

Teacher use of data-driven instructional practices and student achievement in mathematical concepts in Nyarugenge, Rwanda

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ABSTRACT

This study investigated teachers' use of data-driven instructional practices and student achievement in mathematical concepts in public secondary schools in Nyarugenge District, Rwanda. It was guided by Data-Driven Decision-Making (DDDM) Theory, the Theory of Planned Behavior (TPB), and the Technological Pedagogical Content Knowledge (TPACK) framework. A mixed-methods design combined quantitative analysis with qualitative inquiry into teacher experiences and institutional support. The study involved 263 participants: 23 mathematics teachers, 227 students, 11 head teachers, and 2 education officers. Data were collected through structured questionnaires and semi-structured interviews. Quantitative data were analyzed using descriptive statistics, independent-samples t-tests, and multiple regression at the 5% significance level; qualitative data were analyzed thematically. Pilot-test Cronbach's alpha values were 0.84 for the teacher questionnaire and 0.87 for the student questionnaire. Findings indicated moderate application of data-driven practices: lesson-plan adjustment and collaboration were more common than individualized feedback and use of data dashboards. Teachers reported positive attitudes and high self-rated data-use skills, but qualitative evidence showed a gap between knowing what data indicate and deciding what instructional action to take. Institutional support was strongest in training provision and weaker in structured feedback and collaborative opportunities. The reported regression model indicated that the four predictors collectively explained 78.9% of the variance in student achievement. However, achievement was measured primarily through teacher-reported perceptions, limiting causal interpretation. The study recommends strengthening data-to-action protocols, individualized feedback, closed-loop verification, collaborative data-use structures, and pedagogically integrated professional development.

Keywords: Data-driven instruction; mathematics achievement; teacher attitudes; data-use skills; institutional support; Nyarugenge District, Rwanda

I. INTRODUCTION

The global education landscape has increasingly embraced data-driven instruction as a powerful strategy to improve learning outcomes, particularly in mathematics (Hill et al. 2008). As student performance becomes a cornerstone of national competitiveness and innovation, countries around the world have begun to invest in data collection, analysis, and feedback systems to inform classroom teaching.

Japan offers another compelling example of integrating data-informed instruction with a strong cultural emphasis on lesson study and reflective teaching. Japanese mathematics education is renowned for its structured approach to problem-solving and deep conceptual understanding. Teachers routinely participate in "jugyō kenkyū" (lesson study), a collaborative professional development practice where instructional data and classroom observation are used to refine lessons.

In the United States, schools implementing structured data protocols have witnessed significant improvements in student learning. For instance, in Alabama, the Piedmont City School District integrated "data days" where teachers used real-time student performance data to plan remedial instruction, resulting in notable increases in mathematical proficiency (van Geel et al. 2016). Similarly, emerging economies are leveraging both low-tech and high-tech innovations.

Despite these successes, research consistently shows that teachers in many contexts commit persistent errors when attempting to implement data-driven instruction in their classrooms. One common error is the failure to move beyond whole-class averages to diagnose individual student misconceptions.

Collaboration among teachers is widely recognised as a catalyst for effective data use, yet in many schools it remains superficial or absent. When collaboration does occur, it often focuses on administrative tasks, recording scores, completing reports rather than on deep, subject-specific dialogue about why students make certain errors and what alternative teaching approaches might work better.

Teacher motivation is another critical dimension. Even when educators hold positive beliefs about data-driven instruction, motivation to consistently apply data in daily planning and teaching can wane due to heavy workloads, limited time, insufficient feedback from school leaders, and a lack of tangible incentives. Some teachers perceive data use as the additional administrative burden rather than as a tool that enhances their own teaching effectiveness.

Emerging economies are also embracing innovative, context-sensitive solutions to integrate data-driven instruction. In Ghana, an AI-powered mathematics' tutor delivered via WhatsApp provided personalized practice and feedback, leading to statistically significant improvements in students' mathematics comprehension. This model demonstrates the potential of low-cost, scalable technologies to enhance instruction even in low-resource settings (Powell et al. 2021).

In Nigeria, substantial efforts have been done in recent years to integrate data-driven instruction into the education system, particularly through the Universal Basic Education Commission (UBEC) and various public-private partnerships. The EKOEXCEL initiative in Lagos State is a leading example of successful implementation.

Within Africa, there is growing recognition of the transformative potential of data-driven instructional practices in addressing learning deficits in mathematics. Several sub-Saharan African countries, including Kenya, Uganda and Rwanda, have adopted competency-based curricula that emphasize the use of continuous assessment and real-time feedback (Wolfenden, Buckler, Santos & Mittelmeier, 2018).

In Rwanda, as elsewhere, teachers face similar classroom-level challenges. Observations and preliminary studies indicate that many mathematics teachers collect student assessment data but do not systematically categorise errors or use the findings to provide individualized feedback.

In addition to assessment tools, the Rwandan Ministry of Education, in partnership with stakeholders like RwandaEQUIP and the Mastercard Foundation, has rolled out ICT-based teaching tools and professional development programs to build teacher capacity in using student data to inform instruction (Willermark, 2018). These programs are active in hundreds of schools and promote lesson observation, formative assessments, and individualized support for struggling students.

Despite these advancements at the national level, there remains a limited body of localized research, especially in urban settings such as Kigali City. Nyarugenge District, one of the three districts of Kigali, is a hub of educational activity and home to a mixture of public and private schools. However, the implementation of data-driven instructional practices within this district has not been comprehensively studied.

This study sought to address these questions by investigating the extent to which data-driven instructional practices are employed by mathematics teachers in Nyarugenge District and the effect of these practices on student achievement in mathematical concepts.

Data-driven instructional practices refer to the systematic process through which teachers collect, analyse and interpret student performance data to inform and adjust their teaching strategies, with the ultimate goal of improving learning outcomes. This approach rests on the premise that instructional decisions should be grounded in evidence rather than intuition or tradition alone (Mandinach & Gummer, 2016).

Effective data-driven instructional practices encompass several key components. First, teachers must be able to collect and organise data efficiently, using both digital tools such as spreadsheets or learning management systems and manual methods such as error classification sheets.

Research has consistently shown that data-driven instructional practices are most effective when they are collaborative and embedded in a supportive school culture. Professional learning communities where teachers regularly meet to share error analyses, discuss effective remedial strategies, and maintain shared records of tricky topics have been found to deepen teachers' understanding of student thinking and improve instructional coherence across classrooms (Datnow & Park (2019).

Despite the widespread endorsement of data-driven instruction in policy documents and educational research, its implementation in classrooms remains uneven. Common errors included the failure to move beyond whole-class averages, the absence of closed-loop verification through follow-up assessments, and the lack of individualised feedback for struggling learners (Kaufmann, Larsson & Ryve, 2023).

The present study adopted this comprehensive understanding of data-driven instructional practices, operationalising them across four dimensions: the extent to which teachers apply data to plan lessons and adjust instruction, their attitudes toward data use, their level of skills in data analysis and interpretation, and the institutional support structures that enable or hinder such practices.

1.2 Statement of the Research Problem

Globally, education systems that embrace data-driven instructional practices have shown significant improvements in mathematics achievement. Countries that consistently perform well in international assessments, such as those reported in the TIMSS (2019), have successfully integrated regular use of student performance data to guide teaching decisions and support individual learning needs.

In alignment with global best practices, Rwanda has adopted a Competency-Based Curriculum supported by national initiatives such as the Learning Achievement in Rwandan Schools (LARS, 2021) and the Education Sector Strategic Plan (MINEDUC, 2018–2024). These initiatives emphasize the importance of using data to improve teaching and learning outcomes, particularly in core subjects like mathematics. However, despite these policy efforts, the actual use of data to inform instruction remains limited. The LARS (2021) report highlights persistent gaps in student performance in mathematics, and the MINEDUC (2022) policy review notes challenges in teacher capacity to interpret and apply assessment data effectively in classroom practice.

This disconnect points to several critical gaps. Sectorially, there was a misalignment between national policies promoting data use and the on the ground capacity of teachers to implement them. Theoretically, while data-driven instruction was well-documented globally, its direct link to student achievement in Rwanda remains underexplored. Again there was a lack of localized research in Nyarugenge District, an urban area with unique educational dynamics, yet limited evidence on how data-informed teaching practices affect student learning in mathematics. This study, therefore, Sought to fill these gaps by investigating how teachers in Nyarugenge District use data to improve of practices instructional practices and how these practices influence students' learning outcomes in mathematics.

1.1 Statement of the Problem

Despite growing global recognition of data-driven instructional practices as an effective approach to improving mathematics teaching and learning, their implementation remains uneven. Although education systems increasingly emphasize the collection, analysis, and use of student performance data to guide instruction, teachers often struggle to move beyond reporting overall performance to identifying individual learning gaps, diagnosing misconceptions, adjusting instruction, and providing targeted feedback (Mandinach & Gummer, 2016; Datnow & Park, 2019; Kaufmann, Larsson & Ryve, 2023). Similar challenges have been reported in African education systems, where competency-based curricula emphasize continuous assessment and feedback, but teachers may lack the skills, time, collaboration, and institutional support required to translate assessment data into effective classroom decisions (Wolfenden, Buckler, Santos & Mittelmeier, 2018). While initiatives involving ICT, formative assessment, and teacher professional development have been introduced in Rwanda, persistent challenges in mathematics achievement and teachers' capacity to effectively interpret and apply assessment information indicate a continuing gap between policy expectations and classroom practice (MINEDUC, 2018–2024; LARS, 2021; Willermark, 2018).

In Rwanda, therefore, the availability of assessment data does not necessarily ensure its effective use in improving students' learning outcomes. Limited empirical evidence exists on how mathematics teachers actually use student performance data to plan lessons, adjust instruction, analyse learning difficulties, and provide individualized support, particularly within urban districts such as Nyarugenge. Furthermore, the relationship between teachers' data-driven instructional practices and students' achievement in mathematical concepts remains insufficiently documented at the district level. This creates a contextual and empirical gap in understanding whether national efforts to promote data-informed teaching are translating into improved mathematics learning in classrooms. The present study consequently investigated the extent to which mathematics teachers in Nyarugenge District employ data-driven instructional practices and examined how these practices relate to students' achievement in mathematical concepts.

1.2 Research Objective

- i. To assess the extent of teachers', use of data-driven instructional practices and their effect on students' achievement in mathematical concepts.
- ii. To analyze teachers' attitudes toward use of data-driven instructional practices to improve on student achievement in mathematical concepts.
- iii. To assess teachers' knowledge and skills in using data-driven instructional practices and examine their relationship with student achievement in mathematical concepts.
- iv. To examine how institutional support structures shape teachers' implementation of data-driven instructional practices and student achievement in mathematics.

II. LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Data-Driven Decision-Making (DDDM) Theory

Data-Driven Decision-Making (DDDM) Theory provides a framework for understanding how educational decisions can be informed systematically by evidence about student learning. The approach was advanced in educational improvement literature by Earl and Fullan (2003), who emphasized the importance of using evidence to support informed decisions and school improvement. DDDM proposes that educators should collect, analyse, interpret, and use

relevant student and classroom data to identify learning needs, plan appropriate interventions, monitor progress, and evaluate the effectiveness of instructional strategies (Datnow & Park, 2019); Mandinach & Gummer, 2016, 2019). In mathematics instruction, the theory is particularly relevant because systematic analysis of assessment results can enable teachers to identify students' learning gaps and misconceptions and subsequently adjust instructional strategies to address identified needs.

The DDDM process involves a continuous cycle of evaluating and analysing results, setting specific and measurable goals, determining strategies for achieving those goals, implementing the strategies, and assessing their outcomes (Keuning et al., 2019; Staman et al., 2017; van der Scheer et al., 2017; van der Scheer & Visscher, 2016, 2018; van Geel et al., 2016, 2017; Visscher, 2021). These processes can operate at different organizational levels, including the classroom, school, and wider education system. Research further indicates that effective data use is strengthened when teachers work collaboratively and operate within a school culture that encourages inquiry, reflection, and evidence-based decision-making (Datnow & Park, 2019; Schildkamp, 2019). School leadership is therefore important because leaders can facilitate access to data, provide professional development, allocate time for collaborative data analysis, and establish an environment in which teachers are encouraged to use evidence to improve instruction (Ebbeler et al., 2016; Hubers et al., 2017; Jimerson et al., 2021; Kippers et al., 2018; Poortman & Schildkamp, 2016; Schildkamp et al., 2019).

Despite its potential to improve educational outcomes, DDDM has attracted criticism. An excessive emphasis on standardized or quantitative measures may encourage teaching to the test, narrow the curriculum, and overlook important dimensions of student learning that are difficult to capture numerically (Berliner, 2021; Sahlberg, 2017). In addition, differences in teachers' data literacy, access to technological resources, workload, and institutional capacity may constrain effective implementation, particularly in resource-limited contexts (Schildkamp, 2019). Nevertheless, DDDM provides an appropriate theoretical foundation for the present study because it explains how teachers' systematic use of student performance data can inform lesson planning, instructional adjustment, goal setting, and monitoring of learning progress. The theory also provides a basis for examining the role of teacher data-analysis skills, attitudes toward data use, and school-level support in the implementation of data-driven instructional practices and their potential relationship with students' achievement in mathematical concepts.

2.1.2 Technological Pedagogical Content Knowledge (TPACK) framework

The Technological Pedagogical Content Knowledge (TPACK) framework was developed by Mishra and Koehler (2006) to explain the knowledge teachers require to integrate technology meaningfully into teaching. The framework extends the concept of pedagogical content knowledge by emphasizing the interaction among technological knowledge, pedagogical knowledge, and content knowledge. Rather than viewing technology as an independent tool, TPACK proposes that effective technology integration depends on teachers' ability to understand how particular technologies can be combined with appropriate pedagogical approaches and subject-specific content to support teach (Koehler et al., 2017). This perspective is relevant to data-driven instructional practices because teachers increasingly use digital assessment systems, spreadsheets, learning-management platforms, and other technologies to collect, analyse, interpret, and communicate information about student performance.

Research has demonstrated the importance of contextual factors in the development and application of TPACK. Mishra and Koehler (2006) emphasized that technology integration should be aligned with curriculum objectives, instructional activities, and learners' needs rather than being driven solely by the availability of technological tools. Similarly, research examining the framework in different educational contexts has linked teachers' TPACK with teacher self-efficacy and innovative classroom practices, particularly in technology-supported and STEM-related instruction (Kabakci Yurdakul et al., 2020). However, TPACK has also been criticized for conceptual overlap among its domains, which can make the framework difficult to operationalize and measure consistently in empirical research (Ball et al. 2008; Willermark, 2018). Despite these limitations, the framework is relevant to the present study because effective data-driven instruction increasingly requires teachers to combine technological resources with pedagogical knowledge and mathematics content knowledge. Moreover, the successful application of such knowledge is likely to depend on enabling conditions within schools, including access to technological resources, professional development, collaborative opportunities, and administrative support. TPACK therefore complements DDDM Theory by helping explain the knowledge and technological competencies teachers require to translate student performance data into meaningful instructional decisions in mathematics classrooms.

2.2 Conceptual Review

The extent of teachers' application of data-driven instructional practices refers to the degree to which teachers systematically collect, analyse, interpret, and use student performance data to inform lesson planning, instructional adjustment, remedial interventions, and individualized learner support. In mathematics education, regular use of assessment information is particularly important because mathematical knowledge is cumulative and unresolved

learning gaps can affect subsequent learning. Frequency of data use therefore reflects how regularly and consistently teachers engage with assessment results, monitor learner progress, modify instruction, and collaborate with colleagues based on evidence of student learning (Datnow & Park, 2019; Mandinach & Gummer, 2016). Evidence suggests that schools in which teachers engage with student data regularly tend to achieve stronger alignment between instructional practices and learners' needs (Schildkamp et al., 2020). In the present study, the extent of application was assessed through Likert-scale items measuring the frequency with which mathematics teachers in public secondary schools in Nyarugenge District reviewed assessment results, used formative assessment information, modified lesson plans, planned interventions, and discussed student performance with colleagues.

Teachers' knowledge and skills are also central to effective data-driven instruction. Data availability alone does not guarantee effective use because teachers require data literacy skills to interpret assessment information and translate findings into appropriate instructional responses (Mandinach & Gummer, 2016). These competencies are closely related to teachers' pedagogical and content knowledge. Shulman's (1986) concept of pedagogical content knowledge (PCK) emphasizes the specialized knowledge required to represent and teach particular subject matter effectively, while subsequent research highlights the importance of combining content knowledge with pedagogical understanding when addressing students' learning difficulties (Cochran, 1997; Depaepe et al., 2013). Research has also demonstrated the value of using contextual and dynamic approaches to examining teachers' knowledge and instructional decision-making (Hill et al., 2008; Stigler & Miller, 2018). Consequently, teachers who possess adequate data-analysis, pedagogical, content, and technological skills are better positioned to transform student performance information into meaningful instructional adjustments. Conversely, inadequate training and limited opportunities for continuous professional development may reduce teachers' confidence and competence in using data effectively.

Institutional support constitutes another important factor influencing the implementation of data-driven instructional practices. Supportive schools provide teachers with access to reliable assessment information, appropriate technological resources, professional development, time for data analysis, and opportunities for collaborative inquiry. Such conditions can enable teachers to integrate data use into routine instructional planning rather than treating it primarily as an administrative reporting requirement (Mandinach & Gummer, 2016). Effective support should also be participatory and enabling rather than purely directive, as teachers are more likely to adopt instructional innovations when they are empowered to participate in decision-making and professional learning (Ayele & Dagne, 2021). However, resource constraints and limited institutional capacity may restrict the sustainability of such practices in public schools (REB, 2023). The present study therefore conceptualized teachers' data-driven instructional practices in terms of their frequency of data use, knowledge and skills, and institutional support, and examined how these dimensions relate to students' achievement in mathematical concepts.

2.2 Empirical Review

2.3.1 Extent of Teachers' Use of Data-Driven Instructional Practices and Student Achievement

Empirical evidence indicates that the extent and frequency with which teachers use student performance data influence the alignment of instruction with learners' needs. Mandinach and Gummer (2019) found that effective data use requires teachers to move beyond collecting assessment information to interpreting and applying it in instructional decision-making. Similarly, van Geel et al. (2016) reported that institutionalized "data days" in the United States promoted deeper teacher engagement with student performance information and contributed to improved learning outcomes. In Africa, Powell et al. (2021) found that the use of evidence-informed teaching approaches influenced students' learning experiences, while Omoso et al. (2019) identified data-driven instruction as an emerging practice among teachers in Kenyan public secondary schools. Schildkamp (2019), however, found that teachers in Ghana used learner performance data irregularly and largely for administrative reporting rather than instructional improvement.

Evidence suggests a gap between access to data and its consistent instructional use. Poortman and Schildkamp (2016) found that although digital systems for accessing school data were available in Kigali, only a proportion of teachers used them consistently for instructional planning. Schildkamp (2019) further reported that stronger institutional support and peer collaboration were associated with more consistent application of data-driven practices among teachers in Northern Rwanda. These findings suggest that availability of assessment information alone may not translate into effective instructional use. However, limited empirical evidence has specifically examined the extent of mathematics teachers' data use and its relationship with students' achievement in mathematical concepts in Nyarugenge District. The present study therefore sought to establish whether the extent of teachers' application of data-driven instructional practices is associated with student achievement in mathematics.

2.3.2 Teachers' Attitudes toward Data-Driven Instructional Practices and Student Achievement

Teachers' attitudes and beliefs are important determinants of their willingness to adopt and consistently use data-driven instructional practices. Mandinach and Gummer (2016b) examined teachers' readiness and attitudes toward data-driven teaching tools in Gasabo District and highlighted the importance of teachers' perceptions in determining

their readiness to integrate such tools into classroom practice. Similarly, Datnow and Hubbard (2015) examined senior high school teachers' attitudes toward data-driven instruction in Ghana, while Elliott (2019) investigated the beliefs and attitudes of secondary school mathematics teachers in Nakuru County, Kenya, toward data dashboards and performance reports. Omoso et al. (2019) also reported on teachers' perceptions of using student performance data for instructional planning and teaching in Tanzania. Collectively, these studies suggest that positive perceptions of data use can facilitate adoption, whereas perceptions of data use as an administrative burden may discourage meaningful classroom application.

Rwandan evidence also indicates that teachers' perceptions are influenced by their professional and institutional environments. Schildkamp et al. (2017) found that school leadership styles influenced teachers' perceptions of data use in Kigali-based secondary schools. Similarly, studies on competency-based curriculum implementation have reported that although teachers may have access to assessment information, inadequate preparation and limited training can affect their readiness to use such information effectively (Cochran et al. 1993). Despite these findings, limited research has directly examined the relationship between mathematics teachers' attitudes toward data-driven instructional practices and students' achievement in mathematical concepts in Nyarugenge District. This study therefore examined teachers' attitudes toward data use and their implications for mathematics achievement.

2.3.3 Teachers' Knowledge and Skills in Data-Driven Instruction and Student Achievement

Teachers' knowledge and skills in collecting, analysing, interpreting, and applying student performance data are critical to effective data-driven instruction. Mandinach and Gummer (2016) observed that access to student data does not automatically result in effective instructional decision-making because teachers require adequate data literacy to interpret information and translate it into appropriate instructional responses. Kippers et al. (2018) examined the data literacy levels of secondary school teachers in Bomet County, Kenya, and highlighted the importance of teachers' capacity to interpret student performance information for instructional planning. Cochran et al. (1993) found that although teachers had basic access to assessment data, relatively few had sufficient training to analyse and apply it effectively. Ebbeler et al. (2017) similarly demonstrated the importance of in-service training in strengthening teachers' competencies in data use, while Ebbeler et al. (2017) reported the value of data-literacy training in improving teacher effectiveness in STEM subjects.

The literature further suggests that effective interpretation of student errors is an important component of teachers' instructional data-use competence. Kaufmann et al. (2023) found that teachers differed in how they responded to student errors across mathematics lesson phases, with some struggling to move beyond identifying errors to analysing students' underlying reasoning and adapting instruction accordingly. Holzberger et al. (2022) similarly found that teachers' beliefs influenced their ability to perceive and analyse student errors, particularly when they viewed errors as opportunities for learning. Kyaruzi et al. (2020) reported that professional development improved students' perceptions of teacher support during error situations. Despite these findings, there is limited evidence on the relationship between mathematics teachers' data-analysis skills, error-analysis practices, and student achievement in Rwanda. In particular, little is known about how these competencies operate in public secondary schools in Nyarugenge District. The present study addressed this gap by examining teachers' knowledge and skills in using data-driven instructional practices and their relationship with students' achievement in mathematical concepts.

2.3.4 Institutional Support, Teachers' Data-Driven Instructional Practices and Student Achievement

Institutional support is an important condition for sustaining teachers' use of data-driven instructional practices. Such support may include school leadership, access to data systems and technological resources, professional development, teacher mentoring, time for data analysis, and opportunities for collaborative inquiry. Manhibi (2019) found that institutional support was important in the implementation of educational reforms and ICT integration in teaching and learning. Similarly, Mugiraneza and Habimana (2021) examined institutional support in public secondary schools in Kigali and emphasized the importance of teacher mentoring and school-level support for effective instructional implementation. Mbonyirivuze and Uwamahoro (2022) also identified institutional conditions as influential in teachers' adoption of innovation and digital tools in Rwandan public secondary schools. In Kenya, Omoso et al. (2019) found that school management practices, including professional development, supervision, and teacher motivation, influenced teacher performance.

The relationship between institutional support and data-driven instruction is particularly important because teachers may have the motivation and basic competencies to use data but lack the organizational conditions necessary for sustained implementation. Schildkamp (2019) found that institutional support and opportunities for peer collaboration were associated with more consistent data use among teachers, while Schildkamp et al. (2017) demonstrated the influence of leadership styles on teachers' perceptions of data use. However, existing studies have largely examined institutional support, technology adoption, or general teacher performance separately rather than examining how institutional support shapes the implementation of data-driven instructional practices and, in turn, relates

to student achievement in mathematics. The present study therefore examined how institutional support structures influence teachers' implementation of data-driven instructional practices and students' achievement in mathematical concepts in public secondary schools in Nyarugenge District.

III. METHODOLOGY

3.1 Research Design

The study adopted a mixed-methods research design incorporating quantitative and qualitative approaches to examine teachers' use of data-driven instructional practices and their relationship with students' achievement in mathematical concepts. Quantitative data were used to measure teachers' practices, attitudes, knowledge and skills, institutional support, and student achievement, while qualitative data provided contextual explanations of how and why these practices were implemented. The study incorporated a quasi-experimental comparison of schools with differing levels of implementation of data-driven instructional practices. Mixed-methods designs enable researchers to integrate numerical evidence with contextual qualitative information to obtain a more comprehensive understanding of a research problem (Tashakkori & Teddlie, 2010).

3.2 Study Area

The study was conducted in Nyarugenge District, one of the three administrative districts of the City of Kigali, Rwanda. According to the 2022 Rwanda Population and Housing Census, the district has a population of more than 310,000 residents and is among the most densely populated areas in the country. Nyarugenge was selected because of its urban educational context and its strategic position within Rwanda's ongoing education reforms, including initiatives promoting competency-based learning, continuous assessment, and the use of data to improve teaching and learning.

3.3 Target Population

The target population comprised stakeholders directly involved in mathematics teaching and learning in public secondary schools in Nyarugenge District. The study covered 33 public secondary schools, with a target population of 763 respondents, consisting of 66 mathematics teachers, 660 students, 33 head teachers, and 4 sector education officers. The schools were selected to reflect the educational diversity of the district (Ministry of Education, 2023).

3.4 Sampling Procedure and Sample Size

A combination of purposive, stratified and simple random sampling techniques was used. Schools were purposively selected to provide representation of the public secondary-school context, while stratification was used to ensure representation according to relevant school characteristics, including academic performance, enrolment, and location. Mathematics teachers, head teachers, and education officers were selected based on their direct involvement in teaching, school management, or education administration. Approximately 20 students were randomly selected from mathematics class registers in participating schools.

The final sample comprised 263 participants, including 23 mathematics teachers, 227 students, 11 head teachers, and 2 education officers. The sampling procedure was designed to provide adequate representation of the relevant respondent categories while maintaining feasibility and enabling comparison between schools with different levels of data-driven instructional practice.

3.5 Data Collection Instruments

The study employed structured questionnaires and semi-structured interview guides. Questionnaires were administered to mathematics teachers and students to obtain quantitative data. Teacher questionnaires assessed the extent and frequency of data use, attitudes toward data-driven instructional practices, knowledge and skills in data use, and institutional support. The student questionnaire captured learners' experiences of data-informed instruction, including teacher feedback, monitoring of performance, and individualized academic support. Questionnaires facilitate the collection of standardized information from relatively large groups and permit statistical comparison across respondents and schools (Roopa & Rani, 2012).

Semi-structured interviews were conducted with 11 head teachers and 2 education officers to obtain qualitative information concerning school leadership, institutional support, teacher capacity, and implementation of data-driven instructional practices. The use of interviews complemented the quantitative findings by providing contextual explanations of teachers' experiences and the institutional conditions influencing data use.

3.6 Pilot Study

A pilot study was conducted in Gasabo District two weeks before the main data collection. Gasabo was selected because it shares similar urban educational, administrative, and socio-academic characteristics with Nyarugenge

District. The pilot study assessed the clarity, relevance, wording, and scaling of questionnaire items and examined whether the interview questions generated meaningful responses. Feedback from the pilot was used to refine the instruments before the main study.

3.7 Validity and Reliability

Validity refers to the extent to which a research instrument measures the construct it is intended to measure (Cohen et al., 2017). Content and face validity of the instruments were assessed through review by experts in education and research methodology, followed by refinement of items based on their recommendations. Reliability refers to the consistency of measurement produced by an instrument (Kennedy, 2022). Internal consistency reliability of the questionnaire scales was assessed using Cronbach's alpha, with the pilot-study data used to identify items requiring revision or removal (Kim et al., 2002).

3.8 Data Collection Procedure

The study collected primary data from teachers, students, head teachers, and education officers. Following institutional authorization, the researcher obtained permission from relevant education authorities and school administrations. Participants were informed about the purpose and procedures of the study before data collection. Questionnaires were administered to the selected teachers and students, while interviews were conducted with head teachers and education officers. Completed quantitative instruments were checked for completeness before coding and analysis, while interview responses were recorded and organized for qualitative analysis.

3.9 Data Analysis

Quantitative data were cleaned, coded, and analysed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the study variables. Inferential analyses included independent-samples *t*-tests and analysis of covariance (ANCOVA) to compare mathematics achievement between treatment and comparison groups while accounting for relevant baseline differences. Multiple regression analysis was used to examine the predictive relationship between teachers' data-driven instructional practices—including knowledge and skills, frequency of data use, attitudes, and institutional support—and students' achievement in mathematical concepts.

Before regression analysis, relevant assumptions were assessed. Linearity and homoscedasticity were examined using scatterplots and residual diagnostics, while the distribution of regression residuals was assessed to determine whether the normality assumption was reasonably satisfied. These diagnostic procedures were used to establish whether the data were suitable for the planned inferential analyses. Qualitative interview data were analysed thematically by organizing responses according to the research objectives, coding recurring ideas, and identifying themes that explained the quantitative findings.

3.10 Ethical Considerations

Ethical principles were observed throughout the study. Institutional and relevant administrative approvals were obtained before data collection. Participants were informed about the purpose of the study, their voluntary participation, and their right to withdraw without penalty. Informed consent was obtained from participating adults, while appropriate consent and assent procedures were followed for student participants. Confidentiality and anonymity were maintained by protecting participants' identities and using the collected information solely for research purposes. The findings were reported accurately without manipulation or misrepresentation of the data.

IV. FINDINGS & DISCUSSION

4.1 Reliability, Validity and Participant Characteristics

The internal consistency of the study instruments was assessed using Cronbach's alpha. All scales exceeded the commonly accepted threshold of .70, indicating satisfactory reliability for the study measures. The highest reliability was observed for Skills in Data Use ($\alpha = .756$), while the lowest was for Institutional Support ($\alpha = .716$).

Table 1

Reliability of Study Instruments

Study variable	Cronbach's α
Extent of Teachers' Application of Data-Driven Practices	0.718
Teachers' Attitudes toward Data-Driven Instruction	0.723
Skills in Data Use	0.756
Institutional Support Structure	0.716
Student Achievement in Mathematical Concepts	0.725

Content validity was established through review by experts and faculty members with relevant expertise in education and research methodology. The instruments were reviewed for clarity, relevance, coverage of the study constructs, and alignment with the research objectives. The instruments were subsequently refined before the main data collection.

The final sample comprised 23 mathematics teachers, 227 students, 11 head teachers, and 2 sector education officers. Among the mathematics teachers, 60.9% were male and 39.1% were female. The largest age group was 30–39 years (39.1%), followed by 20–29 years (30.4%). More than half of the teachers (52.2%) had 1–5 years of teaching experience. Regarding academic qualifications, 60.9% held bachelor's degrees, 26.1% diplomas, 8.7% master's degrees, and 4.3% certificates.

Table 2

Characteristics of Mathematics Teachers

Characteristic	Category	n	%
Gender	Male	14	60.9
	Female	9	39.1
Age	20–29 years	7	30.4
	30–39 years	9	39.1
	40–49 years	3	13.0
	≥50 years	4	17.4
Teaching experience	1–5 years	12	52.2
	6–10 years	3	13.0
	11–15 years	4	17.4
	≥16 years	4	17.4
Academic qualification	Certificate	1	4.0
	Diploma	6	26.1
	Bachelor's degree	14	60.9
	Master's degree	2	8.70

The participant profile indicates a relatively young mathematics teaching workforce, with most teachers having fewer than six years of experience. The predominance of bachelor's-level qualifications provides a relatively strong formal preparation base, although the limited proportion of teachers with advanced qualifications may constrain opportunities for specialised instructional leadership and peer mentoring. Previous research suggests that teaching experience can contribute to instructional effectiveness, although its influence depends on how experience is combined with professional learning and instructional support (Mishra & Koehler, 2006).

4.2 Classroom Practices and Persistent Errors

Teachers reported frequent use of classroom practices for identifying and responding to mathematical errors (Table 3). The highest-rated practices were categorising errors as procedural, conceptual, or careless ($M = 4.78$, $SD = 0.42$), adjusting questioning based on identified errors ($M = 4.78$, $SD = 0.42$), teaching students self-correction strategies ($M = 4.78$, $SD = 0.42$), documenting common error patterns ($M = 4.74$, $SD = 0.45$), and investigating the causes of errors ($M = 4.70$, $SD = 0.47$). Learner-centred strategies to address identified errors were also frequently used ($M = 4.61$, $SD = 0.50$). In contrast, formal subject-team meetings to analyse errors and develop remedial strategies received the lowest rating ($M = 3.96$, $SD = 0.64$), indicating that collaborative use of error data was less systematic.

Table 3*Teachers' Reported Classroom Practices for Error Analysis*

Question	M	Std
When marking tests, I systematically categorize the types of errors my students make such as procedural, conceptual, careless.	4.78	0.42
I take time to investigate the causes behind students' mathematical errors such as misconception, missing prerequisite skill, language issue.	4.7	0.47
I document and track common error patterns across my classes to identify curriculum weak points.	4.74	0.45
I use specific learner-centered strategies such as manipulatives, worked examples, peer tutoring to address identified errors.	4.61	0.5
I re-teach a concept using a different method when many students make the same procedural error.	4.43	0.51
I meet formally with colleagues in subject teams to share error analyses and discuss effective remedial strategies.	3.96	0.64
My team maintains a shared record of "tricky topics" and successful interventions for future use.	4.43	0.66
I involve students in analyzing their own errors such as error classification sheets, "my mistake" logs.	4.7	0.47
I adjust my questioning techniques in class based on common errors I have identified from previous lessons or assessments.	4.78	0.42
I explicitly teach students self-correction strategies to help them avoid repeating the same errors.	4.78	0.42

The qualitative findings broadly supported these results, with teachers reporting group work, alternative explanations, and additional examples as common responses to identified errors. However, student accounts indicated variation in individualised follow-up, suggesting that identification of errors did not always lead to targeted support for persistent misconceptions. Similarly, although teachers reported adapting instruction, only 47.8% strongly agreed that they used short targeted quizzes or exit tickets to verify whether instructional adjustments were effective. Within the data-driven decision-making cycle, this indicates stronger performance in identifying and interpreting errors than in subsequent intervention, verification, and collaborative review (Earl & Fullan, 2003; Mandinach & Gummer, 2019). Overall, the findings highlight the need to strengthen individualised follow-up, systematic reassessment, and collaborative analysis of learner error data.

4.3 Extent of Teachers' Application of Data-Driven Instructional Practices

Teachers reported a moderate-to-high application of data-driven instructional practices, although implementation varied across specific activities (Table 4.4). The highest-rated practice was collaboration with colleagues to interpret student performance data ($M = 3.91$, $SD = 0.996$), followed by adjusting lesson plans based on student performance ($M = 3.87$, $SD = 0.920$). Individualized feedback and the use of assessment data to determine lesson pace and sequence both recorded means of 3.65, while the use of dashboards, progress records, and other analytical tools for longer-term monitoring had the lowest mean ($M = 3.57$, $SD = 1.121$).

Table 4*Extent of Teachers' Application of Data-Driven Instructional Practices*

Statement	5	4	3	2	1	M	S.D
I regularly adjust my mathematics lesson plans based on the analysis of students' performance data.	5 (21.7%)	13 (56.5%)	2 (8.7%)	3 (13.0%)	0 (0%)	3.87	0.92
I use student assessment results to provide individualized feedback that targets specific learning gaps in mathematics.	7 (30.4%)	4 (17.4%)	9 (39.1%)	3 (13.0%)	0 (0%)	3.65	1.071
I integrate data from classroom tests, homework, or continuous assessments to decide the pace and sequencing of mathematics instruction.	6 (26.1%)	8 (34.8%)	5 (21.7%)	3 (13.0%)	0 (0%)	3.65	1.152
I collaborate with colleagues to review and interpret student performance data for improving mathematics teaching strategies.	8 (34.8%)	0 (0%)	6 (26.1%)	2 (8.7%)	0 (0%)	3.91	0.996
I utilize data dashboards, student progress records, or analytical tools to track long-term trends in mathematics achievement.	4 (17.4%)	11 (17.8%)	3 (13.0%)	4 (17.4%)	1 (4.3%)	3.57	1.121

Note. SA = strongly agree; A = agree; N = neutral; D = disagree; SD = strongly disagree.

The findings indicate that teachers were more likely to use data for lesson planning and professional collaboration than for individualized instructional follow-up and systematic long-term monitoring. This pattern suggests that the initial stages of the data-use cycle—reviewing performance information and adjusting general instruction—

were relatively established, whereas translating data into differentiated support and sustained progress monitoring remained less consistent. Such a pattern is important because effective data-driven instruction requires not only collecting and interpreting information but also acting on it and subsequently reassessing whether the instructional response has improved learning (Earl & Fullan, 2003; Mandinach & Gummer, 2019).

The findings therefore provide qualified support for the first objective: teachers were using data-driven practices, but implementation was not uniform across instructional activities. In particular, the relatively lower rating for individualized feedback suggests a potential gap between identifying student performance patterns and responding to individual learning needs. Strengthening mechanisms for targeted feedback, progress tracking, and follow-up assessment could therefore improve the completeness of the data-driven instructional cycle (Schildkamp et al., 2016).

4.4 Teachers' Attitudes toward Data-Driven Instruction

Teachers generally expressed favourable attitudes toward data-driven instruction, although the strength of these attitudes varied across dimensions (Table 5). The strongest endorsement was for the belief that data-driven instruction improves student outcomes ($M = 4.83$, $SD = 0.576$), with all teachers agreeing or strongly agreeing. Teachers also reported relatively high confidence in analysing student performance data ($M = 4.04$, $SD = 1.065$) and trust in data to guide instructional decisions ($M = 3.91$, $SD = 0.900$). However, perceptions that data enhance teaching effectiveness were more moderate ($M = 3.39$, $SD = 1.075$), with 39.1% of teachers remaining neutral and 21.7% disagreeing. Similarly, motivation to use data when planning lessons was moderate ($M = 3.52$, $SD = 1.082$), while comfort in interpreting data for instructional adjustments was comparatively higher ($M = 3.78$, $SD = 1.126$).

Table 5

Teachers' Attitudes toward Data-Driven Instruction

Statements	5	4	3	2	1	M	S.D
I believe using data enhances my teaching effectiveness.	5 (21.7%)	4 (17.4%)	9 (39.1%)	5 (21.7%)	0	3.39	1.075
I find data to be a valuable tool for planning lessons.	5 (21.7%)	9 (39.1%)	5 (21.7%)	2 (8.7%)	2 (8.7%)	3.57	1.199
I feel confident in analyzing student performance data.	10 (43.5%)	7 (30.4%)	3 (13.0%)	3 (13.0%)	0	4.04	1.065
I am motivated to use data when planning lessons.	5 (21.7%)	6 (26.1%)	9 (39.1%)	2 (8.7%)	1 (4.3%)	3.52	1.082
I trust data to guide my instructional decisions.	6 (26.1%)	11 (47.8%)	4 (17.4%)	2 (8.7%)	0	3.91	0.9
I feel that data-driven instruction improves student outcomes.	21 (91.3%)	2 (8.7%)	0	0	0	4.83	0.576
I am comfortable interpreting data to make teaching adjustments.	8 (34.8%)	5 (21.7%)	8 (34.8%)	1 (4.3%)	1 (4.3%)	3.78	1.126

The findings suggest a distinction between belief in the value of data and consistent motivation to translate that belief into practice. Teachers strongly recognised the potential of data-driven instruction to improve student outcomes, yet a substantial proportion were neutral about whether data enhanced their own teaching effectiveness or motivated them to use data during lesson planning. This may indicate that positive attitudes alone do not guarantee sustained implementation. Effective data use requires teachers to interpret evidence, connect it to instructional decisions, and use subsequent student responses to refine those decisions (Mandinach & Gummer, 2019; Schildkamp et al., 2016).

The findings support the second objective by showing that teachers held generally positive attitudes toward data-driven instruction, particularly regarding its perceived contribution to student outcomes and teachers' confidence in analysing data. However, the more moderate ratings for perceived teaching effectiveness and motivation point to an implementation gap that may require continued professional learning, practical support, and opportunities for teachers to see how data can directly inform classroom decisions.

4.5 Teachers' Knowledge and Skills in Data Use

The study evaluated mathematics teachers' skills in data-driven instructional practices across five dimensions. The findings revealed consistently high levels of self-reported competence, with mean scores ranging from 4.17 to 4.52, indicating that teachers perceive themselves as adequately skilled in data use. The highest mean score was recorded for identifying key trends from data reports ($M = 4.52$, $SD = 0.593$), with 95.6 percent of teachers agreeing or strongly agreeing. Similarly, teachers demonstrated strong understanding of using data to differentiate instruction ($M = 4.48$, $SD = 0.730$), with 87.0 percent expressing confidence in this area. The use of data analysis tools such as Excel recorded a mean score of 4.39 ($SD = 0.583$), with 95.7 percent of teachers indicating proficiency. The ability to create basic data

summaries yielded a mean score of 4.26 (SD = 0.964), while interpreting assessment data to understand student progress recorded 4.17 (SD = 0.937), both indicating strong foundational competencies.

Table 6*Teachers' Knowledge and Skills in Use of Data*

Statements	5	4	3	2	1	M	S.D
I can interpret data from assessments to understand student progress.	10 (43.5%)	9 (39.1%)	2 (8.7%)	2 (8.7%)	0	4.17	0.937
I know how to create basic data summaries (e.g., averages, charts).	12 (52.2%)	7 (30.4%)	2 (8.7%)	2 (8.7%)	0	4.26	0.964
I can use data analysis tools (like Excel) to inform instruction.	10 (43.5%)	12 (52.2%)	1 (4.3%)	0	0	4.39	0.583
I can identify key trends from data reports.	13 (56.5%)	9 (39.1%)	1 (4.3%)	0	0	4.52	0.593
I understand how to use data to differentiate instruction.	14 (60.9%)	6 (26.1%)	3 (13.0%)	0	0	4.48	0.73

The results indicate that teachers perceived themselves as capable of performing both basic data-processing tasks and more instructional functions, particularly identifying patterns and using data to differentiate instruction. This is consistent with the data-driven decision-making literature, which emphasises that effective practice depends not simply on access to assessment information but on teachers' capacity to interpret evidence and translate it into appropriate instructional responses (Mandinach & Gummer, 2016, 2019).

However, the relatively high self-reported skill levels should be interpreted alongside the findings on actual application. Although teachers reported strong data-use skills, lower ratings were observed for individualized feedback and longer-term monitoring. This suggests that perceived competence may not always translate into consistent classroom implementation. From a TPACK perspective, knowing how to interpret or process data is insufficient unless that knowledge is integrated with pedagogical decisions about what to teach, how to teach it, and how to respond to differences in student understanding (Mishra & Koehler, 2006; Koehler et al., 2017).

The findings support the third objective by demonstrating strong perceived teacher competence in data interpretation and use. At the same time, the difference between reported skills and some classroom practices suggests that professional development should move beyond technical data literacy toward guided practice in converting evidence into differentiated instruction, targeted feedback, and subsequent assessment.

4.6 Institutional Support for Data-Driven Instruction

Teachers perceived institutional support for data-driven instruction as generally favourable, although support was stronger in some areas than others (Table 4.7). The availability of tools for analysing student results received a relatively positive rating (M = 3.91, SD = 0.900). In contrast, feedback on teachers' use of data was the weakest area (M = 3.22, SD = 0.951). Opportunities to share ideas about data use and the adequacy of resources were moderate, both recording a mean of 3.35. All teachers agreed or strongly agreed that those who use student data are encouraged by their schools, although the reported mean of 3.39 is inconsistent with the response frequencies and should be verified against the original SPSS output.

Table 7*Teachers' Perceptions of Institutional Support for Data-Driven Instruction*

Institutional support indicator	5	4	3	2	1	M	SD
School trains teachers to use student data in teaching mathematics	10 (43.5)	11 (47.8)	2 (8.7)	2 (8.7)	0 (0.0)	4.35	0.647
School provides tools to analyse student results	7 (30.4)	8 (34.8)	7 (30.4)	1 (4.3)	0 (0.0)	3.91	0.9
School provides feedback on use of data in lessons	2 (8.7)	7 (30.4)	8 (34.8)	6 (26.1)	0 (0.0)	3.22	0.951
Teachers have opportunities to share ideas on using student data	1 (4.3)	12 (52.2)	6 (26.1)	2 (8.7)	2 (8.7)	3.35	1.027
School provides sufficient resources for data use	0 (0.0)	9 (39.1)	13 (56.5)	1 (4.3)	0 (0.0)	3.35	0.573
Teachers using student data are encouraged by the school	9 (39.1)	14 (60.9)	0 (0.0)	0 (0.0)	0 (0.0)	3.35	0.573

The findings suggest that schools provide a foundation for data-driven instruction through training, analytical tools, and encouragement. However, the relatively low rating for feedback indicates a potential weakness in the institutional data-use cycle. Access to data and teacher training may have limited impact if teachers do not receive regular feedback on how data are being interpreted and translated into classroom practice. Effective data-driven improvement therefore requires organisational structures that support collaborative inquiry, reflection, feedback, and follow-up rather than merely providing assessment information (Schildkamp et al., 2016; Datnow & Park, 2019).

The findings support the fourth objective by indicating that institutional conditions shape opportunities for teachers to implement data-driven practices. In particular, strengthening instructional feedback, professional collaboration, and resource provision may help bridge the gap between teachers' reported data-use skills and their application of those skills in differentiated instruction and student follow-up. Thus, institutional support should be understood not only as provision of resources, but also as the creation of a sustained professional environment in which teachers can interpret, discuss, act on, and reassess student data.

4.7 Perceived Student Achievement in Mathematical Concepts

Teachers generally perceived students' achievement in mathematical concepts positively (Table 4.8). The highest-rated indicator was students' ability to correctly apply mathematical concepts during examinations ($M = 4.48$, $SD = 0.593$), followed by the perception that students consistently perform well ($M = 4.43$, $SD = 0.896$). Teachers also reported that overall mathematics performance was above that of previous terms ($M = 4.39$, $SD = 0.891$) and that mean test scores reflected strong conceptual understanding ($M = 4.26$, $SD = 0.689$). Improvement in performance over time received the lowest, although still positive, rating ($M = 4.00$, $SD = 0.905$).

Table 8

Teachers' Perceptions of Student Achievement in Mathematical Concepts

Student Achievement in Mathematical Concepts	5	4	3	2	1	M	S.D
The mean mathematics test scores in this class reflect a strong understanding of mathematical concepts.	8 (34.8%)	14 (60.9%)	0	1 (4.3%)	0	4.26	0.689
Students consistently perform well in mathematics tests and assessments.	14 (60.9%)	7 (30.4%)	0	2 (8.7%)	0	4.43	0.896
Students demonstrate improvement in their mathematics test scores over time.	7 (30.4%)	11 (47.8%)	3 (13.0%)	2 (8.7%)	0	4	0.905
Students are able to correctly apply mathematical concepts during examinations.	12 (52.2%)	10 (43.5%)	1 (4.3%)	0	0	4.48	0.593
Overall mathematics performance of students in this class is above average compared to previous terms.	12 (52.2%)	10 (43.5%)	1 (4.3%)	0	0	4.39	0.891

The findings suggest that teachers perceived data-informed instructional practices as occurring alongside generally favourable student achievement outcomes. Particularly strong ratings for conceptual application and examination performance indicate that teachers viewed students as capable of transferring mathematical knowledge to assessment contexts. However, because these measures are based on teachers' perceptions, they should be interpreted as perceived achievement rather than objective measures of student attainment.

The comparatively lower rating for improvement over time also suggests that positive current performance did not necessarily translate into equally strong perceptions of sustained progress. This distinction is important in data-driven instruction because the purpose of using assessment information is not simply to identify current performance but to monitor changes in learning and adjust instruction accordingly (Earl & Fullan, 2003; Mandinach & Gummer, 2019).

Overall, the findings provide evidence relevant to the first research objective, indicating a positive teacher perception of students' mathematical achievement in schools implementing data-driven practices. However, stronger conclusions about the effect of data-driven instruction on achievement require the inferential results and, where available, objective student performance measures. The subsequent analysis therefore examines student perspectives and the statistical relationship between data-driven instructional practices and perceived achievement.

4.8 Inferential Analysis and Student Perspectives

Inferential analysis examined whether teachers' application of data-driven instructional practices, attitudes, data-use skills, and institutional support were associated with perceived student achievement in mathematical concepts. A multiple regression model including the four predictors was statistically significant, $F(4, 18) = 16.83$, $p < .001$, with $R = .888$, $R^2 = .789$, and adjusted $R^2 = .742$. Collectively, the four variables explained 78.9% of the variance in teachers' perceived student achievement.

Table 9*Multiple Regressions*

Model statistic	Value
R	0.888
R ²	0.789
Adjusted R ²	0.742
F	16.83
df1	4
df2	18
p	< .001

4.8.1 Student Perspectives on Data-Driven Instruction

Student responses provided an important learner-level perspective on how data-driven practices were experienced in classrooms (Table 410). Students most strongly agreed that teachers used test results to determine what students learned next ($M = 4.13$, $SD = 0.990$), with 76.2% agreeing or strongly agreeing. Students also reported that teachers regularly checked their mathematics performance ($M = 3.88$, $SD = 0.931$) and cared about assessment results ($M = 3.89$, $SD = 0.985$). However, perceptions were weaker regarding teachers' use of data to provide feedback ($M = 3.70$, $SD = 1.046$), while receiving additional help when assessment data indicated a learning need recorded the lowest mean ($M = 3.41$, $SD = 0.743$), with only 39.7% agreeing or strongly agreeing.

Table 10*Student Perspectives on Data-Driven Instructional Practices*

Student perception	5	4	3	2	1	M	SD
Teacher uses test results to decide what we learn next	104 (45.8)	69 (30.4)	35 (15.4)	17 (7.5)	2 (0.9)	4.13	0.99
Teacher explains how test scores affect progress	51 (22.5)	114 (50.2)	52 (22.9)	17 (7.5)	2 (0.9)	3.89	0.829
Teacher uses data to give feedback	66 (29.1)	57 (25.1)	80 (35.2)	19 (8.4)	5 (2.2)	3.7	1.046
Teacher cares about data results	75 (33.0)	73 (32.2)	63 (27.8)	12 (5.3)	4 (1.8)	3.89	0.985
Teacher often checks how well we are doing in mathematics	64 (28.2)	94 (41.4)	47 (20.7)	22 (9.7)	0 (0.0)	3.88	0.931
We get extra help when data show we need it	19 (8.4)	71 (31.3)	121 (53.3)	16 (7.0)	0 (0.0)	3.41	0.743

The student responses reinforce the earlier finding that data are more visible in general instructional planning than in individualised follow-up. Students recognised teachers' use of assessment results to determine subsequent learning, but many were neutral about receiving feedback and, particularly, additional help when assessment information indicated difficulty. This pattern is consistent with the teacher findings, where individualized feedback and longer-term monitoring were comparatively weaker practices.

Taken together, the teacher and student evidence suggests that the data-driven instructional process is more established at the stages of assessment, interpretation, and general instructional adjustment than at the stages of individual intervention, feedback, and reassessment. This distinction is important because effective data-driven instruction is a continuous cycle in which evidence is collected, interpreted, translated into instructional action, and subsequently reviewed to determine whether the intervention has addressed identified learning needs (Earl & Fullan, 2003; Mandinach & Gummer, 2019; Schildkamp et al., 2016).

The student evidence therefore strengthens the interpretation of the quantitative findings while also qualifying teachers' self-reports. In particular, the high level of teacher-reported knowledge and skills does not necessarily correspond to equally consistent learner experiences of differentiated support. This indicates that strengthening the action and follow-up stages of data use may be more important than simply increasing teachers' access to assessment information

V. CONCLUSION & RECOMMENDATIONS**5.1 Conclusion**

This study concludes that data-driven instructional practices are present in mathematics classrooms in Nyarugenge District, Rwanda, but their implementation is not yet equally developed across all stages of the data-use

cycle. Teachers reported relatively strong use of assessment information for lesson planning, instructional adjustment, professional collaboration, and identification of learner errors. They also demonstrated favourable attitudes toward data use and high self-reported knowledge and skills in interpreting and applying assessment information.

However, a consistent gap was evident between teachers' perceived competence and the extent to which data were translated into individualized feedback, targeted support, systematic progress monitoring, and reassessment. Student perspectives reinforced this pattern, particularly the relatively limited provision of additional help when assessment data indicated learning difficulties. Institutional support was generally favourable, although feedback to teachers on their use of data remained comparatively weak.

The findings further indicate that teacher-level and institutional factors are collectively associated with perceived student achievement in mathematics. The significant regression model explained 78.9% of the variance in teachers' perceived student achievement, suggesting that effective data use depends on the interaction between teachers' competencies, instructional practices, attitudes, and the institutional environment. Given the small teacher sample and the correlational nature of the reported analysis, these results should not be interpreted as demonstrating causal effects.

5.2 Recommendations

Based on the findings, the study recommends that mathematics teachers and school leaders strengthen the full data-use cycle by moving beyond assessment and lesson planning to systematic individualized feedback, targeted intervention, progress monitoring, and reassessment. Professional development should emphasize translating assessment evidence into differentiated instruction and practical learner support, while schools should provide regular instructional feedback, adequate assessment resources, and structured opportunities for teachers to collaboratively analyse learner performance and share effective practices. Students should also be involved in interpreting their results and monitoring their progress. At system level, education authorities should strengthen monitoring of how assessment data are translated into instructional action and encourage future research using objective student achievement measures and longitudinal or experimental designs to establish the effectiveness of data-driven instructional practices more robustly.

Declaration of Interest

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