessimistic prospects for developing one's teaching: since differentiation is constructed as an impossible goal, it is not worth trying to individualise one's teaching. However, contrary to the previous narrative type, here teachers do not blame children but rather their own lack of skills or challenging school circumstances for their inability to address students' different needs: 'But there is a challenge, the "class" is large'. The teachers also emphasise the need for more organised training to teach children with special needs and learner-friendly methodologies to become competent teachers. Although in-service training exposed the teachers to different learning modalities, they still express misgivings about utilising them in practice:

> One day, a white man (Rogers) came to my class. He came to supervise my class. He gave me support at that time. [. . .] He came, picked out teaching aids and divided the class into groups very fast. The message he delivered within that session, his teaching approach . . . was just very wonderful. Wow, he brought the equipment, the teaching aids, cards and other materials. He made them form words and write words in group. I had tried to do similar things previously, but I never succeeded. Before I finish grouping, doing this and that, the bell rings; however, he divided them in NO TIME. Now, what is it? He was experienced in it. He was trained, just that way. [. . .] Afterwards, I had tried to do what he did. I couldn't. I was not successful. Now, what is it? Honestly, if you come to that and came through that, you will succeed. We have not come that way. Some workshops are needed for teachers, all teachers, something that can make us change the past, set us forward a bit. There are some who are gifted, who can get into the required student-centred approach very fast; they are skilled, gifted [. . .] however, the majority are not. (Biniam, Degree, 25 years of experience)

Extract 5 shows how Biniam positions himself as a teacher in great need of training to successfully differentiate his instruction. He compares the Eritrean teaching context with the Western one and claims that teachers from the Western world differentiate easily in their classrooms, whereas he and his Eritrean colleagues struggle because of their lack of proper training. His expressions 'I couldn't do it', 'I was not successful' and 'teachers are not skilled enough' are indications of his negative self-efficacy beliefs and, simultaneously, he constructs DI as an approach with principles that are difficult to absorb. The teacher concludes his story in a generalised way, saying that 'the majority' of teachers are not skilled enough and need training to differentiate their teaching successfully. The students are indirectly positioned as victims of poor instruction who would benefit if the teachers changed their old ways of teaching.

Discussion

This study examined small stories provided by Eritrean mathematics and science teachers about DI. The need for research was evident since the teachers' narrated experiences provide valuable information about poorly resourced education systems where the concept of DI is not explicitly familiar to teachers and nor have teachers necessarily received any specific training on it, although the countries would have committed to the principles of inclusive education (Asefaw 2016; Habtom, Franciscah, and Mazrui 2019). Although the roots of the concept of DI are in Western education policy, inclusive education has become a global agenda (Geldenhuys and Wevers 2013), and along with it, knowledge about DI is needed in all education systems. Therefore, it is of great importance to examine teachers' narratives of DI– narratives which also have the power to shape teachers' understandings of implementing DI in practice.

The stories narrated by the teachers were grouped into five narrative types, which constructed different meanings of DI. The majority of the narrative types (78%) showed positive aspects, while only 22% of the narrative types represented negative evaluations of DI. The most dominant narrative types were those about caring orientation and flexible pedagogical approaches. Both narrative types strengthened needs-based principles of supporting students through DI (see Raveaud 2005; Tzanni 2018) and were committed to the differentialist ideal, according to which learning is primarily considered an individual activity, as opposed to universalist orientations that prioritise the cohesion of the group over DI (Raveaud 2005). The caring narratives represented a holistic approach to teaching,

constructing DI as an emotionally responsive and child-centred instruction without taking a strong stand on how to teach actual academic contents individually. The dominance of the caring narratives in the data might be partly due to the poor circumstances in which some of the students were reported to live. In addition, the teachers' lack of professional knowledge about how to adopt specific methods for DI might be one of the reasons that most of the narratives reflected a focus on emotional rather than academic support. Since the caring approach has not been explicitly identified in earlier international research on DI, the finding calls for further research in both other poorly resourced education systems and Western education systems where holistic caring might have been differentiated from teachers to student welfare professionals.

The flexible pedagogy narratives were in line with the general definition of differentiation as academically responsive instruction, where teachers modify curriculum objectives, teaching methods and learning activities to address individual students' diverse needs (Stollman et al. 2019; Tomlinson 2014). Thus, the findings indicate that even in the situations where DI as a concept is not well known (Asefaw 2016), teachers can still provide many examples of sophisticated differentiation practices. In this way, teachers seemed to position themselves as strong narrative agents (see Herman 2009) and indicated strong self-efficacy towards managing heterogeneous and large classrooms on their own (Dixon et al. 2014; Malinen et al. 2013; Saloviita 2018; Schwab, Sharma, and Hoffmann 2019). Even in the narratives about failed attempts at implementing differentiation, the teachers expressed that they had tried their best, although the negative outcomes weakened their trust in themselves and led to reluctance to serve all children in the future.

While the narratives about caring orientation, flexible pedagogy or failed attempts described pragmatic successful or unsuccessful solutions to everyday pedagogical challenges, the narratives about self-reflection and demanding approaches were more idealistic regarding future hypothetical circumstances. Both narrative types emphasised the need for change, but the outcomes of these narratives differed. While self-reflective narratives contained forward-looking efforts towards future change, in the demanding narratives, teachers reported that they were not skilful enough to implement DI. These findings are in line with Cambridge-Johnson, Hunter-Johnson, and Newton (2014) and Dixon et al. (2014), who found that teachers' lack of familiarity with the best instructional strategies led to their reticence towards inclusive education. Teachers' attitudes towards diversity are hierarchically developed from self-awareness to a commitment to social justice (Mills and Ballantyne 2010). Therefore, teacher narratives can be considered a valuable starting point for change both for the teachers themselves and the education systems they work within.

Throughout the stories, the teachers' individual autonomy was evident, whereas the community-level responsibility for students remained secondary. The narratives were dominated by successful and unsuccessful personal encounters with students related using the first-person singular pronoun. Although this finding indicates the teachers' strong personal commitment to instruction, it could also indicate that they felt individually responsible for unsuccessful situations, as seen in the narratives about failed attempts. Therefore, mentoring and collaborating with colleagues could be helpful for finding practical solutions to the teachers' pedagogical challenges (see Malinen et al. 2013).

The results might have been different if teachers of subjects other than mathematics and science had been included, as natural science teachers probably use different teaching methods than social science teachers. Since the selection procedure was based on consulting the school governing bodies, the data could be biased. Furthermore, the narratives are not direct reflections of the study participants' classroom realities but are told situatedly in the interview contexts. However, the significance of the narratives cannot be downplayed, since through storytelling, teachers' also shape culturally acceptable pedagogical ideologies and construct their professional agency as teachers for whom implementing DI in their day-to-day classroom practices is either possible, infeasible or worth a try.

Conclusion

The findings of this study revealed that DI implementation is also possible in challenging contexts. Although the teachers described large classroom sizes, ill-equipped classrooms and a lack of specialised training, they also expressed their commitment to supporting all students and showed positive attitudes towards DI. These emancipating narratives have wider relevance, as the positive narratives could also be utilised to understand DI more broadly in the future, thereby changing the negative stories narrated by some teachers. Thus, it is important to highlight the narratives about everyday applications of DI in pedagogical discussions within and among schools and in teacher education programmes in different contexts. Especially, the flexible pedagogical approaches and self-reflective understandings of the teachers may help the wider community to see the practice of teaching from a different perspective and incorporate such elements into teaching processes. In poorly resourced education systems, this is particularly remarkable and points to the key role of teachers in improving the quality of education. Finally, the findings regarding the wide range of caring approaches and the personal commitment of teachers to provide emotional support for their students show the importance of the contextualisation of DI beyond the Western countries, where the work roles of teachers and other school staff members are more differentiated but where the need for building the inclusive and caring communities has become increasingly important.

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II

THE USE OF QUESTION MODIFICATION STRATEGIES TO DIFFERENTIATE INSTRUCTION IN ERITREAN MATHEMATICS AND SCIENCE CLASSROOMS

by

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Article

The Use of Question Modification Strategies to Differentiate Instruction in Eritrean Mathematics and Science Classrooms

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Abstract: This qualitative study aimed at examining the question modification strategies Eritrean elementary and middle school teachers used to differentiate their instruction and meet the diversity in the classroom as well as the functions these strategies served in classroom interactions. The research data consisted of videotaped recordings (N = 11 videotaped lessons) of classroom interactions in eight mathematics and science classrooms, which were analysed through interaction analysis. The findings showed that Eritrean teachers utilised the following five question modification strategies either independently or in combination: repetition; rephrasing; clarification; decomposition; and code-switching. Although repetition was the most commonly used strategy, it was not found to help teachers to differentiate their instruction. Likewise, the utilisation of rephrasing was dependent on how effectively teachers captured students' misunderstandings and modified their questions accordingly. Instead, clarification, decomposition, and code-switching were found to be the most highly developed question modification strategies from the viewpoint of differentiation. It was concluded that the question modification strategies were dominant and workable elements of classroom interactions in teacher-led and poorly-resourced large classrooms, such as those in Eritrea.

Keywords: differentiated instruction; elementary and middle schools; inclusive education; interaction analysis; mathematics and science classrooms; question modification strategy

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1. Introduction

Questioning has been identified as one of the most important and frequently used teaching strategies in mathematics [1] and science classrooms [2]. Teachers' questions help them to initiate and sustain classroom discussions, introduce new topics, request clarifications from their students, follow up on students' ideas, and understand students' thoughts [3]. Questions also attract students' attention and cause them to listen carefully, leading them to be more explicit and determined in their explanations [4], as well as eliciting critical thinking and raising it to a higher level [3,5–7]. Furthermore, questions have been found to help students recall the information learned and engage them in classroom activities [4–7]. Especially teachers' follow-up questions are considered a mark of being interested in their students' thinking and ideas [8].

This study focuses on analysing the question modification strategies used for differentiation in mathematics and science classrooms in elementary and middle schools. While inclusive education aims to guarantee equal participation for all students in classroom activities and minimise the exclusion of students from the education system [9–11], differentiated or academically responsive instruction is key to promoting inclusive education in practice by adapting instruction to individual differences in heterogeneous classrooms [12–14]. Differentiated instruction refers to the means through which teachers modify curriculum objectives, content, methods, classroom activities, and assessments to

respond to the diverse needs of all learners and maximise their learning opportunities [15]; see also [16,17]. It can be carried out on the following levels: what a student is to learn (content); how the student will learn (process); and how the student is to display what has been learned (product) [15]; see also [11].

Modifying teacher questions and their level of difficulty according to students' learning needs can be considered a part of differentiating one's teaching process [13]. Callahan and Clark [18] reported that, in practice, questioning plays a role in differentiating instruction by providing a conducive environment for increased student engagement and helping teachers to structure tasks and assess their students' knowledge and understanding. In addition, question modification strategies enable teachers to address the difficulties experienced by different students and adapt the question to the cognitive level of their students [19].

In Eritrea, where this study was conducted, classrooms are heterogenous, the class sizes are generally large, and resources for instruction and learning materials are scarce. In such situations, one of the instructional strategies that teachers can use to differentiate their instruction is questioning [6]. Using various question modification strategies can help to make the school curriculum accessible to all students [20] and help students with learning needs develop confidence [1,19]. Teachers' resourcefulness and innovative differentiated instruction practices have been found to play a central role in schools with limited resources [21], and instruction is teacher-driven [22]. It is in this context that this study aims to investigate the types of teacher question modification strategies and the functions they serve in differentiating instruction.

1.1. Types of Teachers' Questions

Teacher questions and questioning have been researched extensively [23]. Dahal, Luitel, and Pant [1] concisely defined questioning in the instructional context as any idea that requires a response from the learner in the classroom. Astrid et al. [5] defined a question as any sentence in an interrogative form that is used as an instructional cue or a stimulus and can arouse learners' interest in the learning contents or the teachers' directions. Questioning is also an indication of how much teachers encourage students' engagement [6].

The type of questions and the way in which they are asked influence the nature of the cognitive processes students engage in when constructing knowledge [19,20,24]. Previous studies on mathematics and science classrooms have shown that teachers predominantly use closed-ended, low-level questions [2,25,26]. These questions may help teachers determine students' prior knowledge and misconceptions about a topic, keep students' attention focused on the lesson or task in progress, and encourage students to review material they have already learned [26]. In science classrooms, closed-ended questions are typically used in whole-group settings to support students' recognition and recall of information [25].

Contrary to closed-ended questions, so-called open questions allow a wide range of possible responses and promote students' evaluation and deep thinking [19]. Such questions require students to think on higher cognitive levels, enabling them to imply, infer, evaluate, and formulate hypotheses and make judgements [2]. In addition, teachers' open-ended questions promote dialogical interaction and pedagogic engagement, which lead to the active participation of students in classroom discourse [20]. Indeed, Dahal et al. [1] argued that the pedagogical design should utilise questioning as a mathematical tool which helps students actively analyse and process information to answer challenging questions (see also [2]. Lee and Kinzie [25] noted that teachers in science classrooms use open-ended questions, especially during experiments (demonstrations) in small-group settings, seeking to elicit predictions and reasoning.

Teacher questions and questioning have been examined based on different learning theories. According to Dahal et al. [1], teachers use questioning to control, monitor, and/or engage students in learning, which is an application of behaviourist theory. In contrast, understanding questioning as part of the process of knowledge construction lies at the core of cognitive theories of learning [26]. Oliveira [3] stated that questioning is used to diagnose

and extend students' ideas and scaffold their thinking. Ormrod [26] related questioning and teacher questions to individual learning perspectives and social constructivism. Students can construct knowledge individually as well as socially through classroom interactions aided by questioning [1,26,27]. In relation to this, Pritchard and Woollard [28] noted that one characteristic of constructivist teaching is teaching through questioning.

1.2. Teachers' Question Modification Strategies

Teachers use question modification strategies to modify the form and/or the content of their questions when they aim at elaborating on students' thinking [20], fail to obtain students' verbal responses to their initial question, or when they sense that the question is difficult for the students [7,29]. Teachers might modify their questions at the word or sentence level as well as through question reframing [7]; see also [24]. Tofade, Elsner, and Haines [19] argued that question modification strategies greatly influence the effectiveness of the question, and they view them as an indication of teachers' effectiveness. Alshenqeeti [24] also noted that calling on individual students to answer a question after modification helps to break the silence and elicit responses.

Teachers tend to use a variety of strategies to modify their questions. These strategies include repetition [2,29,30], rephrasing [7,19,29], simplification [7], offering cues, and providing examples as a way of modifying the initial question [29]. Other types of question modification strategies include pauses, code-switching and/or translation [7,30], as well as probing and decomposition [7]. Hu, Nicholson, and Chen [31] also added chaining to the list, referring to situations in which the teacher ties two exchanges together with a question (e.g., 'Do you agree with him? What do you think of her reply?').

The usage and frequency of the different modification strategies are impacted by the familiarity or unfamiliarity of teachers with the strategies [31]. Repetition has been reported to be the most frequently used modification strategy [2,29], followed by simplification and rephrasing. Meanwhile, probing, chaining, or decomposition are rarely used [29]. According to Cabrera and Martinez [32], repetition provides opportunities for students to learn concepts they did not initially comprehend and may give them more time to process information. Conversely, Tofade et al. [19] argued that repetition of the same question several times could be intimidating to students. They further argued that the combination of repetition, rephrasing, simplification, and decomposition might not produce the desired responses from students [19]. These strategies have also been criticised, as the use of many questions accompanied by modifications could be an indication of the dominance of teacher talk, with minimal room for student-to-teacher and student-to-student interactions [33].

Jusoh, Abdul Rahman, and Salim [7] indicated that code-switching is one of the most widely used teaching techniques and the 'most straightforward strategy' for modifying challenging questions in English-as-a-second-language classrooms. Code-switching refers to the use of two or more languages (dialects or codes) within the same speech exchange or communicative episode, whereas translation is understood as a form of code-switching [34,35]. It has also been noted that language issues are important aspects of mathematics and science teaching, where students are required to use the language of science with peers and teachers and to engage in knowledge construction and evaluation [2]; see also [3]. For instance, teachers' questions display authority in classroom discourse and can elicit either lower- or higher-level thinking or encourage or discourage students' uncertain, tentative, and experience-based answers [3]. Indeed, Oliveira [3] indicated that these aspects of classroom discourse in mathematics and science classrooms are directly influenced by language, which is also the focus of this study.

1.3. The Aim of this Study

In this study, we examine the kinds of question modification strategies elementary and middle school teachers use in mathematics and science classrooms as a means of differentiating their instruction. Earlier research on question modification is limited to the secondary and tertiary education levels, and little is known about how teachers modify their

questions at the elementary and middle school levels. However, these levels represent basic education and, thus, form the critical foundation for implementing inclusive education. The research gap is even wider when relating question modification strategies to differentiated instruction because, regardless of the fact that several independent studies being made on question modifications and differentiated instruction, the link between the two has not been studied previously. The present study aims to address this research gap by investigating the role teacher question modification plays as an instructional tool in differentiating instruction in mathematics and science classrooms in Eritrea. This study is also expected to add to the research knowledge on how mathematics and science teachers in poorly resourced, large class-size, teacher-centred, and heterogeneous classrooms modify questions to differentiate their instruction. This study seeks to answer the following research questions: (1) What kinds of question modification strategies do Eritrean teachers use in mathematics and science classrooms to differentiate their instruction? (2) What functions do various question modification strategies serve in differentiating instruction?

2. Materials and Methods

2.1. Study Context

The research context of this study is Eritrea, located in the Horn of Africa. The current Eritrean education system consists of the following three tiers: compulsory basic education (elementary school, grades 1–5, and middle school, grades 6–8), secondary education (grades 9–12), and further and higher education [36]. Elementary-level education is offered for all nine ethnic groups in their own mother tongue [37,38], whereas English is the medium of instruction from grade 6 onwards. Regardless of this policy, Tigrigna (50% of the population are Tigrigna, and, thus, it is the most widely spoken language in Eritrea) and Arabic are officially considered working languages [39], which implies that Tigrigna dominates classroom interactions when students move from elementary to middle schools (see [40]).

As a signatory of international declarations and conventions advocating inclusive education [41], the Government of Eritrea is committed to addressing the diverse needs of all learners regardless of their disabilities or backgrounds. However, until recently, inclusive education was considered the provision of educational services for children with hearing and visual disabilities in mainstream classrooms in regular schools [21]. Since 2005, the government of Eritrea began to set up separate self-contained classrooms in some elementary schools throughout the country for children with intellectual and developmental disabilities [36,42,43]. Whenever these children show progress in their performance, they have an opportunity to attend lessons in mainstream classrooms. Thus, despite the commitments to the principles of inclusive education, the Eritrean education system is not fully inclusive. The quality of resources, instructional materials, as well as teacher preparation programs to successfully implement an inclusive approach are limited (See [10,38,42,43]).

Recent studies revealed that, even though Eritrean teachers face many challenges and lack specific training for implementing inclusive education, they tend to hold positive perceptions towards learner-centred interactive pedagogy [22] and differentiated instruction [21]. However, both practices are overshadowed by traditional teacher-directed practices and large class sizes (50 to 70) [21,22,40]. As a result, whole-class learning is the most common instructional practice, while small-group and one-on-one instructions are limited (see [21]). Further, the rigid and centralised curriculum leaves little room for flexibility and adaptation at the school level [22,40].

2.2. Data and Participants

The research data consist of videotaped recordings (11 lessons) of classroom interactions in eight mathematics and science classrooms. For these two subjects in the Eritrean context, teachers typically apply diverse teaching methods and provide various activities to engage students, while in some other subjects, instruction is based more on lectures.

The data included five elementary school classrooms (grades 4 and 5) and three middle school classrooms (grades 6) from five different schools and from two cities in Eritrea (three public schools and two private schools). The cities were purposefully selected because of their diverse student populations representing several ethnic groups and different language backgrounds.

The classroom sizes in the researched schools varied from 50 to 70 students, and a total of 455 students participated in this study. These students represented several ethnolinguistic groups (including minority groups). In addition, there were some students with physical and sensory disabilities, learning difficulties, autism spectrum disorders, as well as intellectual and developmental disorders included in the classrooms. Several students came from poor home backgrounds, and some of them were taken care of by their grandparents or other guardians. Despite the diversity of the special educational needs and the large classroom sizes, there was only one teacher in each classroom. Moreover, apart from one mathematics teacher who was also trained as a special education teacher and who was teaching in a mainstream classroom, there were neither special education teachers nor support teachers in the classrooms observed.

The length of the observed lessons varied between 32 and 43 min (mean = 37 min). The lessons consisted of teacher-directed whole-group instructions, teacher questioning, group work, and independent activities. The independent activities included individual students working on the blackboard (mathematics lessons) and field experiments (science lessons). All the lessons took place as part of the normal school day. Engaging students in questioning and answering were typical features of both mathematics and science classrooms. However, the mathematics classrooms also engaged students in solving mathematical problems individually and in small groups. Additionally, the students actively commented on and gave feedback to the teachers and other students who worked on the blackboard. By contrast, the science classrooms involved teachers' presentations using diagrams and some demonstrations and experiments inside and outside the classroom.

Eight teachers participated in this study, four males and four females. Their teaching experience varied from 6 to 25 years (mean = 16.5 years). The participants were purposefully recruited for video-recorded observation through consultation with directors and pedagogic heads, who identified teachers who were thought to utilise different teaching methods. Local approval and informed consent were sought from the district school authorities, school principals, teachers, and parents of all the students who participated in video recordings of classroom instruction. Prior to data collection, the first author discussed the aims of this study with the participants as well as how the data would be utilised. The participants were informed that they could withdraw their consent anytime [44]. An overview of the participants and the observed lessons is provided in Table 1.

2.3. Procedure

The data were collected in 2019 using three video cameras. Two cameras were placed in the front right and left corners of the classroom at an angle to capture most of the classroom activities. The third camera was held by a research assistant sitting on one side of the room, who moved the camera slightly to follow the teacher's movements around the classroom without distracting the teachers and the students. A microphone attached to a mobile phone was placed inside each teacher's clothing to audio-record everything the teacher was saying throughout the lesson. For each teacher, one or two lessons were video-recorded on two consecutive days. The abundant video footage and audio data provided a rich source for data reconstruction [45], from which the authors defined the actual data set for analysis.

The selected video recordings from the grade 5 lessons were transcribed and translated from Tigrigna to English. The medium of instruction in grade 6 was English. However, when the data contained code-switching, the episodes were translated from Tigrigna and Bilen (another local language) to English. All the transcriptions and translations were made by the first author (Tigrigna speaker) with the help of two Bilen speakers. The

anonymity of the participants from harmful use of data was maintained by removing personal (background) identifiers and using pseudonyms [46,47].

Table 1. Research participants and the collected data set.

Pseudonym of the Teacher	Gender	School Type	Teaching Experience in Years	Educational Background	Grade	Subject	Number of Students	Number of Video-Recorded Lessons	Topic of the Lessons
Adam	M	Public	22	Certificate	6	Math	60	2	Business mathematics
Eyob	M	Private	23	Certificate	5	Math	70	1	Decimals and fractions
Martha	F	Public	24	Certificate	5	Math	50	1	Integers
Mehari	M	Private	25	Degree	6	Science	60	2	Lenses and magnifying glasses
Miriam	F	Public	7	Diploma	5	Math	55	1	Decimals and fractions
Natsnet	F	Private	6	Degree	6	Math	60	1	Expressing ratios and fractions
Solomon	M	Public	12	Diploma	4	Math	50	2	Computing proper, improper, and mixed fractions.
Tsega	F	Private	13	Certificate	5	Science	50	1	Metamorphosis in the life cycle of animals
Total							**455**	**11**	

Note: Certificate = 1 year of college education; Diploma = 2–3 years of college education; Degree = 4 years of college education.

2.4. Data Analysis

A qualitative interaction analysis [45,48] was performed to analyse the data. Interaction analysis situates knowledge and action in the details of naturally occurring everyday social interactions in time and space [48]. The goal of interaction analysis is to find patterns in how participants utilise social and material resources to structure their interaction with others [48]. Since interaction analysis represents microanalysis [47], it enabled us to notice how teachers locally interpret what is going on in the classroom during questioning sessions, how students react to their questions (i.e., whether they answer or fail to answer the question correctly), and how teachers interpret students' responses and actual learning needs when modifying their questions [48]. Interaction analysis was also related to our view of learning—the sociocultural learning theory. In this theory, learning is viewed as an ongoing process of social participation in which learning occurs through people's collaborative knowledge construction through interactions with one another [49–51].

After carefully watching the video recordings of the lessons, the first author identified all the questioning episodes (N = 227) in the data and transcribed and translated them into English. The analysis began by identifying all the question modification episodes from these questioning episodes. The following criteria were used to identify these episodes: (1) a teacher presents two or more consecutive questions about the same topic either in one turn or in a close-knit turn after a student response; (2) the reason for modifying an original/initial question is related to the students' incorrect answer and misunderstanding or failure to elicit responses from the students. Thus, the question modifications were made in order to help students understand the learning contents and to answer the question or solve the problems either individually or in small groups. A total of 155 episodes (94 in mathematics and 61 in science) contained either one or more question modifications, and there were 295 question modifications (any question modification strategy appearing within each questioning episode was counted only once, although a teacher used the

same strategy several times during the episode). Most of the video recordings provided data for this study, while one video-recorded lesson from a mathematics teacher did not provide the required data. This might have been due to the teacher's tendency to present straightforward questions that were immediately answered correctly by the students.

After identifying the question modification episodes and sharing them with all the authors, the first and last authors examined the selected episodes separately and classified them into categories that emerged from the data (data-driven analysis). The classification was based on how and to what extent teachers modified their questions. The differences between original and modified questions might be related either to the content of the questions (e.g., were the word choices used in the questions changed or repeated?) or to the form of the questions (e.g., did teachers shorten, expand, or break down an initial question or did they demonstrate the content of the question in some way?). The first and last authors cross-checked their preliminary categorisation through discussions to reach a mutual understanding of the question modification strategies used by the teachers. However, the authors did not count inter-coder reliability. Based on the above-mentioned dimensions and the discussions with all the authors, teachers' modification strategies were classified into five types: repetition; rephrasing; clarification; code-switching; and decomposition. Subsequently, the analysis focussed on what purposes these question modification strategies served in classroom interaction [24]. The question modification strategies and the functions they served in the interaction were identified inductively from the video recordings, and the strategies were conceptualised and named based on theory and the previous literature (see, e.g., [19,29,30]. The six most representative and illustrative episodes were selected for the data extracts to demonstrate how the teachers used question modification strategies in practice in classroom interactions. The transcription symbols found in the extracts can be found in Appendix A.

3. Results

The data analysis revealed five different question modification strategies utilised by teachers either independently or in combination (see Table 2). Four of the strategies, repetition, rephrasing, clarification and decomposition, were used by both elementary and middle school teachers, and apart from decomposition, they were used by all seven teachers who modified their questions in response to the students' needs. Meanwhile, code-switching was only used by middle school teachers, whose medium of instruction was English, the students' second language. When teachers leaned on a combination of different modification strategies for the same question, repetition was the most common strategy used concurrently with the other strategy types.

Table 2. Use of the details in the question modification strategies.

Question-Modification Strategies	Repetition	Rephrasing	Clarification	Decomposition	Code-Switching
Main content	Question is repeated wholly or partly	A word or a phrase of an original question is reformulated	Adding further explanation, additional information, or a reminder of the previous lesson to the question	A complex question is broken down into sub-questions	Shifting language from English to local languages
Classroom context	Whole-class dialogue	Whole-class dialogue and small group discussions	Whole-class dialogue and blackboard work	Whole-class dialogue and blackboard work	Whole-class dialogue and one-on-one guidance

Table 2. *Cont.*

Question-Modification Strategies	Repetition	Rephrasing	Clarification	Decomposition	Code-Switching
Main function	Drawing students' attention to a question, and engaging them in the classroom dialogue	Making the questions more understandable by guiding students' attention to the core of the problem	Addressing a gap in students' knowledge by teaching and rehearsing the learning content	Guiding students step by step to solve complex questions through simplification	Addressing language barriers and engaging minority students in the dialogue
Percentage of the episodes (N = 155), in which the question modification strategy was used	57%	48%	45%	22%	19%

The majority of teacher question modification episodes occurred during whole-class dialogue. There were also one science and three mathematics lessons, where teachers (Mehari, Adam, Eyob, and Miriam) gave defined tasks and questions to different mixed-ability small groups of students. Sometimes, the difficulty, complexity, and abstraction levels of these questions varied. In addition, all the mathematics teachers offered blackboard assignments to students, but only one of these teachers, Solomon, gave different questions (the difficulty level of which varied) to individual students during blackboard work. The difficulty level of questions was also increased when a student managed to solve simpler problems. All the names used for teachers and students in the extracts are pseudonyms.

3.1. Repetition

Repetition, that is, repeating one's question in an original or a shortened form either once or many times, is one of the most common question modification strategies teachers used in science and mathematics classrooms. This occurred in 57% of teacher question modification episodes. Repetition was mostly used as an independent strategy, but in 23% of the repetition episodes, it was used in combination with the other question modification strategies. This strategy was only used in whole-class teaching, as seen in Extract 1. This extract is from a grade 5 science classroom with 50 students. The topic of the lesson was a 'metamorphosis in the life cycle of animals'.

Extract 1:

Elementary school, teacher = Tsega, student = Embaba.

1	Tsega:	Animals who undergo incomplete metamorphosis? (some hands raised)
2		(2.0.) Animals who undergo incomplete metamorphosis? (3.0) Animals
3		who undergo incomplete metamorphosis? (5.0) (teacher is moving
4		towards the back) Embaba (calls a girl who sits in the last seat)
5	Embaba:	Locust.
6	Tsega:	Locust.
7	Embaba:	Cockroach.
8	Tsega:	Cockroach.
9	Embaba:	Cricket.
10	Tsega:	Cricket. Very good, excellent.
11		(Tsega smiles, and students clap when seeing the gesture of her hands)

In Extract 1, the teacher (Tsega) repeats her original question after only a few students have raised their hands, 'Animals who undergo incomplete metamorphosis?' (line 2). After this repetition, more of the students raise their hands. However, Tsega waits for 3 s (line 2) and then repeats the question for the third time exactly in the same form as before (lines

2–3). By this time, almost all 50 students have raised their hands. After a 5-s pause, Tsega calls on 'Embaba' (line 4), a girl who is sitting in the back seat. Embaba lists the answers correctly (lines 5, 7, and 9), and Tsega confirms each answer by repeating it after the student.

This extract showed that the repetition of the question and the pauses between them slowed the pace of learning and encouraged the students to raise their hands in an attempt to answer the question. This was reflected in the increasing number of hands raised after each repetition and pause. The repetition also seemed to work by eliciting the desired answer from one student, Embaba, who was sitting at the back of the classroom and seemed to be absorbed in her own thoughts before raising her hand after question repetitions. Thus, the aim of this question modification strategy was to grab the attention of the whole classroom and elicit a response from students in a situation where only a few of them had raised their hands after the teacher's question. In addition, this strategy was used when teachers sought to correct students' incorrect answers. Since repetition was the easiest and simplest strategy to put forward the questioning episode, this might explain its prevalence in the data. Although the use of repetition may not promote students' access to the learning content, it might contribute to differentiation by slowing the pace of instruction, benefitting some of the students.

3.2. Rephrasing

In 48% of the teachers' question modification episodes, rephrasing was used as a strategy. It was used mainly independently but in 19% of the rephrasing episodes, also in combination with the other question modification strategies. In this case, teachers expressed their original question in a different way by changing or adding a word or phrase to their initial question. For instance, instead of asking, 'now have you observed the error?', a math teacher might rephrase it, 'where do you think the error might be?' Teachers use rephrasing when students give incorrect answers or are reluctant to answer in a whole-class teaching environment and sometimes in a single group during small-group discussions. The following extract is from a grade 5 mathematics classroom, where the teacher asks questions of the whole class before they begin to work in small groups on the topic of decimals and fractions. The class size is 55 students.

Extract 2:

Elementary school, a female teacher = Miriam, students = Joel and Berhane.

1	Miriam:	What is the symbol, when we say out of hundred? (1.0)
2		(several students are lifting their hands shouting 'teacher'.) (1.0)
3		What is the symbol? (with emphasis)
4		(More hands raised) (5.0)
5	Miriam:	Yes, Joel.
6		(the boy sitting in the back is initially reluctant, but finally raises his hand in hesitation when the teacher calls his name)
7	Joel:	It has the shape of hundredth.
8	Miriam:	It has one out of hundredth sign. But what do we call it in English?
9		(Several students shout 'teacher, teacher'.)
10	Miriam:	It is called what? Yes, Berhane. (calling on another boy)
11	Berhane:	Percent.

The teacher (Miriam) starts her lesson by asking, 'What is the symbol when we say out of hundred?' (line 1). Although several students raise their hands, she repeats her question in line 3 in a shorter form, 'What is the symbol?' Then, she calls on Joel, a boy who was first hesitant to raise his hand but eventually slowly raised it (line 6). However, his answer, 'It has the shape of hundredth' (line 7), does not seem to correspond to Miriam's expectations. This is reflected in how Miriam builds on what Joel said in line 6 by replacing Joel's word 'shape' with the word 'sign' and the expression 'hundredth' with 'one out

of hundredth'. In addition, Miriam begins to present a rephrased question using the conjunction 'but', which implies that the connected phrases are not directly related (line 8). The rephrased question, 'What do we call it in English?' (line 8) suggests that the teacher is searching for a specific word as an answer. This modification is followed by expressions of excitement and willingness to answer from several students, who shout 'teacher, teacher' while raising their hands (line 9). Miriam again rephrases her question as 'It is called what?' and lets another student, Berhane, answer (line 10). Berhane immediately answers correctly, 'Percent' (line 11).

This extract showed that rephrasing might involve either the insertion of a word (line 3) or presenting the question in a very different form (line 8). However, in all cases, the changes were small, and they were intended to elicit appropriate responses from the students. Although the first rephrasing did not produce the response expected by the teacher, the last one (line 8) elicited an appropriate response from the student (Berhane).

In summary, the function of rephrasing is to offer the original question in a slightly modified and more focused form to elicit appropriate responses from students. What is noteworthy is that the rephrased questions were not typically presented in a more concrete form than the original one. Rather, they defined the teacher's purpose more specifically by emphasising certain elements of the original question based on the students' incorrect answers. On the one hand, this strategy seemed to help the students engage in attempting to answer, but on the other hand, it sometimes required the use of other question modification strategies, such as repetition and cueing, before the students produced the correct answer. Thus, the efficiency of rephrasing from the viewpoint of differentiated instruction depended on how carefully the teacher was able to observe and interpret the causes of students' misunderstanding when highlighting certain core contents of the original question.

3.3. Clarification

Clarification appears in the data when the teachers provide the students with extra explanations for an original question through elaborations, cues, and reminders of previously learned or related lessons or formulas. For example, when clarifying an original question on the additions of decimals, a mathematics teacher (Eyob) presented the following rule: 'Even if we add zero, there is no problem. It will become easy for addition.' This strategy occurred in 45% of the teachers' question modification episodes and was used by mathematics teachers in 16% of the episodes in combination with decomposition. Clarification was mainly used during whole-class teaching, especially in situations after one or many students experienced difficulties working out a problem on the blackboard.

The following extract is taken from a grade 6 mathematics classroom with 60 students. The topic of the lesson was 'business mathematics'. The teacher wrote the question on the blackboard and started reading it to the students.

Extract 3:

Elementary and middle school; a male teacher = Adam; a student = Mary.

1	Adam:	Abel bought a goat for 350 Nakfa and sold it for 300 Nakfa. What is his
2		cost price? (reads from the blackboard) (1.0) What is the cost price of
3		the goat?
4	Several students in unison:	300.
5	Adam:	Cost price? (with emphasis) (1.0) Bought. (2.0) Sold (underlining both words on the
6		blackboard).
7	Mary:	The cost price is 350. (A girl answered)
8	Adam:	Cost price is . . .

9	All students and teacher in unison:	[350 Nakfa]

In Extract 3, the teacher (Adam) begins the episode by reading the question, 'What is his cost price?' (lines 1–2) from the blackboard and then rephrasing the question a little in lines 2–3. Several students shout the wrong answer '300' in unison (line 4). Adam corrects the students by repeating the main concept of his original question ('cost price?'), with emphasis (line 5), which is followed by clarification. The clarification offers a cue to students by underlining two words from the question on the blackboard, 'bought, sold', with pauses in between (line 5). The pauses and the use of a loud voice indicate the emphasis the teacher gives to the cues. In line 7, a student named Mary is able to answer the question correctly, '350'. While Extract 3 shows how clarification was made through relatively simple cue-giving, the following extract shows a more elaborate and detailed way of using this strategy. This extract is from a grade 4 mathematics classroom with 50 students. The topic is computing proper, improper, and mixed fractions. In the extract, a mathematics teacher clarifies the question $4/7 \times 3/8$ after one student fails to answer it, and a second student struggles for 2 min and 13 s before answering it correctly.

Extract 4:

Elementary and middle school; a male teacher = Solomon.

1	Solomon:	Now, what do you think you observe? (1.0) What is your major problem?
2		(4.0) $4/7 \times 3/8$ (writes the question on the blackboard silently). Is this not
3		the question, yes?
4	Some students:	Yes
5	Solomon:	Now follow me: (2.0) can eight be multiplied and go back to become four?
6	Some students:	No, no.
7	Solomon:	When eight is multiplied it will always go forward. If I say eight times one,
8		eight; with two, sixteen; with three, twenty-four; with four, thirty-two; it
9		keeps on growing higher. However, if you start with the bigger lower
10		number (denominator), you cannot understand it. With this (pointing to
11		number 8), you should go with its multiples. (1.0) I have to ask 'the upper
12		(numerator) four should be multiplied by what number to get eight?' (1.)
13		"We should take the smallest number, always. Am I right?" (with emphasis)
14	Some students in unison:	Yes.
15	Solomon:	Therefore, in order to take a small number; by four, one; by four, two. The
16		simplified number you wrote at the bottom should give you the result eight,
17		because two times four gives you eight (3.0). In order not to get confused,
18		always take the smallest numbers, so that you can multiply. (he provides
19		further explanation for a few seconds), do we agree?
20	Students in unison:	Yes.
21	Solomon:	(2.0) Here, the seven and three (pointing to the right side of the question).
22		If I say three times one, it is three; three times two, it is six; three times three
23		it is nine. Is there any number that links the two (seven and three) or not?

24	Majority of the students in unison:	No there is not.
25	Solomon:	Therefore, you multiply nominator with nominator, and denominator with
26		denominator and that is over (multiplying and writing the result as a single
27		fraction, three over fourteen).

In Extract 4, the teacher (Solomon) starts the clarification episode after observing how two students, Saba and Elsa, struggle with simplifying a fraction. First, he presents the problem to the whole class, 'What did you observe?' (line 1) and 'What is your major problem?' (line 1). After writing the original question on the blackboard (line 2), he reminds the students about the mathematical rule in the form of the question in line 5. The rule is related to the fact that it is impossible to multiply a natural (counting) number and then obtain a lower number as an answer. Solomon's clarification seems to be understandable to the students, as they answer correctly in unison, 'No, no' (line 6). In lines 7–13 and 15–19, the teacher also gives a short explanation of the principle and concrete examples of multiplying, 'If I say eight times one, eight; with two, sixteen; with three, twenty-four . . . ' (lines 7–9).

In lines 9–11, the teacher clearly indicates how the students may fail to answer the question if they start the simplification process with the denominator, the number 8, which is larger. He explains that the starting point for solving the problem is the upper numerator, which is the smaller number, in this case, 'four' (lines 11–12). He speaks with emphasis and reminds the students about the exceptionless rule, 'Always we should take the smallest number. Am I right?' (line 13). 'Am I right?' is the question tag through which the teacher expresses that he expects the students to agree with his statement. The majority of the students also produce a confirmatory response, replying 'yes' in unison in line 14. A similar kind of confirmation is also obtained from the students in line 20 to the teacher's tag question, 'Do we agree?' (line 19). In lines 15–17, the teacher continues his clarification based on the explanations he gave in lines 7–13. The teacher reaffirms that students should take the smallest number 'in order not to get confused' (lines 17–19). On the second side of the question (seven and three), he asks if these numbers have anything in common (lines 21–23). The reply from the students in line 24, 'No, there is not', shows that they have understood that simplifying ends here, and they should move on to multiplication and get the result 3/14. In this extract, Solomon uses cues three times (lines 5, 13, and 23), provides extra elaborations (e.g., lines 9–11 and 15–19) and provides the students with a formula (lines 25 and 26).

The function of clarification as a strategy seems to be demonstrating, explaining and instructing students on learning contents that are abstract or complicated and perceived by the students as challenging. Therefore, after observing students' challenges in answering the original question, teachers might begin a teacher-led instruction sequence in which they demonstrate how the problem should be solved. Thus, at its best, the use of clarification was an indication of teachers' readiness to flexibly change their teaching agenda according to students' actual needs, which is an integral part of differentiated instruction. In Extract 4, the intended result was met on three occasions when students replied to the teacher correctly (lines 14, 20, and 24). However, since the understanding of all students was not checked, the need for additional instructional support remains unknown.

3.4. Decomposition

In this strategy, teachers break down a question into several smaller parts, thereby directing the problem-solving step by step until the students have answered the whole question presented to them at the beginning. This question modification strategy, occurring in 22% of the question modification episodes, is especially common in mathematics lessons. Decomposition seemed to be a useful strategy as such since it was almost purely utilised independently and only in 9% of the decomposition episodes in combination with

clarification. Decomposition usually appeared in a context where a mathematical problem was written first on the blackboard or read from the textbook, after which teachers began to break down the question into smaller parts, to which students were also requested to reply. The teachers might also deal with each section of the question first and finally provide a general conclusion to answer the original question (e.g., 'first let us place decimal numbers in their proper places and begin with the right-end side'). Decomposing the questions could also be accompanied by repetition as well as clarification, and code-switching. The use of decomposition often occurs after individual students working on the blackboard fail to answer the question correctly.

The following extract is taken from a grade 6 mathematics classroom (60 students), where the topic of the lesson was expressing ratios and fractions. First, the teacher reads a question from the textbook, 'A country has about 2600 villages, out of which 1680 villages have electricity supply. Express the villages without electricity as a fraction of the total number of villages.' Then, she calls on two students to work on the blackboard independently. After observing that they produced an incomplete answer, she began to decompose the question both in English and Tigrigna.

Extract 5:

Elementry and middle school; a female teacher = Nastnet; students Samuel and Noah.

1	Natsnet:	Express the villages out of electricity as a fraction of the total number
2		of villages. ናይቶም ኤሌክትሪሲቲ ዘይብሎም ምስ ናይ መን ኢሉና፡ (The translated version is situated inside the square brackets, immediately following the original Tigrigna version) [It asks us to
3		over fraction those which don't have electricity, with which?] ምስ [with]
4		the total number of villages. Samuel and Aron ንዑ [come] (she calls on
5		two boys to work on the blackboard, who work for a while). ሬሾ ገይሩላ
6		ድዩ፡ [has he put a ratio?] (3.0) What do we do if we are to find those
7		without electricity?
8	Some students in unison:	ነጉድል [we subtract]
9	Natsnet:	ከነጉድል ኣሎና [we have to subtract]
		(18-s-long data removed where the teacher and the student are subtracting 1680 from 2600)
10	Natsnet:	ናይ መንን ናይ መንን ሬሾ ኢሉና፡ [It asked us whose and whose ratio?]
11	Students in unison:	እቶም ኤሬክትሪሲቲ ዘለዎም [those with electricity] with እቶም ኤሌክትሪሲቲ
12		ዘይብሎም [those without electricity]
13	Natsnet:	How many do have electricity?
14	students and teacher in unison:	One thousand six hundred eighty (Natsnet writes it on the blackboard).
15	Natsnet:	Without electricity?
16	students and teacher in unison;	Nine hundred twenty (Natsnet writes it on the blackboard).
17	Nastnet:	One thousand six hundred eighty over nine hundred twenty (she writes 1680/920 on the blackboard).
18		This is the ratio.

19	Majority students in unison:	Zero by zero.
20	Natsnet:	So, ከነፋኹሶ ኣሎና መስለኒ፡ [I think we need to simplify?] (3.0) hundred
21		sixty eight out of ninety-two. እንዳበልና ከነፋኹሶ ንኽእል ኢና [We can
22		continue simplifying by two]
23	Some students:	Yes.
24	Nastnet:	እሀ፡ [what?] (1.0). By two ክንደይ ኣሎና፡ [How much do we have?]
25	Natsnet and students in unison:	By two, eighty-four, by two, forty-six.
26	Several students:	By two (shouting).
27	Natsnet and students in unison:	(2.0) By two, forty-two]
28	Several students:	By two, twenty-three (shouting).
29	Natsnet:	ካብዚ ክጎድል ይኽእል ድዩ፡ ክፋኾስ፡ [Can it be subtracted? Simplified?]
30	Majority students and teacher in unison:	ኣይኽእልን! [it cannot]
31	Natsnet:	እንታይ እዩ፡ [What is it?] Prime ስለ ዝኾነ [because it is prime]. እሀ፡ [yes?]
32		ካብኡ ንንዮው ክፋኾሰልና ኣይክእልን እዩ። [It cannot be simplified beyond that]
33		ስለዚ ኣርብዓን ክልተን ኣብ ልዕሊ ዕስራን ሰለስተን መጂኣትልና ኣላ።. [Therefore, we
34		get the result as forty-two over twenty-three.]

In Extract 5, the teacher (Natsnet) begins by reading the question from the textbook in English, followed by repeating each section in Tigrigna, which indicates that Natsnet is using the repetitive function of code-switching. In lines 2–4, she concretises what is requested in the question. Samuel and Aron move forward to compute the question, which they do with some gaps. This is evident when Nastnet remarks, 'Has he (the first boy) put a ratio?' (lines 5–6). This is followed by decomposing the original question into its parts after she asks, 'What do we do if we are to find those without electricity? (lines 6–7). The students seem to quickly grasp the idea, answering, 'We subtract' (line 8). The teacher confirms this in line 9, and both the teacher and the students begin to subtract 1680 from 2600 step by step. In line 10, the teacher returns to the part of the original question, 'Whose and whose ratio?' This seems to act as a reminder to the students. They reply to her correctly (lines 11–12). In lines 13 and 15, Natsnet asks each section of the question, while the students reply in lines 14 and 16, respectively. After getting both figures with the students, she shows them the exact number to simplify as a ratio in lines 17–18, writing 1680/920 on the blackboard. This immediately elicits a response from the majority of the students as they shout, '0 by 0', knowing exactly what to do with it (see line 19). Natsnet confirms they are correct, suggesting, 'So, I think we need to simplify?' with a brief 3-s pause and writing the simplified figure, which is now 168/92 (lines 20–21). The simplification process continues until line 28. After this, the teacher closes the questioning sequence in lines 29 and 31–32 and explains why they cannot go any further. The students show they understand this by replying to the teacher's question, 'Can it be subtracted? Simplified from this? (line 29)

with 'No, it cannot' (line 30). This final explanation brings the decomposition process to an end.

The teacher first uses subtraction as a decomposition strategy to obtain the number of villages without electricity. This step is followed by writing the result in a ratio form to move forward in the simplification process with the students. The teacher decomposes the question into a much simpler form by helping the students to simplify the figure until they arrive at a point when they can no longer divide by 2. What was consequential in the immediate interaction was that each strategy that the teacher used generated a correct response from at least the majority of the students, who replied immediately in unison. On one occasion, the students even took the lead and began simplifying when the teacher immediately wrote the ratio (line 19).

Thus, the extract indicates that the decomposition process helped the majority of the students to carry out problem-solving processes by concretising the original broad question by breaking it down into its components. The new sub-questions were more specific than the original ones and modelled how the broad problem should be solved. Thus, the teachers utilised decomposition to differentiate their instruction by lowering the cognitive level of the questions on the basis of the systematic task analysis and recognition of their students' starting level in relation to problem-solving.

3.5. Code-Switching

The fifth and final question modification strategy is code-switching, in which teachers use more than one language when modifying the questions. This strategy is most commonly used in middle school classrooms occurring in 19% of all teacher question modification episodes. It was utilised both as an independent strategy and in 30% of the episodes also as a means of repetition. Typically, teachers first present an original question to the whole class in English and then repeat the question wholly or in part in Tigrigna (the local language the majority of the students can understand). Code-switching is used both during whole class discussions as well as with specific individuals on a one-on-one basis.

The following extract is taken from a grade 6 science lesson, the topic of which is 'Lenses and magnifying glasses'. This is an experiment class, and the teacher and 60 students are outside in the field experimenting with how magnifying glasses burn paper in direct sunlight and the other uses of lenses and magnifying glasses.

Extract 6:

Elementary and middle school; a male teacher = Mehari; a student = Fadega.

1	Mehari:	What is the use of the magnifying glass? (1.0) ቀንዲ ስርሑ እንታይ እዩ እዚ፧
2		(The translated version is situated inside the square brackets, immediately following the original Tigrigna or Bilen versions) [What is the major use of this?]
3	Some students in unison:	Magnify.
4	Mehari:	ቀንዲ ስርሑ እንታይ እዩ፧ [What is the major use?] (with emphasis)
5	Few students in unison:	ንምርኣይ [to see]
6	Mehari:	T. Magnify. ሰበት የዕብዮም ክርእዩሉ እዮም ዝጥቀሙሉ ማለት እዩ [It means
7		people use it to see things magnified] (5.0) Fadega, wérenigéni? [What is
8		it?] (2.0) Wira ésrakhun? [What did it do?]
9	Fadega:	(- -) incomprehensible sound in Bilen.
10	Mehari:	Xawsekw Arikhwa? [What else?]
11	Fadega:	beher ése qwalisekw. [It burns]

10	Mehari:	Xawsekw Arikhwa? [What else?]
11	Fadega:	beher ése qwalisekw. [It burns]
12	Mehari	beher ése qwalisekw; Xawsekw Arikhwa? [It burns. What else?]
13	Fadega:	beher ése qwalisekw; Kwénwédo qwalisekw [It burns, magnifies, it
14		enlarges]
15	Mehari:	Kwénwédo qwalisekw [magnifies, it enlarges]
16		(other students laugh)

In Extract 6, the teacher (Mehari) presents his first question to the whole class in English (line 1). Immediately after this, he code-switches the same question, rephrased a little, to Tigrigna twice to help all his students understand the question (lines 1 and 4). Between the questions, some students have already answered 'magnify' in English, and after the last question, other students provide a different answer, 'to see', in Tigrigna. The teacher combines both these alternative answers when producing the right answer in line 6, 'Magnify. It means people use it to see things magnified' in Tigrigna. After a 5-s pause, he calls on Fadega, a student from a linguistic minority group, and asks him, 'What is it?' in Bilen (line 7). When the student does not immediately answer, he modifies the question in Bilen, 'What did it do?' (line 8). Fadega produces an answer in Bilen in line 9. This answer cannot be heard in the video, but the teacher seems to partly accept it because he asks him, 'What else?' in Bilen (line 10). The teacher continues talking to Fadega in Bilen until he is able to complete his answer correctly (see lines 11 and 13).

This extract indicates that the function of code-switching is to provide students with equal access to the original question when it is presented in their native language. This did not mean mere translation; rather, the teachers also clarified the meaning of the original question by presenting it in reformulated form during code-switching. Hence, code-switching might involve either rephrasing the original question or presenting the translated question in the same form as the original question. Thus, this question modification strategy helps teachers address the language barriers of students from the linguistic minority group by providing a sequence of questions in their own languages. The use of code-switching was an indication of teachers' awareness of and sensitivity to the ethnic and linguistic backgrounds of their students rather than forcing the students to use only one official medium of instruction in the classroom. The strategy can both optimise students' understanding of the original question and strengthen and respect their native language. These principles are also essential cornerstones of differentiated instruction.

4. Discussion

This study aimed to identify the question modification strategies Eritrean teachers use in mathematics and science classrooms to differentiate their instruction, as well as the functions these strategies serve in differentiating instruction. Although questioning styles and strategies have been widely examined, there is a lack of research relating question modification strategies to differentiated instruction. In addition, on the whole, concrete strategies for implementing differentiated instruction have seldom been studied in educational contexts where material resources are limited and class sizes are large. The following five question modification strategies were present in the data: repetition; rephrasing; clarification; decomposition; and code-switching. However, question modification strategies observed in other studies, such as chaining and probing (see [7,19,31]), were not present in our data.

These findings indicate a two-fold relation between the question modification strategies to the principles of differentiated instruction. First, the use of question modification strategies represented only a narrow view of differentiation; apart from giving individual questions (the difficulty level of which varied) to individual or small groups of students in some lessons, the teachers carried out traditional teacher-led, whole-class teaching. This was contrary to the student-centred starting point of inclusive education and differentiated

instruction. This also meant that all the question modification strategies represented a reactive response to students' learning needs, not proactive planning, which would also be an essential element of differentiation [15]. Second, although differentiated instruction did not appear in this study as an individualised pace of learning, curriculum structure, or learning content for students, teachers used question modification strategies to engage all students in classroom discussions in oversized but mixed-ability learning groups. This strategy, which is aimed at guaranteeing equal participation for all students in classroom activities from their own individual premises, is also the main idea of inclusive education and differentiated instruction [11,12,52]. In addition, the teachers seemed to react sensitively and spontaneously to potential misunderstandings or learning challenges during questioning sequences, despite a large number of students and their potentially varied learning needs. Thus, although the idea of differentiation did not form a starting point for classroom organisation in this study, it did not prevent teachers from trying to provide students with optimal access to knowledge by responding to their situational learning needs.

Repetition was the most common question modification strategy, which all the teachers utilised frequently. Although it provided more time for students to produce responses (see [7]), it did not offer any alternatives for understanding the learning content, and thus, it had little to do with differentiating instruction. Therefore, the power of repetition to elicit responses from students and to provide an opportunity for slowly responding students to participate in the questioning sequence was strongly related only to the pauses and waiting times (see also [19]). Even though the use of repetition may not promote students' access to the learning content, it might contribute to differentiation by slowing the pace of instruction, benefitting some of the students. Rephrasing was also found to serve a similar purpose in facilitating students' responses. However, unlike repetition, rephrasing was a strategy through which teachers responded quickly to students' misunderstandings by narrowing their original questions to a specific part of the problem. Thus, the utility of rephrasing depended on how effectively the teachers captured the core of the students' misunderstanding and were able to modify their questions accordingly.

Clarification and decomposition were found to be the most highly developed question modification strategies from the viewpoint of differentiation by showing teachers' situational flexibility and readiness to change their original questioning agenda when noticing that it did not match students' needs and skill levels. Decomposition met students' learning readiness by reducing the cognitive requirements of the original questions, whereas clarification involved flexibly moving from the questioning to the instruction sequence when observing gaps in students' knowledge. Thus, it can be concluded that both question modification strategies represented differentiation on both the content and process levels by prompting thinking about the learning content on several levels and modifying the teaching strategies and mechanisms through which students could understand the learning content [15,52,53]. The findings revealed that teachers tended to clarify and decompose questions at the whole-class level; hence, it is difficult to evaluate their effects on individual students. However, teachers sometimes presented different questions and problems to different small groups of students, in which case they also differentiated the process through which students were intended to make sense of the learning contents [15,16]. Matching students' needs with individually tailored tasks is an essential part of differentiated instruction.

The use of code-switching was a holistic example of differentiating instruction through the content, product, and environment [15,53]. It was carried out either during whole-class teaching or individual one-on-one supervision, where linguistic minority students were given access to the content in their own languages, thus meeting the students' learning profile [16]. In line with the findings of Jusoh et al. [7] and Tofade et al. [19], code-switching also gave students permission to lean on their first languages when producing an answer to the original question and demonstrating what they had learned. This question modification strategy not only helped students to understand the main concepts but also influenced the

emotional climate of the classroom positively by engaging all students in common work (see [19]).

The findings further revealed that the use of question modification strategies depended on the type of original questions the teachers used. The most complex and abstract higher-order questions called for clarification and decomposition as question modification strategies, while simply closed-ended questions that required the recall of factual information were answered easily when teachers utilised repetition. Thus, the successful utilisation of clarification and decomposition allowed teachers and students to address low- and high-level questions and facilitated a deeper understanding of the questions (see [2,16]). Conversely, low-level questions did not facilitate learning at a higher cognitive level, and thus, repetition and rephrasing were mainly utilised to encourage students to recall previously learned material or to think about certain concepts [16]. In fact, the sole use of low-level questions was found to diminish the need for using question modification strategies, as one of the eight video-recorded teachers only presented simple low-level questions and did not have to use question modification strategies in her questioning.

5. Limitations

Even though the video recordings provided an authentic opportunity to observe what really happens in instructional interactions in Eritrean mathematics and science classrooms and minimise researcher bias when reconstructing data, the quality of the data was weakened by the lack of available equipment and poor lighting in many classrooms. In addition, the interactions between the teachers and students during individual supervision as well as during small-group discussion sessions were not captured perfectly. Hence, only a few episodes of one-on-one interactions could be used in the analysis. The similarities and differences between the lessons for mathematics and science were not analysed, which can be considered a limitation. The use of three languages in the data and the translation process was also challenging. Since the sample size was limited to only five schools and eight teachers, the findings of this study require further confirmation using a larger sample of teachers and students from different contexts with scarce resources.

6. Conclusions

The overall findings show that question modification strategies are indispensable, dominant elements of classroom interactions and one of the most powerful forms of pedagogic talk in teacher-led and poorly resourced classrooms, such as those in Eritrea. While the lessons were mainly mass-produced, through questioning, the teachers were able to make the classrooms lively and engage students in the common discussion. The use of question modification strategies also showed the willingness of the teachers to modify their initial questions flexibly and creatively, especially when utilising clarification and decomposition. In addition, using code-switching as a question modification strategy served both demonstrative and affective functions in classroom interactions in the multilingual societal context. Due to the large class sizes, not all students were asked to demonstrate their understanding individually. However, the teachers modified their instruction according to their general observations and impressions or when some of the students failed to answer their questions correctly. Therefore, more information is needed about the use of question modification strategies in one-on-one teaching sessions, where there would be more opportunities to check students' understanding and differentiate the content of the questions according to individual learning needs by either lowering or raising their complexity levels. In addition, further research is needed on the relationships between repetition and waiting time (pauses), as well as on the effects of using different languages on question modification. The connections and combinations in using the question modification strategies that were identified are formed in the specific classroom contexts under study. Understanding the role of the different strategies in supporting students' learning can help teachers to further develop their practice. These findings, therefore, call for strengthening teachers' potential-

ities and expertise through ongoing in-service teacher training programmes, leaning on research-based teaching practices.

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Appendix A. Transcription Symbols

(1.0)	The length of the pause is 1 s or more.
[text]	First author's translation of text spoken in a local language.
(text)	Comments from the transcriber.
(- -)	Incomprehensible.

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III

DIFFERENTIATION-RELATED TENSIONS IN THE THINKING AND INSTRUCTION OF ERITREAN ELEMENTARY AND MIDDLE SCHOOL MATHEMATICS TEACHERS

by

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Differentiation-related tensions in the thinking and instruction of Eritrean elementary and middle school mathematics teachers

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Differentiation-related tensions in the thinking and instruction of Eritrean elementary and middle school mathematics teachers

Abstract

Differentiated instruction is key to implementing inclusive education and addressing the individual needs of all students. This study explores the pedagogical tensions related to differentiation in Eritrean elementary and middle school mathematics teachers' thinking and instruction practices. The research data consist of 8 teacher interviews and video recordings of their teaching in 10 mathematics lessons. The findings from a thematic analysis reveal three tensions: adapting instruction to students' individual needs versus carrying out whole-class frontal teaching; providing individual tasks versus abstract content-laden teaching; and utilising peer learning versus emphasising individual-oriented competition. The study highlights the need to increase Eritrean mathematics teachers' awareness of the contradictory discourses surrounding classroom practices. Teachers require both material and human support and training on research-based differentiated instruction practices to foster the inclusion of all students.

Keywords

Pedagogical tension, Differentiated instruction, Inclusive education, Mathematics education, Thematic analysis, Eritrea.

Introduction

Addressing students' individual needs in mainstream heterogeneous classrooms is a crucial component of inclusive teaching (Saloviita, 2018; Savolainen et al., 2022). Inclusive education aims to ensure equitable access and equal participation for all students in classroom activities and minimise the exclusion of students from the education system (Adu-Boateng & Goodnough, 2022; UNESCO, 2020). Differentiated instruction (DI) is considered one concrete way of advancing inclusive education by considering students' diversity and their individual, academic, and social needs when planning and implementing instruction (Lindner et al., 2021; Saloviita, 2018; Schwab et al., 2022; UNESCO, 2020). When committing to the principles of inclusive education, it is crucial to recognise student diversity (UNESCO, 2020). Despite the importance of DI in implementing inclusive education, its practices seem to be challenging for teachers (Authors, 2021a; Suprayogi et al., 2017).

This study examines the tensions related to DI in the thinking and instruction of elementary and middle school mathematics teachers in Eritrea. The country faces resource limitations, overcrowded classrooms, and inadequate provisions for special needs education (Authors, 2021a; Ministry of Education [MOE], 2018, 2019a pp. 64). Despite these obstacles,

as a signatory of international conventions promoting inclusive education (UNESCO, 2000), the Government of Eritrea is committed to addressing the diverse needs of all learners regardless of their backgrounds (MOE, 2018). In this challenging context, which is common in many Sub-Saharan African countries, it is crucial to research how Eritrean mathematics teachers understand the principles of inclusive education and view DI in an attempt to make their classrooms more inclusive. Differentiated math instruction is especially important, since mathematical skills develop hierarchically (see, e.g. Cirino et al., 2016), and it is therefore important for teachers to identify their students' learning stage and differentiate their instruction to meet the students' specific needs. DI has also been found to improve students' achievement in mathematics (see, e.g. Prast et al., 2018; Russo et al., 2021). By presenting Eritrean mathematics teachers' views and particularly the tensions related to DI in the teachers' discourse and their instructional practice, this study responds to the need for additional research on how teachers implement DI in practice and the potential conflicting views they may hold.

The concept of differentiated instruction

DI can be defined as a pedagogical approach in which teachers address and respond to the diverse needs of individual students by flexibly modifying the content materials, methods, and products of school curricula, making them accessible and understandable to all students in the classroom (Lindner et al., 2021; Tomlinson, 2014; Westwood, 2018; UNESCO, 2020). DI deviates from the traditional one-size-fits-all approach to instruction (Fox & Hofman, 2011). Rather, DI places learners at the centre of learning and acknowledges learners' preference for active learning (Ismajli & Imami-Morin, 2018). Through DI, students have several learning options, such as varied (tiered) assignments, paces of learning, curriculum compacting, learning contracts, and modes of expression (Wan, 2017). Teachers in differentiated classrooms can also utilise flexible grouping (Lindner et al., 2021; Wan 2017), and they set expectations that all learners should succeed (Gaitas & Martins, 2017).

Teachers differentiate instruction in their classrooms in different ways (Godor, 2021). According to Tomlinson's (2014) model, DI has three dimensions: differentiating content, process, and product. Content refers to what students are required to learn and the materials and ways of achieving this. Process refers to the activities and instructional strategies teachers design to help students make sense of the learning contents (e.g. through various tasks), while product refers to ways in which students demonstrate what they have learned. In addition, Tomlinson (2014) emphasises the need for accepting, healthy and authentic learning

environments that respect diversity and support DI. Formative assessment in the context of DI aims to foster students' ongoing growth and development by moving away from the traditional one-size-fit all approaches (Tomlinson & Moon, 2013). This approach recognises the importance of tailoring assessments to individual students' needs, allowing for personalised feedback and support to promote their learning progress.

When carrying out DI, teachers can employ collaborative and peer learning methods (Alegre et al., 2019; Lindner et al., 2021; Suprayogi et al., 2017). George (2005) also indicated that effective DI involves flexible grouping through which students learn meaningfully from peers. Peer learning involves designing tasks that facilitate the mastery of content knowledge and skills as students work together in groups, learn from each other, and provide feedback on each other's works (Vygotsky, 1978). This kind of collaborative learning promotes active learning, reduces peer competition, and mitigates isolation among students (Ismail & Al Allaq, see also Buchs et al., 2021). Teachers have the option to form mixed-ability groups, enabling students to collaborate on complex tasks and ill-defined problems, construct new knowledge, make group decisions, engage in peer assessment of learning tasks, and utilise peer tutoring (Chopra & Banerjee, 2022). The practice of peer learning is linked to social learning and constructivist theories of learning (Vygotsky, 1978). Moreover, DI is linked to multiple intelligence and theories of styles of learning (Wan, 2017).

Teacher views on DI

Previous studies have identified factors that influence teachers' readiness to implement inclusive education through various DI approaches. A meta-analysis conducted by Yada et al. (2022) showed that teachers' self-efficacy for inclusive practices is positively associated with their attitudes toward inclusive education (see also Savolainen et al., 2022). Thus, teachers who feel they are sufficiently prepared for inclusive classrooms seem to positively respond to the diversity of their students through DI (Pozas & Letzel, 2020; Rodriguez, 2012). In line with this, teachers' knowledge of DI strategies influences their confidence in using them; conversely, a low sense of self-efficacy related to DI is linked to teachers' sense of failure in implementing specific DI strategies and a lack of practical mastery in DI (Porta et al., 2022).

Wan (2017) found that teachers often prefer teacher-dominated activities to address students' individual needs, which can be considered as the opposite of DI. Recently, Gaitas et al. (2022) reported that teachers who claimed to engage in DI prefer whole-class frontal teaching as a way to address students' individual needs, which the authors considered a shift in thinking regarding teaching and learning. Despite this, the majority of teachers have been

found to use differentiation regularly, and female teachers seem to utilise it even more frequently than male teachers (Saloviita, 2018). However, many teachers do not feel comfortable implementing DI because of the extra demands to prepare themselves for it (Wan, 2017). Letzel et al. (2020) argued that the value teachers place on DI is an important predictor of DI implementation, and teachers' perception of a lack of resources negatively affects the implementation of DI. Further, teachers' knowledge and experience, the availability of materials, and adequate planning time positively impact the implementation of DI (Rodriguez, 2012).

Inclusive educational settings tend to increase teachers' fears of stress, an increased workload, and difficulties in applying DI (Dixon et al., 2014; Savolainen et al., 2022). Hence, teachers believe that differentiation is more commonly utilised in special classes than in regular or inclusive classes (Lindner et al., 2021; Sharma et al., 2018). Meanwhile, an increased understanding of the student-centred nature of DI and confidence in implementing it leads to teachers' positive attitudes toward DI (Porta, et al., 2022).

Depending on their teaching experiences and the way they have been trained, different teachers seem to prefer different DI strategies (Godor, 2021). Whole-class teaching is an established traditional teaching method that is common among more experienced teachers, who identify with the method more than inexperienced and less trained teachers (Lindner et al., 2021; Saborit et al., 2016). Teachers with greater teaching experience may also lose interest in experimenting with innovative strategies, whereas younger teachers may feel uncomfortable with traditional methods and thus gravitate toward more innovative strategies (Lindner et al., 2021; Saborit et al., 2016).

The aim of the study and research question

According to previous research, teachers report a variety of challenges related to implementing DI in practice (Letzel et al., 2020; Porta et al., 2022; Wan, 2017). In this study, we consider these challenges through the lens of pedagogical tensions. Pedagogical tension refers to a mixture of epistemic, cultural, and social dilemmas related to day-to-day teaching processes and the decisions teachers have to make in relation to what and how to teach (Braaten & Sheth, 2017). Tensions arise when teachers aim to pursue new teaching ideals, including DI, while remaining faithful to more traditional and potentially conflicting teaching principles (Windschitl, 2002) or when they must negotiate their own experiences and contradictory beliefs when translating and applying the curriculum in practice (McCarthey et al., 2014; Mufic & Fejes, 2022).

Although teachers' attitudes towards the adoption of DI have been studied extensively, there is a lack of empirical evidence on the specific pedagogical tensions teachers encounter in their classrooms when they attempt to differentiate their instruction. This gap is even wider in contexts where teachers with limited education, working in under-resourced, large, heterogeneous classrooms try to differentiate their instruction. Consequently, by examining the pedagogical tensions in Eritrean mathematics teachers' thinking and instruction, the current study aims to analyse how the principles of inclusive education through DI are put into practice in Eritrean mathematics lessons. Attitudinal ambivalence (e.g. tensions in people's thinking) has been found to lead to weaker and less stable attitudes, which are more prone to attitudinal change compared to attitudes with low ambivalence (see, e.g. Conner & Sparks, 2002; Jonas et al., 2000). Therefore, it is crucial to understand the tensions related to DI in order to elicit change in teachers' thinking and behaviour. Accordingly, the following research question guided this study: What kinds of tensions related to DI exist in Eritrean elementary and middle school mathematics teachers' thinking and instruction?

Methods

Study context

The present study was conducted in Eritrea, located in the Northeast Africa. The structure of the Eritrean education system is organised as follows: two years of pre-school (from 4 years of age), five years of elementary school, three years of middle school, four years of secondary school, and two to five years of tertiary education (MOE, 2011). In Eritrea, 16.4% of primary school-aged children, most of whom are from nomadic and semi-nomadic communities, are out of school (MOE, 2019b; UNICEF, 2021). Eritrean classrooms are large in size (from 50 up to 70 students) and characterised by heterogeneity in terms of students' language and ethnicity; sensory, physical, developmental and intellectual disabilities; and religious and cultural worldviews.

The government of Eritrea is a signatory of international conventions advocating inclusive education (MOE, 2008) and promotes the inclusion of all students, with special attention given to children with disabilities and other special needs (MOE, 2018, 2019a). Even though Eritrea has not yet ratified the Convention of the Rights of Persons with Disability (CRPD) (see UN (N.Y.), 2006), the MOE policy draws its guiding principles for inclusive practices from several international conventions and guidelines including the legally binding document, CRPD (see MOE 2008). However, the attempts towards implementing

inclusion in education were limited to establishing special classrooms for children with sensory, developmental and intellectual disabilities within regular schools in 2004 (MOE, 2008). Additional special classrooms have been built throughout the country since 2019 with support from the Global Partnership for Education (GPE) programme (MOE, 2019a). The country programme document indicates that teachers from minority groups are also given training for special classrooms in targeted regions (MOE, 2019a). These kinds of practices cannot be considered full inclusion, but rather integration. For example, the MOE policy defines IE as *'access to education of previously excluded learners or the "integration" of children, young people and adults with physical or sensory disability into regular schools and education programmes'* (MOE, 2008, pp 17).

The MOE policy requires the inclusion of all school-aged children in mainstream classrooms regardless of their background without discrimination (MOE, 2008; 2009). The curriculum reforms also advocate Learner-Centred Interactive Pedagogy (LCIP) and continuous formative assessment at all levels of Eritrean schools (MOE, 2009). Recent studies have shown that teachers have positive views on LCIP (Authors, 2021b), DI, and inclusive education (Authors, 2021a). Despite these efforts, large class sizes, under-resourced classrooms, and a shortage of qualified teachers are widespread challenges throughout the country (Authors 2017; MOE, 2019a). Moreover, securing teachers, especially female teachers, in rural areas is challenging (MOE, 2019a). In addition, due to a lack of appropriate training, Eritrean teachers are often unsure how to carry out inclusive practices (Authors, 2021a) or they respond mainly reactively to the students' learning needs (Authors, 2023a, 2023b). Eritrean teachers are also expected to strictly follow the prescribed curriculum, which forces them to utilise traditional whole-class teaching and content-laden lectures (see Authors, 2021b, 2023c). According to the government of Eritrea, all children in elementary school should learn in their mother tongue, while English is the language of instruction beginning at the middle school level (MOE, 2011).

Data and participants

Data for the study was collected from five schools (3 public, 2 private) in January–March 2019. The research data consisted of narrative interviews of 8 mathematics teachers (4 female, 4 male) and videotaped recordings (10 lessons) of classroom interactions. Purposeful sampling was used to obtain information-rich data (Patton, 2015). The school directors and the pedagogic heads of the respective schools identified math teachers who they regarded highly due to their integrity, care for their students, and use of various strategies for

differentiating their instruction. The teachers' background factors are shown in Table 1. A total of 450 students participated in the video-recorded classes of these 8 teachers.

Table 1. Biographic data and current professional settings of participant teachers

Pseudonym	**Teaching experience, years**	**Gender**	**Age**	**School type, public/ private**	**Teaching Grade(s)**	**Educational background[1]**	**Subject**	**Number of students per class**
Selim	27	M	46	Public	4 &5	Diploma	Math	55
Martha	24	F	42	Public	5	Certificate	Maths	50
Eyob	23	M	45	Private	5	Certificate	Maths	70
Adam	22	M	44	Public	6 & 7	Certificate	Maths	60
Solomon	12	M	39	Private	4 & 5	Diploma	Maths	50
Miriam	7	F	26	Public	5	Diploma	Maths	55
Natsnet	6	F	28	Private	6	Degree	Maths	60
Bekita	4	F	23	Public	4	Certificate	Maths	50

[1]Certificate = 1 year of college education; Diploma = 2-3 years of college education; Degree = 4 years of college education

Prior to the video recordings, each teacher was interviewed. Five broad, open-ended interview questions were forwarded to the participants to elicit uninterrupted narratives of their attitudes, classroom experiences, and the challenges they face in differentiating their instruction: 1) How would you describe students' diversity in your classroom? 2) How do you teach individually? 3) What does responding to diverse learners mean to you? Or how do you feel about it? 4) Would you please describe successful and unsuccessful stories about trying to modify or adapt your instruction? 5) Do you have anything to add? The duration of the narrative interviews was between 8 and 45 minutes, resulting in 75 pages of transcribed data (12-point Times New Roman font, 1.5 line spacing).

The video data were collected by the first author with the help of non-participant research assistants who were recruited by the first author. Three video cameras were used. Two were installed on the front corners of the classrooms to capture the classroom activities, while the third camera was held by a respective research assistant, who sat on one side of the classroom and recorded the teachers by following their movements. A total of ten mathematics lessons were recorded. Each lesson lasted between 32 and 43 minutes (mean = 37 minutes).

Prior to the interviews and the video recordings, the first author discussed the aims and purposes of the study with the teachers, and informed consent was obtained from each participating teacher and the parents of the students who were video recorded. The necessary research permissions were also obtained from the MOE and the schools.

Data analysis

Thematic analysis (see Braun & Clarke, 2022) was used as the method for analysing the interview and video data. A theme refers to a concept that organises a group of repeating ideas or patterns that run throughout the data (Vaismoradi et al., 2016). Through inductive thematic analysis, it was possible to study the subjective understandings and the underlying and even implicit meanings of DI given by teachers during their talk and instruction (Braun & Clarke, 2022; Vaismoradi et al., 2016).

The analysis began by carefully reading the transcribed interview data and watching the extensive video recordings of the mathematics lessons. After becoming familiar with the data, the authors noticed that both data sets contained incoherent and even conflicting views on and approaches to DI. These tensions appeared either in teachers' contrasting views and beliefs or in the gap between their stated teaching ideals and those they seemed to implement in reality. Thus, further analysis was focused on these pedagogical tensions.

The identification of tensions was based on coding the various meanings of DI given by the teachers in the interviews. In this phase, we leaned on Tomlinson's (2014) definition of DI which consisted of four ways to differentiate instruction (content, process, product and environment). When we found that the participants produced something contrary or opposite to a particular meaning or that they acted against it in practice, the inconsistency and variety in meanings within individuals were defined as tensions. Notably, the participants did not usually construct these tensions explicitly or consciously. Rather, the tensions were typically implicit and emerged as contradictions in the participants' talk and actions. Three pedagogical tensions were identified through discussion among the authors, with each tension representing a theme (see Braun & Clarke, 2022). Although the tensions were created from the interview and video data inductively, the final understanding and naming of the tensions were based on previous literature and theory-derived thinking about DI. The classroom practices were reported as they appeared in the data without blaming the teachers for their actions or non-actions.

Findings

This study examined what kinds of tensions related to DI exist in Eritrean elementary and middle school mathematics teachers' thinking and instruction. All the teachers indicated that they differentiated their instruction. We identified three pedagogical tensions from the data related to implementing DI: (1) adapting instruction to students' individual needs versus carrying out whole-class frontal teaching; (2) providing individual tasks versus abstract content-laden teaching; and (3) utilising peer learning versus emphasising individual-oriented competition. All the names used for teachers and students in the data extracts are pseudonyms. Both data sets from the interviews and the video recordings (descriptions of video-recorded class activities) are *quoted in italics* and utilised equally.

1. *Adapting instruction to students' individual needs versus carrying out whole-class frontal teaching*

The first tension is related to differentiating by content (see Tomlinson, 2014), that is the balance between recognising students' individual needs and managing large teacher-led classrooms. In the latter case, teachers describe implementing traditional whole-class instruction, where the learning contents are taught similarly to all students through lectures, demonstrations, and explanations. Conversely, when addressing students' needs, teachers modify their instruction flexibly.

Extract 1 (interview data)

> *Before three years while teaching in grade one, I found a girl I did not know she was Deaf…Now the other teachers never cared about her. I felt sorry for her. Fortunately, that year a sign language training started in the school. I took the six-month training. That same year the girl didn't do well, hence she had to repeat the grade. The following year, luckily, she was assigned to my class. We did, ha ha* [with excitement] *very well together. When I was teaching her, I use both languages* [Tigrigna and sign language] *simultaneously, speaking to the whole class, at the same time explaining to her.* [--] *To tell you the truth, when other teachers invigilate her e.g. oral English, I translated and tell her in sign language.* (Bekita, grade 4 mathematics teacher)

In extract 1, Bekita describes how she committed and devoted herself to supporting one prelingually Deaf student who had been left at the same school without support. With the intent of making the instruction linguistically accessible to this student, Bekita educated herself with sign language training. Subsequently, she adopted a multilingual approach in the classroom while accommodating the needs of this student and the rest of the students. Additionally, she acted as an advocate in the school community by promoting and using sign

language, while other teachers continued to only use local language instruction. While the interview data reveal her narration about this proactive action, the video recordings show that she extends her aid reactively whenever students ask for her help. At the same time, the video data illustrates how her lesson is dominated by whole class frontal teaching, although, Bekita is also seen to provide individualised support to a few students (see Extract 2).

Extract 2 (description of video-recorded class activity)

> *Bekita starts her lesson of computing fractions with whole class teaching by giving two examples of computing fractions on the blackboard. When giving these examples, she also activates the whole class through questioning and answering sessions. After explaining the steps of computing fractions, she writes two questions on the blackboard with which students have to work individually and write the phases of problem solving on their exercise books. She reminds the whole class to first copy the two model calculations from the blackboard, and then start working on the problems. The session is followed by 18 minutes of silent individual work of students while the teacher is moving around to observe how the students are coping. She provides individualised support to seven students (out of the total 50) who tell to struggle with solving the mathematical problems. Her reactive support includes giving clarification to one of the students, reading the question from the blackboard to a student with reading difficulty, guiding with the computation steps for struggling students, and helping a student write a wrongly copied question correctly.*
>
> (Author's description of Bekita's video-recorded class activity)

In extract 2, the video data shows that Bekita is engaged in whole-class frontal teaching with her 50 students for almost the whole 33-minute lesson. Even though she also provides individualised support to a few students for a brief moment (about 6 minutes of her 33 minutes long lesson), she is predominantly engaged in a whole-class frontal teaching instead of adapting her instruction to the students' individual needs. In addition, she emphasises responsive DI strategies instead of proactive strategies. For example, she waits until her students call her and ask for support before she approaches them and gives advice on them. Although she is occasionally engaged with few students who need her special support, those episodes are the extension of her whole-class frontal teaching where students are silent recipients of the knowledge which she provides, and which is the same for all students.

The examples of Bekita's interview data and the descriptions of her video-recorded instruction show how the teachers struggle with addressing students' individual needs when

the class sizes are large. This also appears elsewhere in the data. For instance, Natsnet, sixth-grade mathematics teacher, tells how she tries to create a good rapport with her students, because she thinks that it helps to "*make the subject interesting"* to students and to get the student think that "*mathematics is fun"*. On the other hand, however, she tells how she tries to identify students' interests and needs mainly on the whole classroom level: *"You have to bring all the children to the same level"* and *"We ask: 'in our today's lesson, we will study this [ratio]. What do you know about such thing?'. You receive some information from the students. Such and such and such, then you convey what you wanted to convey as a message".* Similarly, another sixth-grade mathematics teacher, Adam, recognises students' different learning styles: "*Some understand via explanations or when delivered with examples; others understand through story telling or joke*s." Despite this, he balances between meeting students' "*endless"* needs and an attempt to manage the whole sixty student's classroom: *"But consideration of students' individual needs should not create conflicts. You cannot meet all the demands; you just narrow your angle. It should be in line with the teaching learning process".* Also, the video-recordings of Adam's instruction reveal this same tension. On the one hand, Adam strongly identifies with his students by creating such mathematical problems which are concrete, authentic and meet students' everyday life: *"Abrehet is a businesswoman. One day she bought 10 Kgs of oranges for 120 Nakfa and sold them for 150 Nakfa. Does she gain or lose? How much is her profit or lose? What is the percentage?"*. Each everyday problem is also followed by several steps of solving the problems as well as detailed explanations from the teacher's side. On the other hand, these explanations are the same to all students and therefore, the students are considered as a homogeneous community, not as individuals with different needs.

2. Providing individual tasks versus abstract content-laden instruction

The second tension was between providing individually planned tasks to different students according to their level of skills and relying on contents from the prescribed curriculum, textbooks, and teacher guidebooks. Planning individual tasks represents differentiation by process (see Tomlinson, 2014). This seldom occurred in the data, since Solomon, a 4th grade mathematics teacher was the only teacher who reported that he varies the difficulty level of the tasks on the basis of the formative and continuous assessment. Extract 3 from a 50-student classroom shows how the same teacher follows the principles of differentiating tasks in the mathematics class, the topic of which is computing proper, improper and mixed fractions.

Extract 3 (description of video-recorded class activity)

> *After computing several problems with his students during a whole-class frontal learning, Solomon leads individual students to work out problems with different forms and difficulty levels step by step (e.g. multiply a proper fraction with a whole number; multiply a mixed fraction with a proper fraction; and multiply two mixed fractions by changing them to improper fractions). When the students are ready, the teacher asks some of them to compute on the blackboard. He systematically modifies the difficulty level of the questions so that the simplest questions are answered by the assigned students within a few seconds, whereas the most difficult ones are solved by the most able students. He also respects students' own pace; some students solve the questions fast, while the others need more time to complete the task. By observing and identifying students' gaps of knowledge during the problem solving, he gives appropriate support to students through hints, recalling a formula, reminders to proceed from the opposite direction, or brief explanations of principles. Solomon also uses the individual tasks as a mean of assessing their understanding of the learning content and provides corrections to the respective students. He also explains each mistake to the whole class and provides the appropriate correction. In this way, he is able to correct the misconceptions of the students while helping them build an understanding of the respective mathematical rules and principles.*
>
> (Author's description of Solomon's video-recorded class)

Extract 3 describes how Solomon designs individual activities for his students according to their skills level in mathematics. He spends more than 75% of the 40-minute lesson engaging students in individual activities and presenting them on the blackboard. The variety of the tasks shows that he is able to identify students' strengths and weaknesses and to provide appropriate support to each student accordingly. Solomon also seems to act as a facilitator of the learning process, and the difficulties of some of the students with solving the mathematical problems are addressed by giving cues, reminding formulas, providing clarifications and inviting additional suggestions from other students. Through creating the individual tasks, the teacher can direct his students step-by-step on the zone of their proximal development, beginning with tasks of the simplest proper fraction and proceeding to the most challenging mixed fraction types. Solomon's actions are thus meant to help students to understand the learning content and actively engage in their own learning.

Solomon's strategy of utilising task differentiation as a way to meet students' individual learning needs and implement inclusive education is an exception in the data. In another video-recorded session, Solomon also tries to cover a lot of topics (proper, improper and mixed fractions) within one 40-minute lesson without providing various tasks to different students. This emphasis of content-laden instruction appears even clearer in the following extract 4, where another teacher, Martha, states that she primarily favours and engages in abstract content-laden instruction.

Extract 4 (interview data)

> *Especially in our village, meaning, in our school, it is good to use a student-centred approach when you teach students, but because the book is voluminous it creates problems for us. It creates problems. And, later, the students frustrate us—they come to school without doing the activities you give them.*
>
> (Martha, grade 5 mathematics teacher)

In the beginning of extract 4, Martha refers to student-centred learning as an ideal instructional model, which should be practiced by every teacher. However, despite promoting the principles of student-centred learning, she states that she often fails to meet students individual learning needs. This is justified by locally provided instructions such as the strict requirements of content-laden curriculum, the "book". The extract also reveals a potentially vicious circle: the mismatch between the difficulty level of the tasks and students' skill levels results in students' weaker commitment to learning. Martha's use of plural (we) instead of the singular (I) suggests that the challenges of student-centred learning are encountered not only by Martha.

3. Utilising peer learning versus emphasising individual-oriented competition

The third tension was between utilising peer learning as a means of differentiating instruction and leaning on individual-oriented competition. The tension represents differentiation by learning environment (Tomlinson, 2014). Peer learning appeared in the data when teachers formed small mixed-ability groups and provided opportunities for cooperation between peers when solving complex and ill-structured tasks. In contrast, when utilising competition in their instruction, teachers rely on the use of competitive tasks to push students to work better than their counterparts. In the following video extract 5, Miriam, a mathematics teacher, utilises peer learning as a way to differentiate her instruction on the topic of percentage in a 55-student classroom.

Extract 5 (description of video-recorded class activity)

After giving an introduction, Miriam divides the students into six-member small heterogenous groups and provides each group with at least one problem written on a piece of paper. She repeatedly reminds students to work both individually and collaboratively by asking them to "work individually first" and then, to *cross-check their results among the group members and negotiate the problem solving until they would get similar results. She also repeatedly encourages the students to help each other through the phrases such as "show her" or "help each other". At the same time, she moves around the class to give further support, whenever necessary. When she finds that some of the groups have completed their task, she gives them another question to engage the group in peer work. Miriam also gives each group the opportunity to show their work to the whole class on the blackboard.*

(Author's description of video-recorded class activity)

In extract 5, Miriam groups her students based on the proximity of their seats. For instance, two desks in a row form one group (six students). The video also showed that she purposely mixes students by moving some students to other groups (probably aiming to form heterogenous groups). The 40 minutes lesson time is completely devoted to solving mathematical problems in the small groups and presenting the results of the group work on the blackboard. Reminding the group to first *"work individually"* might indicate that the teacher aims at preparing each member of the heterogenous group to contribute to common work, and the repeated reminders of "*help each other"* show that she expects her students to provide peer support and to be committed to work collaboratively. The students also seem to engage in collaborative work by scribbling in their exercise books, talking to each other, and arguing. Towards the end of the lesson, when individual students from each small group come out to work on the blackboard, the other students encourage, guide, giving positive remarks or correct them. Throughout the lesson, the teacher models a facilitator role by supporting each group's active engagement in the task, and also providing extra explanations whenever needed.

Contrary to extract 5, in which Miriam utilises peer learning and collaboration as a means of differentiating instruction, interview extract 6 shows how the same teacher also utilises competition between classmates as a motivational factor.

Extract 6 (interview data)

I feel my students was special. Especially, because there was a spirit of competition last year. Now they go beyond their limit and work harder. [--] It is mathematics. You give them a lot of exercises, but when they compete individually, and when I informed them of competitions, not only in intra-class competitions but also in inter-class ones, I found them to be more successful. They ask one another, how much did you score, um? Now, this means that they record the scores of their competitors. They begin to compete to such degree. Moreover, I found them do be more successful. So far, I have not found [any one left behind].

(Miriam, grade 5 mathematics teacher)

In interview extract 6, Miriam highlights the importance of competition to motivate students. Miriam notes that the content of grade 5 mathematics is difficult and voluminous: *It is mathematics* [emphasised]. She uses both intra- and interclass competition to make the subject enjoyable. She argues that based on her observations, competition and comparing their grades for the course motivates and engages students in learning. Miriam also states that she has seen positive changes and improved learning results in her students because of engaging them in competition.

Further, teachers expressed that imposing sanctions as a part of competition may support and motivate their students even more.

Extract 7 (Interview data)

I will make an agreement with them [students]. If one makes a mistake, we do something; if two mistakes, we do another. Now the students themselves will voluntarily tell you that anyone who makes one mistake will receive one smack. One with two mistakes receives two smacks, others will prefer kneeling down the student, and still others would suggest a different activity as a punishment. I proceed with such agreements to make them work hard. [- -] After the agreement, they make competition, and the students become more outstanding, smarter.

(Adam, grade 6 mathematics teacher)

From this view, the emphasis on competition carries a risk of turning into labelling and punishing students. Although the teachers indicate that they have good intentions in punishing students by beating them with sticks and/or making them kneel in front of students (e.g. to get them perform better), these actions are contrary to the general principles of DI and inclusive education.

Discussion

This study investigated the pedagogical tensions related to DI in the thinking and instruction of Eritrean elementary and middle school mathematics teachers. Three pedagogical tensions were identified resulting from the attitudinal ambivalence or conflicting pedagogical views of the same teachers as well as the contradiction between how teachers described DI and how they actually differentiated their instruction: (1) adapting instruction to students' individual needs versus carrying out whole-class frontal teaching; (2) providing individual tasks versus abstract content-laden teaching; and (3) utilising peer learning versus emphasising individual-oriented competition. The findings also showed that mathematics was mainly differentiated by content and process, whereas differentiation by product did not occur in the data (see Tomlinson, 2014). Differentiation by content mainly meant a reactive response to students' learning needs through modifying one's teaching, whereas differentiation by process (designing individual mathematical problems) and by learning environment (utilising peer tutoring and collaborative problem solving) referred to proactive planning, which is the cornerstone of DI.

The comparison of the findings with earlier literature revealed that some of the identified tensions are commonly related to DI in different contexts and countries, whereas others are more culture specific and bound to the study context. For instance, whole-class frontal teaching is a relatively established and general practice globally regardless of the class sizes (see, e.g. Gaitas et al., 2022; Lindner et al., 2021), and teachers face the same dilemma as teachers in this study regarding whether to adapt to the current developmental needs and mathematical skill levels of students or to adhere to the requirements of the prescribed math curriculum (Godor, 2021). Similarly, a lack of resources and the challenges related to large class sizes, or a lack of personal support have also been found in teachers' experiences in studies carried out in prosperous countries (see, e.g. Gaitas & Martins, 2017; Gitschthaler et al., 2021; Letzel et al., 2020). This might partly be due to the teachers' tendency to externalise responsibility to something outside of themselves rather than internalising responsibility to themselves by attempting to develop their instruction.

Possible reasons for these tensions related to DI both globally and in this study might be teachers' misunderstanding of the nature or conception of DI as something that does not concern all students and all instruction (Gaitas et al., 2022; Porta et al., 2022), but is limited to special education teachers' duties and low-ability students instead of being essential to subject teachers. In addition, teachers might lack DI knowledge and experiences in their pre-service education and have limited experience with academically diverse learners (Gaitas &

Martins, 2017). Consequently, they may not know how to differentiate instruction for diverse students, or they may feel unprepared and thus be reluctant to take responsibility for all forms of diversity (see Dixon et al., 2014: Gaitas & Martins, 2017, Porta et al., 2022).

More culture-specific findings in this study concerned the emphasis on individual-oriented competition, and the dominance of summative assessment, as well as the use of punishment as a motivating factor. Both punishing and labelling students are practices against the convention that advocate children's rights which Eritrea ratified (see UN, N.Y b) Contrary to previous research, which has emphasised peer learning values and cooperative learning over competition (Lindner et al., 2021; Buchs et al., 2021; Vu et al., 2021), our findings showed that Eritrean teachers did not view individual or intra-class competition as negative. Rather, they referred to it as an effective way of motivating students and making the classrooms more enjoyable. One possible explanation for these findings is that talking about DI and student-friendly classroom management practices are relatively new in Eritrean schools (see Andegiorgis, 2019). In addition, in Eritrea, tests and examinations are administered at fixed intervals during academic terms, and the Ministry of Education requires schools to increase the number of students who pass their grades, which could compel teachers to favour summative assessment over continuous formative and dynamic assessment. Further, the contradicting findings related to competition may be due to the widespread culturally bound orientation, where competition is considered both acceptable and constructive. Regardless of the teachers' beliefs, both individual and intra-class competitions as well as controlling and punitive environments hinder effective DI because they elicit a fear of appearing incompetent or being discriminated (Buchs et al., 2021; Vu et al., 2021). Hence, an intervention is required to challenge such teachers' beliefs and practices through both pre- and in-service trainings that are deeply rooted in globally established research-based practices that foster motivation and equal treatment among diverse students.

Another noteworthy finding is that even though the Eritrean mathematics teachers alternated between the tensions to varying degrees or clung to teacher-dominated approaches, they identified students' potential difficulties with math, discussed various reasons for them (e.g. language barriers, lack of motivation, weak number sense, challenges with reasoning with numbers), and generally had positive attitudes toward implementing DI. Similarly, teachers attempted to design real-life and meaningful mathematical problems and tasks for students (see Chopra & Banerjee, 2022; D'Intino, 2022; Nachtigall et al., 2022). This is of great importance, since as typical in mathematics, also in this data the tasks given by teachers were mainly multi-step problems, solving them required both persistence and motivation to

as well as concentration on performing several consecutive steps before finding a correct solution. Therefore, whole-class frontal teaching and abstract content-laden instruction are ineffectual when there are gaps in individual students' starting level and when the instruction does not meet their skills level (see Nachtigall et al., 2022; Tomlinson, 2014; Tomlinson & Moon, 2013).

Limitations

This study has some limitations that should be considered. The participant teachers of this study were selected by the pedagogic heads and the school directors which could be subject to social desirability bias resulting in participants referring to ideal practice rather than actual practice. However, the use of video recordings may have reduced the possibility of social desirability bias in the interview data. On the other hand, the participant teachers' conscious of being recorded might have caused some pressure to appear an especially good and effective teacher. Furthermore, although the findings of the current study provided insights into the pedagogical tensions in the teachers' thinking and instruction, the data came from a relatively small sample of mathematics teachers which may limit the transferability of the findings. Additionally, supplementing this research with students' experiences could offer further insights into the efficiency and usefulness of the DI strategies from the students' perspective (see Godor, 2021).

Conclusion

The study showed that pedagogical tensions can be effectively identified by combining interview data and video recordings of teacher instruction. Identifying and uncovering these tensions present in the instruction and pedagogical thinking of teachers helps to understand how teacher practices both advance and hinder DI. In addition, acknowledging the presence of pedagogical tensions in classroom instruction is essential, as acknowledging the ambivalence in teachers' thinking is a fruitful starting point for changing teachers' attitudes (Conner & Sparks, 2002; Jonas et al., 2000). Despite the various challenges related to DI reported by teachers, their positive views on the theoretical foundations of DI offer hope for improving the implementation of DI. In addition, even though Eritrean teachers had not received specific training on DI, the participating teachers were found to intuitively vary their instructional approaches in ways that foster DI, indicating future possibilities of strengthening the use of DI in Eritrean schools. For instance, the teachers used the conducive aspects of

peer learning by constructing either random or purposeful mixed-ability small groups. Thus, even in large classes, teachers can apply the principles of scaffolding and the zone of proximal development outlined by Vygotsky (1978), which are ideal for differentiating instruction. Moreover, through whole-class frontal teaching the teachers were able to address individual needs of some students by changing the mode of delivery, engaging students in question-and-answer sessions, and providing individual feedback.

However, the teachers could do even more if they received the proper support. For instance, understanding teachers' frustration in implementing DI could pave the way for strategies to support teachers and minimise their fears, boosting their confidence in the potential and implementation of DI (see Gaitas et al., 2022; Porta et al., 2022; Savolainen et al., 2022). Building on the identified tensions, the findings of the present study may aid the development of pre-service and in-service teacher training in Eritrea and beyond. Without continuous development of pedagogical competence mathematics teachers may struggle to successfully carryout DI (see Russo et al., 2021). Thus, professional development programmes could focus on increasing the awareness of alternative teaching strategies that are responsive to students' diversity (see Godor, 2021). Additionally, teachers need to be given educational, material, and organizational support to modify their instruction flexibly and innovatively and continue to evolve their teaching strategies accordingly. Finally, a holistic approach that involves all relevant stakeholders, including the educational authorities, schools, and teacher education institutions is required to support teachers in their challenging work.

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