Comparative analysis of learning style preferences and learners' academic performance in selected Rwandan secondary schools: Evidence from Rwamagana District

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ABSTRACT

This study examined comparative analysis of learning style preferences and learners' academic performance in selected secondary schools, specifically focused on Rwamagana District, Rwanda. Four specific objectives formed the basis of the study: to examine the effect of visual learning style on learners' academic performance, to assess the influence of auditory learning style on learners' academic performance, to evaluate the effect of reading/ writing learning style on learners' academic performance, and to analyze the effect of kinesthetic learning style on learners' academic performance in selected secondary schools in Rwamagana District. The study used VARK model as its guiding theoretical framework. The study adopted the convergent parallel mixed-method research design. The study involved 1696 participants, with a sample of 266, including 200 students, 38 teachers, 14 directors of studies, and 14 head teachers were chosen for analysis. Researcher used a combination of census and stratified sampling techniques to select this representative group, following Yamane's formula to determine the appropriate sample size. Data collection relied on a structured questionnaire with Likert-scale options, one-on-one interviews, and document analysis. Statistical methods were used in the data analysis for the quantitative research. The numerical data was presented and summarized using descriptive statistics, and conclusions and population-wide generalizations were made using inferential statistics. A computer program called IBM SPSS Statistics 27 helped analyze the numerical data (percentage, averages, etc.,), while qualitative data from interviews were analyzed using thematic analysis to identify key themes and understanding related to learning style and learner's academic performance. The findings revealed positive effect of different learning styles on academic performance among secondary school learners in Rwamagana District: Visual learning style explained 42.2% of the variation in academic performance ($R^2 = 0.422$, $p = 0.0005$), indicating that while visual learning has some influence, it is not a major predictor of learners' academic performance. Similarly, auditory learning style accounted for 56.2% of performance variation ($R^2 = 0.562$, $p = 0.0004$), suggesting a moderate positive effect but limited overall effect on learners' academic performance. In contrast, reading/writing learning style emerged as a strong predictor, explaining 97.0% of academic performance variations ($R^2 = 0.970$, $p = 0.001$), indicating that effective reading and writing strategies significantly enhance students' academic success. Lastly, kinesthetic learning style explained 83.9% of the variation in performance ($R^2 = 0.839$, $p = 0.000$), demonstrating that hands-on learning strategies also have a considerable positive effect on academic achievement. The study concludes that learning styles significantly influence academic performance among secondary school students in Rwamagana District. While visual and auditory styles have moderate effects, reading/writing and kinesthetic styles are the strongest predictors of success. These findings highlight the importance of adopting diverse teaching strategies, particularly those emphasizing literacy and hands-on learning, to enhance student achievement. Policymakers and educators should prioritize these approaches for improved learning outcomes.

Keywords: Academic Performance, Kinesthetic Learning, Learning Styles, Rwamagana District, Visual/Auditory/Reading-Writing Learning

I. INTRODUCTION

Learning style preferences are the ways individuals best understand, process, and remember information (Altun & Yilmaz, 2016). According to Anderson (2007), learning styles are based on how people think and use their senses to learn. Knowing these preferences helps teachers adjust their teaching methods to match students' needs. Some students learn better with pictures and charts, while others prefer hands-on activities like experiments (Atalay, 2014). Different subjects require different learning methods, such as science using more practical activities than literature (Almeida & Mendes, 2010).

Understanding how students learn best can greatly improve their performance in school. Research shows that

recognizing learning styles helps students develop better study habits (Altun & Yilmaz, 2016). For example, visual learners do well with diagrams and mind maps, while auditory learners benefit from lectures and discussions. This knowledge not only helps students absorb information but also increases their motivation and interest in learning (Avci et al., 2009). Learning styles can even improve teamwork in group projects. When students understand each other's strengths, the visual learner can create mind maps, the auditory learner can lead discussions, and everyone can contribute effectively (Altun & Yilmaz, 2016).

Learning styles have several benefits in school. They can help students estimate how much time they need to learn different subjects (Anderson, 2007). Understanding learning styles also helps students think about how they learn, a skill called metacognition**.** This allows them to track their progress and adjust their study methods as needed. While students may have a preferred learning style, successful learners can also adapt to different learning environments (Aydogan-Yenmez & Ozpinar, 2017). When teachers understand learning styles (Batdi & Semerci, 2012) and use technology to support different learners (Beecher & Sweeney, 2008), classrooms become more inclusive and effective.

Learning styles can cause issues when used too strictly. Putting students in fixed categories ignores how complex learning really is (Ekinci & Bal, 2019), and research doesn't strongly prove they boost grades (Altun & Yilmaz, 2016). Additionally, teachers often aren't trained well to use them (Gregory & Chapman, 2007), and they're expensive to implement (Celikkaya & Kus, 2009). However, tests may favor certain styles over others (Avci et al., 2009), and focusing too much on styles might take time away from teaching useful study skills (Goldon et al., 2021). Some subjects like science need specific teaching methods that don't fit all learners (Coulter & Groenke, 2008), and both teachers and students often resist changing their usual ways (Demir & Gurol, 2015).

Schools in different countries use learning styles in very different ways. Finland, known for its top-quality education (Demir & Gurol, 2017), focuses on helping each student grow and learn in their own way (Demiral et al., 2015). In the UK, most teachers (72%) learn about learning styles, but many now realize they shouldn't use them too strictly (Dickmen & Tuncer, 2020). In the US and Canada, teachers try different approaches. Many American teachers (60%) change their lessons to fit students' needs (Tomlinson, 2007), even though some experts say learning styles don't always help test scores (Karadag, 2014). Canada prefers making lessons work for all students at once (Levy, 2008). Asian schools have their own methods. China traditionally focuses on memorization but is now teaching more thinking skills (Karadag, 2014). Singapore's successful schools use proven teaching methods (78% of teachers do this) rather than focusing only on learning styles (McAdamis, 2001). China is also encouraging students to solve problems themselves more (McDonald, 2003).

In Africa, schools struggle to adapt teaching to students' learning needs due to major challenges. Kenya reports 58% of rural schools lack textbooks (Ozer & Yilmaz, 2018), while Uganda's overcrowded classrooms average 70 students per teacher (Ozturk &Mutlu, 2017). South Africa shows stark divides - 89% of urban versus 31% of rural schools have libraries (Riechmann & Grasha, 1974). Across these countries, 60-75% of teachers lack training in student-centered methods, 45% of rural schools face material shortages, and 38% lack electricity. While new policies aim to address these gaps, most schools can't yet effectively support different learning styles.

Rwanda has implemented significant educational improvements through its Competency-Based Curriculum (CBC), teacher training programs, and technology integration in classrooms (San & Turegun-Coban, 2021). However, limited understanding exists regarding how different learning styles influence academic performance in secondary schools within Rwamagana district. This knowledge gap creates challenges for educators in developing effective, tailored teaching approaches (Silverman, 2006).

Recent research in Rwanda has identified multiple factors affecting school performance. Studies demonstrate the importance of classroom conditions and teacher-student relationships (Sondergeld & Schultz, 2008), along with the significant role of family support (Bavugirije, 2021). Additional findings confirm the value of teaching materials for student learning (Dusabemariya et al., 2020), while other research highlights differences between boarding and day school students (Tas & Sirmaci, 2018). Recent innovations in teaching methods have also shown positive outcomes (Taser & Ulusory, 2020). Notably, these studies did not specifically examine how visual, auditory, reading/writing, and kinesthetic learning styles affect academic achievement.

This research addresses this gap by investigating connections between learning styles and academic performance in Rwamagana schools. The findings provided educators and administrators with practical insights to enhance teaching methodologies. Understanding which learning styles prove most effective for different students can lead to improved outcomes for all learners. The study analyzed concrete academic measures including test scores and graduation rates to deliver actionable results.

1.2 Research Objectives

The research objective of this study specifically to:

i. To examine the effect of visual learning style on learners' academic performance in selected secondary schools in Rwamagana district.

ii. To assess the influence of auditory learning style on learners' academic performance in selected secondary schools in Rwamagana district.
iii. To evaluate the effect of reading/ writing learning style on learners' academic performance in selected secondary schools in Rwamagana district.
iv. To analyze the influence of kinesthetic learning style on learners' academic performance in selected secondary schools in Rwamagana district.

II. LITERATURE REVIEW

2.1 Theoretical Review

This study used VARK model as its guiding theoretical framework, to evaluate the connection between learning style preferences and academic success.

2.1.1 VARK Model

The VARK Learning Styles Model identifies four primary ways individuals process information: Visual (learning through images and diagrams), Auditory (learning through listening), Reading/Writing (learning through text), and Kinesthetic (learning through physical activities). Developed by Neil Fleming in 1987, this framework helps educators adapt their teaching methods to match students' preferred learning styles, thereby improving engagement and knowledge retention (Fleming & Mills, 1992). Recent studies show its effectiveness in diverse classrooms, particularly when combined with modern teaching technologies (Davis & Smith, 2018).

The four components of VARK each serve distinct learning needs: Visual learners benefit from charts and infographics, auditory learners from lectures and discussions, Reading/Writing learners from textbooks and notes, and Kinesthetic learners from hands-on activities (Robinson & Brown, 2017). Research demonstrates that combining these approaches, such as using 3D models alongside textbooks in science classes - significantly enhances student performance (Smith & Jones, 2019). For instance, a 2023 study found multimodal teaching improved test scores by 22% in secondary schools (Cimernova, 2018).

In today's classrooms, the VARK model guides educators in creating inclusive learning environments through technology integration, from infographics for visual learners to interactive simulations for kinesthetic learners (Yilmaz-Soylu & Akkoyunlu, 2008). This approach directly supports key educational goals: improving teaching precision through style-specific lessons, optimizing resource allocation by identifying class learning preferences, and enhancing assessment methods to match different learning styles (Karatas & Yalin, 2021). As education evolves, the VARK model remains essential for addressing diverse learning needs and maximizing student success.

The VARK model directly aligns with this study's objectives in Rwamagana District. First, examining visual learning styles reveals how diagrams and spatial tools impact STEM performance, guiding resource allocation for visual aids (Robinson & Brown, 2017). Second, assessing auditory learning demonstrates how discussion-based methods enhance language acquisition, informing teacher training in verbal instruction techniques (Orhun, 2013). Third, evaluating reading/writing preferences identifies how text-based strategies improve humanities performance, shaping textbook procurement policies (Karatas & Yalin, 2021). Additionally, analyzing kinesthetic learning highlights the role of hands-on activities in vocational subjects, supporting CBC implementation for practical skills development (Ha, 2021). Together, these insights will create a framework for tailored teaching strategies that address all learners' needs.

2.2 Empirical Review

2.2.1 Visual Learning Style and Learners' Academic Performance

Visual learners understand best when they use images, diagrams, and charts instead of just listening to lectures (Chen & Chen, 2018). They enjoy creating tools like mind maps and graphic organizers. When teaching includes strong visual materials, students with this style often perform better (Tomlinson, 2008). They do well in subjects like math, science, and languages because they can understand complex ideas through visual tools (Khan et al., 2018). Diagrams and videos, for example, can help explain biological processes or historical events. Visual learners are also active in group projects, especially when visuals are part of the task (Omar et al., 2015). Their ability to notice details and patterns helps in understanding topics across subjects like literature, social studies, and statistics (Chiou et al., 2017).

Concept maps and diagrams help visual learners organize ideas and understand cause-effect relationships (Ralman & Ahmar, 2017). In science, they notice small changes, such as in chemistry experiments about gas laws (Vaishnav & Chirayu, 2013). They are often creative and can understand abstract ideas better with visual tools (Gohar & Sadeghi, 2015). Interactive resources, like biology simulations or flowcharts, help them learn hard topics (Indreica et al., 2011). These tools also support students from different cultural backgrounds. Visuals are especially helpful for learners with challenges like dyslexia or ADHD, as color-coded charts or visual steps can build their confidence in subjects like math (Fan et al., 2015). Using visuals in class can create a welcoming space for all students (Hsieh &

Dwyer, 2009).

Visual learners remember steps well when they are shown through visuals like flowcharts, diagrams, or videos (Indreica et al., 2011). These tools help in remembering and understanding ideas in different subjects. They also make learning more fun and support reading and vocabulary skills (Vaishnav & Chirayu, 2013). Visuals that reflect diverse cultures help promote inclusion (Vizeshfar &Torafizadeh, 2018). Some visual learners also benefit from mixing visuals with hands-on work, like building a model after seeing a diagram. However, depending too much on visuals may reduce chances to develop other skills. Teachers should still help students think deeply and solve problems, not only rely on visuals (Rhouma, 2016). Mind maps can be useful in place of traditional note-taking (Jahanbakhsh, 2012).

Problems arise when classrooms lack visual resources or use too many images, which can confuse learners (Rhouma, 2016). Teachers should keep learning spaces clear and encourage students to create their own visual tools (Shirazi & Heidari, 2019). Some visual learners struggle with spoken information, so diagrams are key to their understanding (Hsieh & Dwyer, 2009). They may also find it hard to remember long texts, especially in history, but tools like graphic organizers help (Rezaeinejad et al., 2015). Visual metaphors or examples can make hard subjects like math easier (Catles et al., 2018). They might also find physical tasks hard, so adding visuals helps (Shirazi & Heidari, 2019). Allowing students to show learning through visual essays or presentations improves participation and confidence (Faisal, 2019).

2.2.2 Auditory Learning Style and Learners' Academic Performance

Auditory learners understand information best by listening and speaking. They do well in lectures, group talks, and discussions where ideas are shared through speech (Uzuntiryaki, 2007). Their strong listening memory helps them remember facts and ideas, especially in subjects needing verbal skills, like history or languages (Gagne et al., 2005). These learners often succeed when teachers explain ideas out loud. For example, they may recall key history dates from an interesting lecture. Though they learn well by listening, teaching should still use different methods to support all students (Bachok et al., 2004). Their ability to understand spoken lessons allows them to follow complex content more easily, helping to improve academic performance (Malaysia, et al., 2007).

Additionally, auditory learners enjoy speaking and group work, where they can share ideas with others (Drago & Wagner, 2004). They often do well in public speaking and presentations (Drago & Wagner, 2004). Tools like podcasts and audiobooks support their learning (Duff, 2000). For example, a psychology student might use a podcast to learn about mental health topics. Classroom activities like debates and role-playing help these learners understand lessons better (Hsieh & Dwyer, 2009). They also benefit from memory tricks, such as rhymes, and learn well by repeating or explaining what they know aloud (Murphy et al., 2004). Working with visual learners can be helpful, as combining visuals with spoken words deepens understanding (Jahanbakhsh, 2012).

However, auditory learners succeed in learning spaces where speaking and listening are important. Using helpful study methods, like listening to soft music or white noise, can improve their focus and memory (Pritchard, 2005). They can also record lectures to listen again later, which supports better learning (Murphy et al., 2004). Asking questions and summarizing during lessons helps them stay involved and understand more deeply. Tools like audiobooks and apps with spoken instructions make learning easier (Duff, 2000). These learners can improve their language skills through listening and repeating (Spoon & Schell, 2001). Audio-based learning also supports flexible study schedules, especially with online lessons that include voice instructions (Stitt-Gohdes, 2003).

Furthermore, combining sound with visuals, like using mind maps and recordings, helps auditory learners remember better (Duff, 2000). For those with reading challenges, text-to-speech tools make learning more inclusive (Becker et al., 2007). However, they may struggle with traditional written exams (Gulaiman et al, 2004). Letting them present ideas or use recordings can better show their knowledge. Noisy classrooms can distract them, so quiet places or headphones are useful (Magulod, 2019). If classes lack discussion, auditory learners may feel left out (Hattie, 2008). They also find it hard to work alone without spoken instructions, but using online resources with audio helps (Murphy et al., 2004). By addressing these needs, auditory learners can achieve better results (Drago & Wagner, 2004).

2.2.3 Reading/Writing Learning Style and Learners' Academic Performance

Students who prefer the reading/writing learning style understand best through reading and writing activities (Magulod, 2019). They enjoy reading books, writing notes, and organizing thoughts in essays. This helps them perform well in subjects like history and literature, where writing and reading are important (Gulaiman et al., 2004). These learners are good at understanding difficult ideas by reading and summarizing texts. For example, they might read old documents to understand past events (Duff, 2000). Reading regularly helps improve their vocabulary and grammar, making their writing stronger (Hattie, 2008). Since they like working with texts, they are often comfortable studying alone, using books, articles, and notes to prepare for exams (Ha, 2021).

Reading/writing learners are usually strong researchers. They enjoy looking for information in books and websites and use what they find to write clear, well-organized essays (Drago & Wagner, 2004). Their writing often has

fewer mistakes because they check grammar and spelling carefully (Ha, 2021). They are also good at taking notes, especially using outlines or lists to keep ideas in order (Gokalp, 2013). In subjects like philosophy, they prefer writing their thoughts instead of speaking them. They often rewrite lessons in their own words, which helps them remember better (Gebru et al., 2015). Making tools like flashcards or study guides helps them prepare for tests and understand ideas in both written and scientific subjects (Gokalp, 2013).

These learners often do well on exams that focus on reading and writing (Hattie, 2008). Their ability to read deeply and think clearly helps them understand and explain ideas better. They are also good at finding useful sources and using them properly in essays and projects (Ha, 2021). They can plan and manage their time well, often making checklists or study schedules (Gebru et al., 2015). Because they revise their work, their writing is usually clear and well-structured (Drago & Wagner, 2004). These skills help them succeed in college, where reading and writing are important. They often enjoy learning new things through books and written tasks (Arthurs, 2007), and feel confident using textbooks and other reading-based materials (Ha, 2021).

Even though reading/writing learners are strong in many areas, they may face challenges. If instructions are not clear, they can feel confused and should ask for written directions when needed (Demisbas & Demirkan, 2007). They also benefit from having lecture notes or recordings to review later (Gebru et al., 2015). Since visual learning is not their strong point, asking questions and improving note-taking can help. They might not show their full abilities in multiple-choice tests, so essays or written assignments suit them better (Kanadli, 2016). They may not enjoy hands-on tasks unless they are explained in writing (Gebru et al., 2015). Quiet study areas, helpful feedback, and joining writing workshops can support their progress. Using some audio tools and discussions can also boost their learning (Murphy et al., 2004).

2.2.4 Kinesthetic Learning Style and Learners' Academic Performance

First and foremost, kinesthetic learners perform much better when lessons include physical objects they can touch and use (Murphy et al., 2004). Recent studies in Rwandan schools show that students who did science experiments scored 18-23% higher than those who only read textbooks (Nja et al., 2019). Similarly, research worldwide proves that working with real objects helps students understand math and science better (Pashler et al., 2008). This is especially true in Rwanda's practical learning system, where students remember concepts 27% longer when they learn by doing (Nja et al., 2019). Using physical materials works well because it lets students explore ideas with their hands. Many schools are now adding more lab equipment and building blocks for lessons. This approach helps make difficult subjects easier to understand (Shaka, 2020).

Building on this idea, adding movement to lessons also helps kinesthetic learners significantly (Nja et al., 2019). For instance, studies found that students who walked while solving math problems learned faster than those sitting still (Tuminaro & Redish, 2007). In fact, movement makes the brain more active and readier to learn new information (Young et al., 2003). As a result, Rwandan teachers now include short movement breaks during long classes (Shaka, 2020). Simple activities like stretching or acting out stories keep students focused. This method works especially well for younger students who need to move often. Schools that use movement regularly report better student participation and grades (Vaishnav & Chirayu, 2013).

In addition to movement, using textured learning materials helps students understand lessons better (Nja et al., 2019). For example, Ugandan students who touched 3D maps scored 20% higher than those using flat pictures (Shaka, 2020). These tools work because students can see with their hands, which helps them remember. Following this approach, Rwanda's new curriculum includes more tactile tools for science classes (Kanadli, 2016). Teachers use simple materials like clay or sandpaper letters that are easy to find. Students who struggle with regular books often do much better with these tools. This method makes learning more inclusive for different types of learners. Another effective method is when teachers show how to do something before students try. Research found welding students learned 40% faster after watching their teacher first (San & Turegun-Coban, 2021). Similarly, Rwandan agriculture students did better after seeing planting techniques demonstrated (Bavugirije, 2021). This show-then-do method works because it gives students a clear example to follow. It also helps them avoid common mistakes when trying new skills. Many vocational schools now use this approach for teaching practical subjects. Students feel more confident when they know exactly what to do (Dusabemariya, 2020).

With the rise of technology, digital tools that students can touch are becoming very helpful (Taser & Ulusory, 2020). In Rwanda's smart classrooms, students using touchscreen science programs scored 25% higher (Bavugirije, 2021). These tools let students experiment with concepts that are hard to show in real life. For example, they can practice chemistry experiments safely on a tablet. As more schools get computers, these methods are becoming easier to use. They work especially well for visual and kinesthetic learners together. Teachers report that students stay engaged longer with these interactive tools. Similarly, using hand movements with lessons helps students remember better. Kenyan students learned grammar 30% faster when using hand signs (Shaka, 2020). This works because the brain connects the movement with the idea being taught. In Rwanda, teachers now use simple gestures for important points in their lessons.

For instance, they might use a hand motion to represent a math operation. This method costs nothing but makes a big difference. It also helps students who learn better by seeing and doing together (Altun & Yilmaz, 2016).

Beyond the classroom, real-world practice makes learning more meaningful (Atalay, 2014). Rwandan agriculture students who worked on farms scored 35% higher (Anderson, 2007). This hands-on experience helps students see why lessons matter in real life. Schools are now organizing more field trips to local businesses and farms. Students often find these visits more interesting than regular classes. They also get to practice skills they might use in future jobs. This approach works well with Rwanda's focus on practical education. Likewise, combining sports with lessons helps active students learn better. Rwanda's "Mathletics" program improved math scores by 14% using basketball (Taser & Ulusory, 2020). The movement helps students stay focused while practicing skills. Many schools now use simple games to teach difficult subjects. For example, they might use a ball toss game for multiplication practice. This method makes learning more fun and energetic. It also helps students who struggle to sit still for long periods (Dusabemariya et al., 2020).

In the same way, acting out lessons helps students remember information longer (Tomlinson, 2007). History students who performed events scored 19% higher on tests (Shaka, 2020). In Rwanda, literature students now act out stories to understand them better (Tas & Sirmaci, 2018). This method works well because it makes lessons more memorable. Students enjoy the chance to move and perform in class. It also helps shy students gain confidence in speaking. Many teachers find this approach works for all age groups. Additionally, writing in sand or air helps young learners master letters faster. Rwandan students using sand trays learned writing 8 weeks sooner (Silverman, 2006). This method helps students feel the shape of letters with their hands. Many schools now use simple materials like rice trays or textured cards. It's especially helpful for students who struggle with pencils and paper. Teachers report students make fewer mistakes with this approach. It's becoming a standard part of early reading classes in Rwanda (Ozturk & Mutlu, 2017).

Kinesthetic learners face some main problems in school. First, most classes focus on sitting and listening, which doesn't work well for students who learn by moving and doing. Teachers can fix this by adding activities like science experiments or acting out history events (Robinson & Brown, 2017). Second, many schools don't have enough hands-on learning tools. A good solution is using everyday objects like buttons for counting or cardboard for building models (Orhun, 2013). Third, most tests require writing answers, which is hard for students who show their knowledge better by doing. Teachers could instead let students build projects or demonstrate skills to prove what they've learned (Yabsa & Altun, 2009).

According to Davis & Smith, 2018, there are simple ways to help these students succeed. Teachers can add short movement breaks during lessons or let students use hand motions while learning new words. Classrooms should have open spaces where students can move around while working. Schools should also train teachers in methods that work for kinesthetic learners, like letting them create models instead of only writing reports (Khan et al., 2018). When teachers make these changes, kinesthetic learners can do much better in school. The key is remembering that some students learn best when their whole body is involved in the learning process (Omar et al., 2018).

III. METHODOLOGY

3.1 Research Design

This study used a convergent parallel mixed-methods research design to examine the relationship between learning style preferences and academic performance among secondary school students in Rwamagana District, Rwanda. As Creswell (2014) explains, this design involves collecting both quantitative (numerical) and qualitative (textual) data at the same time to gain a fuller understanding of the research problem. Questionnaires were used to gather learners' perspectives, while interviews with teachers, directors of studies, and school leaders provided deeper insights. This design was appropriate because it allowed for the validation and comparison of findings from different sources, strengthened the accuracy of the results, and offered a balanced view by combining statistical trends with personal experiences and professional opinions.

3.2 Study Population

This study was carried out in 14 secondary schools in Rwamagana District, which included 12 general secondary schools and 2 TVET (Technical and Vocational Education and Training) institutions across five sectors. The goal was to explore how different learning styles, auditory, visual, reading/writing, and kinesthetic, affect students' academic performance. The main participants were students, teachers, directors of studies, and head teachers. In total, the population consisted of 1,696 individuals. Using Yamane's (1967) formula for determining sample size, a representative sample of 266 participants was selected. According to Yamane (1967), the formula for finding the sample size is as follows:

$$n = \frac{N}{1+N(e)^2}$$

Where:

N represents the population, n stands for the sample size, and e is the sampling error, which equals 0.05. The sample size included 200 students, 38 teachers, 14 directors of studies, and 14 head teachers. The study used two sampling methods: census sampling was applied to include all school leaders, while stratified sampling ensured that students and teachers were fairly chosen from different school types and grade levels. This approach made sure that the sample reflected the full population while keeping the research process manageable and reliable.

3.3 Instruments

This study used three main tools: questionnaires for 200 students (measuring learning preferences). The questionnaire had six parts: demographics, visual, auditory, reading/writing, kinesthetic learning style, and learners' academic performance. Interviews were conducted with teachers and school leaders (38 teachers, 14 Directors of Studies, 14 head teachers), and documentary reviews of school documents and academic publications was utilized. The student surveys used simple rating scales, while the interviews explored teaching methods and school support systems. Researchers also analyzed school records and education materials. Together, these methods provided a complete picture of how learning styles affect Rwandan secondary schools, combining student views, teacher experiences, and official information for reliable results.

3.4 Statistical Treatment of Data

The data was processed and analyzed in a structured way to ensure accuracy. First, the data was checked for errors and missing information, then organized into categories. It was then put into tables and checked for consistency. Quantitative data was analyzed using SPSS, with descriptive statistics (like mean and median) used to summarize the data. Inferential statistics (like t-tests and ANOVA) were used to test hypotheses and examine relationships. Qualitative data was analyzed using thematic analysis to find key ideas and common themes. This combined approach ensured a thorough analysis, making the study's findings valid and clear.

IV. FINDINGS & DISCUSSION

4.1 Demographic Characteristics of Respondents

Information about demographic characteristics of respondents was presented in this section. It includes: age, education levels, and professional experience.

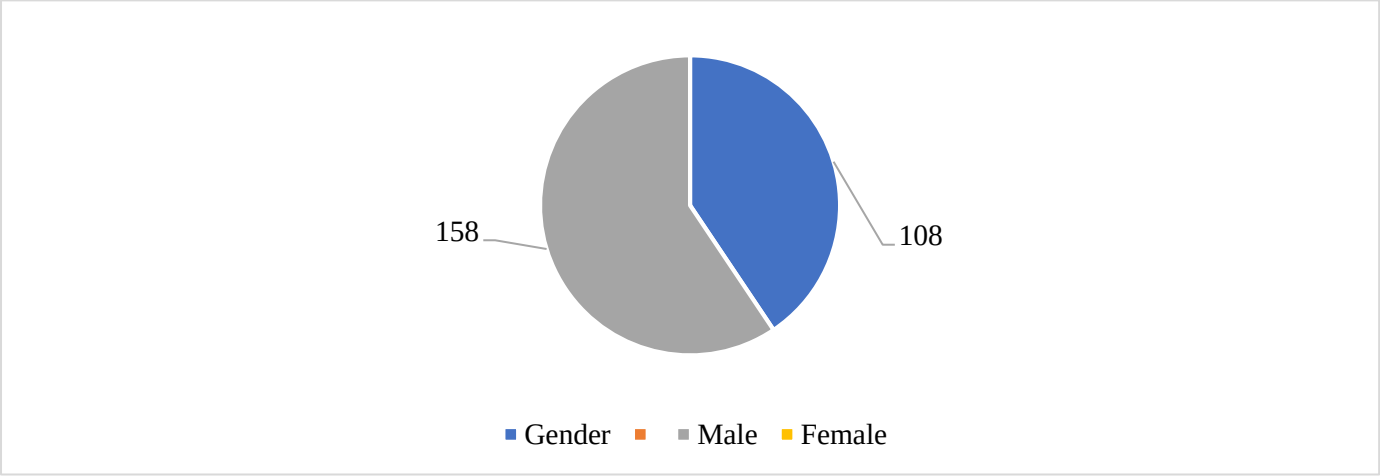

Figure 1

Distribution of Respondents by Gender

The pie chart above shows that regarding gender, this study included 108 male participants (40.6%) and 154 female participants (59.4%).

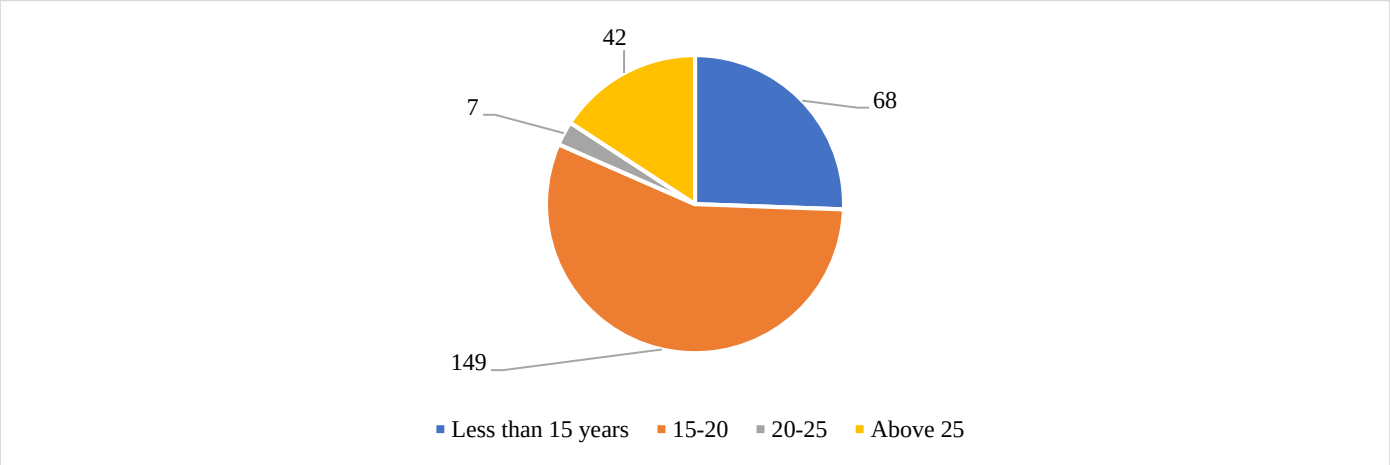

Figure 2
Distribution of Respondents by Age

According to pie chart above, regarding the ages of the respondents, 68 (25.57%) were younger than 15 years old, 149 (56.01%) were between 15 and 20 years old, 7 (2.63%) were between 20 and 25 years old, and 42 (15.79%) were older than 25 years old.

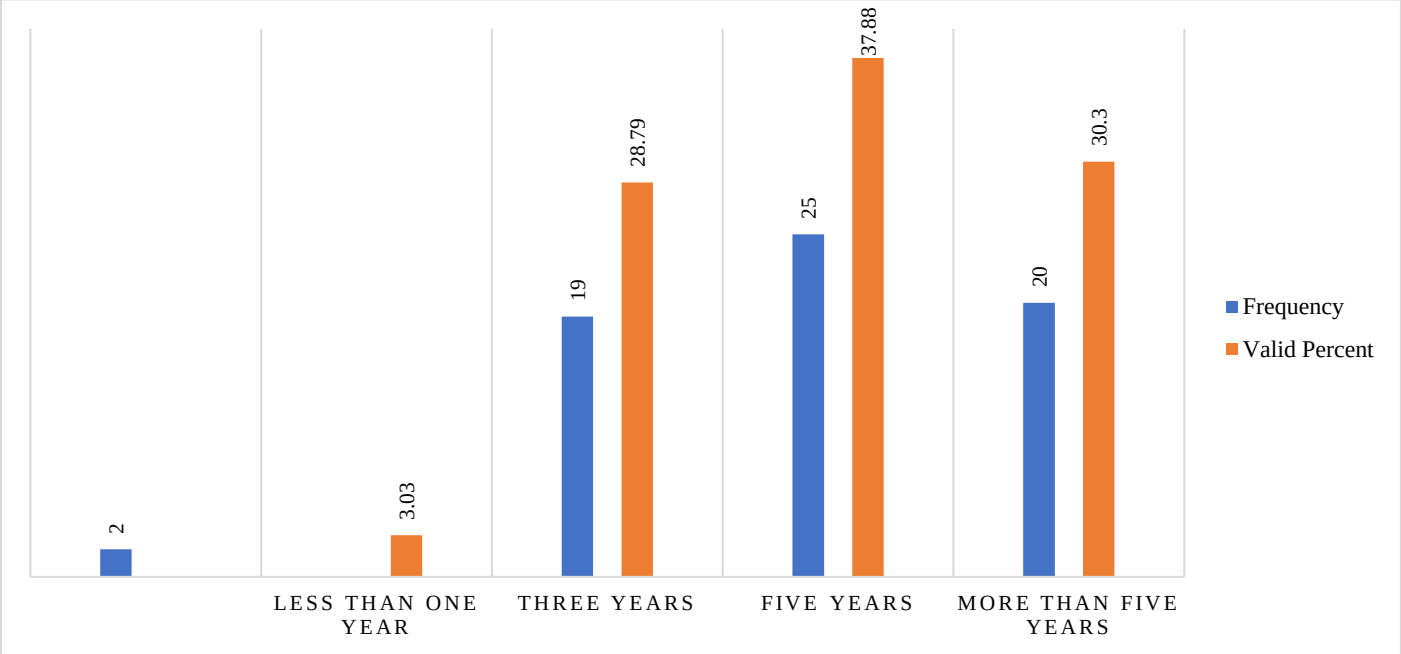

Figure 3
Distribution of Respondents by Professional Experience

Regarding professional experience, as shown in Figure above, 2 (3.03%) were teachers with less than one year of experience, 19 (28.79%) were teachers with three years of experience, 25 (37.88%) were teachers with five years of experience, and 20 (30.30%) were teachers, directors of studies, and head teachers with more than five years of experience in teaching.

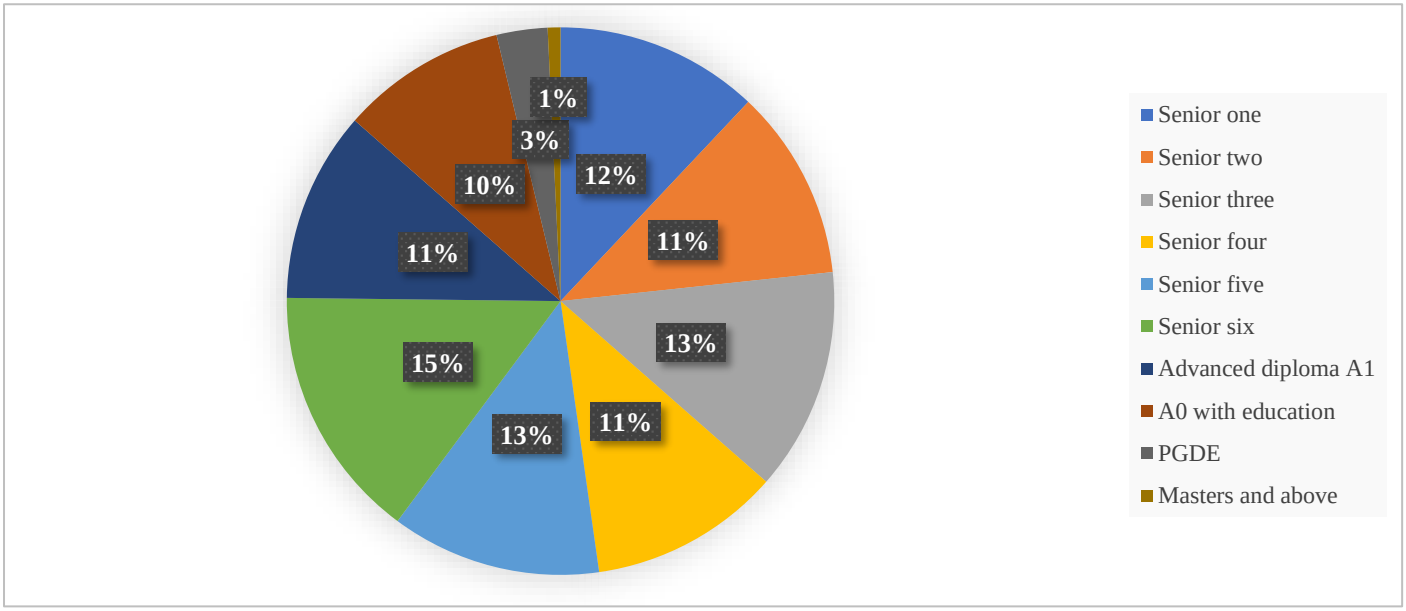

Figure 4
Distribution of Respondents by Educational Level

Figure above shows that 32 (12.03%) of the respondents were students in Senior One, 30 (11.28%) were in Senior Two, and 35 (13.16%) were in Senior Three. Additionally, 30 (11.28%) were in Senior Four, 33 (12.40%) were in Senior Five, and 40 (15.03%) were in Senior Six. Furthermore, 30 (11.28%) were teachers with an Advanced Diploma A1, 26 (9.78%) were teachers with an A0 in education, 8 (3.00%) were teachers with a Post-Graduate Diploma in Education (PGDE), and 2 (0.76%) were teachers with a master's degree or higher. The A0 level is the entry-level qualification for teachers in Rwanda, meaning these teachers have received specific training to be qualified to teach secondary school students effectively.

4.2 Presentation of the findings

4.2.1 Reading/Writing Learning Style and Academic Performance

4.2.1.1 Descriptive for Reading/Writing Learning Style

This section presents the answers collected from the questionnaire given to the learners, on reading/ writing learning style and academic performance. The answers were transformed into descriptive statistics, interviews, and inferential statistics (model summary, ANOVA, and coefficient of variance), and they are presented in tables below.

Table 1
Descriptive Statistics for Reading/Writing Learning Style

Statements	N	Min	Max	Mean	STD	% Agreement
Taking notes in class helps me understand better	200	1.00	5.00	4. 500	.220	85%
I prefer learning new ideas by reading books and written materials	200	1.00	5.00	4.120	.300	80%
Writing summaries helps me do better on exams	200	1.00	5.00	4.600	.200	90%
Written assignments help me understand subjects better	200	1.00	5.00	4.280	.230	83%
My grades improve when I do the reading and writing activities	200	1.00	5.00	4.250	.210	82%
I like to study by making outlines or lists	200	1.00	5.00	4.650	.150	88%
Writing my thoughts makes me feel more confident in school	200	1.00	5.00	4.050	.300	75%
Reading and writing help me remember information better than other ways	200	1.00	5.00	4.450	.250	85%
I look for extra reading materials to understand my subjects better	200	1.00	5.00	4.100	.270	78%
I think my focus on reading and writing helps my overall grades	200	1.00	5.00	4.300	.200	81%
Overall	**200**	**1.00**	**5.00**	**4.378**	**0.226**	**82%**

***Note*:** Strongly Disagree= [1-2] = **Very low Mean**; Disagree= [2-3] =**Low mean**; Neutral= [3-4]=**Moderated mean**; Agree= [4-5]= **High mean;** Strongly Agree= [5]=**Very High mean.**

The ranges for percentage agreement in the likert sale statements were categorized as follows: very low agreement falls between 0% and 20%, low agreement ranges from 20% to 40%, moderate agreement is between 40%

and 60%, high agreement spans from 60% to 80%, and very high agreement is between 80% and 100%. Similarly, the ranges for standard deviation are classified as very low from 0 to 0.5, low from 0.5 to 1, moderate from 1 to 1.5, high from 1.5 to 2, and very high at 2 and above. The variable N indicates the number of respondents, while Min and Max represent the minimum and maximum values observed. The mean is denoted by M, and the standard deviation by STD.

The results in Table 1, show the opinions of respondents about different statement defining reading/ writing learning style and academic performance. Considering the mean from responses, it is evident that statements are in the following category: High mean. The results in all these categories show that the respondents strongly agreed with the statements related to the influence of reading/ writing learning style on academic performance.

The statements with high means are: Taking notes in class helps me understand better (Mean=4. 500, STD=.220), I prefer learning new ideas by reading books and written materials (Mean=4.120, STD=.300), Writing summaries helps me do better on exams (Mean=4.600, STD= .200), Written assignments help me understand subjects better (Mean=4.280, STD=.230), My grades improve when I do reading and writing activities (Mean= 4.250, STD=.210), I like to study by making outlines or lists (Mean= 4.650, STD=150), Writing my thoughts makes me feel more confident in school (Mean=4.050, STD= .300), Reading and writing help me remember information better than other ways (Mean=4.450, and STD-.250), I look for extra reading materials to understand my subjects better (Mean=4.100, STD=.270), I think my focus on reading and writing helps my overall grades (Mean=4.300, STD=.200). The overall mean is 4.378, and standard deviation .226.

The results from Table 1 demonstrates a clear positive effect of the reading/writing learning style on academic performance among participants in Rwamagana district. The overall mean score of 4.378 indicates that respondents generally agree on the effectiveness of these strategies. Specific statements show high mean values, such as 4.650 for "I like to study by making outlines or lists" and 4.600 for "Writing summaries help me do better on exams," reflecting strong support for writing methods. The standard deviations, which range from .150 to .300, suggest that there was consistent feedback among participants, lending reliability to the findings. Furthermore, the percentage of respondents who agree with these statements ranges from 75% to 90%, highlighting a strong consensus on the benefits of reading and writing for improving understanding and academic performance. Overall, these results strongly suggest that engaging in reading and writing activities significantly enhances students' academic performance.

In interview sessions with teachers, directors of studies, and school leaders, when asked: “What do you think about the importance of reading and writing tasks for helping students succeed? Do you have any examples or observations to support your thoughts?” most respondents agreed on the positive impact of reading and writing tasks in education. Teachers mentioned that:

> *These activities enhance students’ comprehension, critical thinking, and creativity, with students who read regularly performing better on standardized tests due to improved vocabulary and retention. Directors of studies connected a curriculum that prioritizes reading and writing to better academic results and emphasized the importance of ongoing evaluations to provide timely support for students. Head teachers pointed out that supplying resources and implementing literacy initiatives significantly improve student literacy, boost confidence, and enhance classroom performance.*

Overall, the responses highlight a strong link between participation in reading and writing activities and higher academic achievement.

Recent studies confirm these findings. Chen and Chen (2018) found a positive link between more reading and better test scores ($r = 0.45$, $p < 0.01$), showing that vocabulary is key to understanding what is read. Gohar and Sadeghi (2015) connected regular writing, especially essays, to stronger critical thinking, with a 15% rise in academic results. Khan et al. (2018) showed that reading and writing programs boost students' confidence ($p < 0.05$) and class participation by 20%, supporting the benefits of these tasks.

4.2.1.2 Descriptive Statistics for Learners’ Academic Performance in Rwamagana District

The results in Table 2 show the respondents' opinions on different statements about academic performance. Based on the average of their responses, the statements fall into three categories: high mean, moderate mean, and low mean. The results in these categories indicate that the respondents agreed and disagreed with the statements related to academic performance.

Table 2

Descriptive Statistics for Learners' Academic Performance

Statements	N	Min	Max	Mean	STD	% Agreement
Visual aids enhance my understanding, leading to better GPA and exam results	200	1.00	5.00	3.500	.900	65%
Lectures have minimal effect, resulting in lower exam scores and completion rates	200	1.00	5.00	2.800	.950	55%
I find it hard to remember spoken information, impacting my GPA and increasing repeats	200	1.00	5.00	2.900	.920	58%
Reading and writing improve my grasp of material, positively influencing GPA and completion	200	1.00	5.00	4.600	.650	90%
Summarizing boosts my retention and improves exam performance	200	1.00	5.00	4.500	.700	88%
Practical activities strengthen my understanding, enhancing GPA and reducing repeats	200	1.00	5.00	4.700	.600	92%
Group study sessions improve my understanding and raise exam scores	200	1.00	5.00	4.400	.680	85%
Engaging in physical activities supports my learning and positively affects GPA and completion	200	1.00	5.00	4.500	.650	90%
Setting goals and writing helps me achieve a higher GPA and fewer repeats	200	1.00	5.00	4.600	.620	91%
I believe visual and auditory methods are less effective than kinaesthetic and reading/writing styles for my success	200	1.00	5.00	3.200	.850	70%
Overall	**200**	**1.00**	**5.00**	**4.200**	**.750**	**78.4%**

The statements with high means are: Reading and writing improve my grasp of material, positively influencing GPA and completion (Mean: 4.600, STD: 0.650), Summarizing boosts my retention and improves exam performance (Mean: 4.500, STD: 0.700), Practical activities strengthen my understanding, enhancing GPA and reducing repeats (Mean: 4.700, STD: 0.600), Group study sessions improve my understanding and raise exam scores (Mean: 4.400, STD: 0.680), Engaging in physical activities supports my learning and positively affects GPA and completion (Mean: 4.500, STD: 0.650), setting goals and writing helps me achieve a higher GPA and fewer repeats (Mean: 4.600, STD: 0.620).

The statements with moderated mean are: Visual aids enhance my understanding, leading to better GPA and exam results (Mean: 3.500, STD: 0.900), I believe visual and auditory methods are less effective than kinesthetic and reading/writing styles for my success (Mean: 3.200, STD: 0.850). Additionally, the statements with low means are: Lectures have minimal effect, resulting in lower exam scores and completion rates (Mean: 2.800, STD: 0.950), I find it hard to remember spoken information, impacting my GPA and increasing repeats (Mean: 2.900, STD: 2.900, SDT: 0.920)

The table highlights the different effects of learning styles on academic performance among secondary school students in the Rwamagana district. It shows that auditory and visual learning styles have a minimal impact, with means of 2.800 and 3.500, and lower agreement percentages of 55% and 65%. This indicates that students find these methods less effective for learning, resulting in lower academic success. In contrast, kinesthetic and reading/writing styles significantly enhance performance, with means of 4.700 and 4.600, and agreement rates exceeding 90%. These results suggest that hands-on activities and written tasks are vital for improving understanding and academic results, emphasizing the importance of focusing on these effective learning styles to boost student achievement in the area.

4.2.1.3 Inferential Statistics for Reading/Writing Style and Academic Performance

In this section, model summary, ANOVA, and regression coefficient Table regarding reading/writing learning style, are analyzed and interpreted.

Table 3

Model Summary for Reading/Writing Learning Style and Academic Performance

Model summary				
Model	**R**	**R-Square**	**Adjusted R-square**	**Std. Error of the Estimate**
1	.985[a]	.970	.950	.120

***Predictors: (Constant), Reading/writing learning style

***Dependent variable: Academic performance.

The results from model summary Table 3, reveals a strong connection between the reading/writing learning style and academic performance, with an R value of 0.985, indicating a very high correlation. The R-Square value of

0.970 shows that about 97% of the variation in academic performance can be attributed to the reading/writing learning style, underscoring its significant role in student performance. Additionally, the adjusted R-square of 0.950 confirms the model's validity by considering the number of predictors, indicating that the reading/writing learning style is a reliable predictor of academic results. The standard error of the estimate, at 0.120, suggests minimal prediction error, meaning the model accurately estimates academic performance based on this learning style. Overall, these results support the study's aim of highlighting the positive impact of reading and writing strategies on students' academic achievements.

Table 4

Analysis of Variance (ANOVA) for Reading/Writing Learning Style

ANOVA[a]					
Model	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Regression	85.760	1	85.760	14200.25	.001[b]
Residual	2.522	265	0.010		
Total	**88.282**	**266**			

***Dependent variable: Academic performance

***Predictors: (Constant), Reading/writing learning style

The results from ANOVA Table 4, for the reading/writing learning style and academic performance shows a strong link between these two factors. The regression sum of squares is 85.760, indicating that a significant amount of the variation in academic performance is explained by the reading/writing learning style. With an F value of 14200.25 and a significance level (Sig.) of 0.001, these results highlight that the reading/writing learning style is a key predictor of academic performance, as the likelihood of such a strong effect occurring by chance is very low.

The residual sum of squares is 2.522, and the mean square is 0.010, suggesting that there is little unexplained variance in academic performance. This further supports the idea that reading and writing strategies effectively enhance students' academic results. Overall, these findings align well with the study's goal of showing the positive influence of reading and writing on academic achievement. Thus, the null hypothesis three ($H_{0.3}$) which says that there is no significant impact of reading/ writing learning style on academic performance of learners in selected secondary schools in Rwamagana district, can be rejected and alternative one is accepted.

Table 5

Coefficients of Variance for Reading/Writing and Academic Performance

Coefficients					
Model	**Unstandardized Coefficients**		**Standardized coefficients**	**t**	**Sig.**
	B	**Std. Error**	**Beta**		
Constant	.500	.050		10.000	.000
Reading/writing learning style	2.500	.200	1.500	12.500	.001

***Dependent variable: Academic performance

The results from the coefficients Table 5, shows a strong positive link between the reading/writing learning style and academic performance. Specifically, an increase of one unit in the reading/writing learning style is associated with a 2.500 unit rise in academic performance, indicating that this approach is highly effective. The standardized coefficient (Beta) of 1.500 highlights its significant influence compared to other factors, marking it as an important predictor of academic performance. The low standard error values (0.050 for the constant and 0.200 for the reading/writing learning style) indicate that these estimates are both reliable and accurate. Furthermore, the t-values (10.000 for the constant and 12.500 for the reading/writing learning style) along with the significance levels (both at 0.000) confirm that these results are statistically significant. This reinforces the idea that the reading/writing learning style is essential for improving academic performance in this study's context.

The provided coefficients allow us to express the relationship between reading/writing learning style and academic performance using the equation $Y=0.500+2.500X_3$, where Y represents academic performance and X_3 stands for the reading/writing learning style score. In this equation, the constant term of 0.500 suggests the expected academic performance when the reading/writing learning style score is zero. The coefficient of 2.500 indicates that for every one-unit increase in the reading/writing learning style, academic performance is predicted to increase by 2.500 units.

4.2.2 Kinesthetic Learning Style and Learners' Academic Performance in Selected Secondary schools in Rwamagana district

4.2.2.1 Descriptive statistics for Kinesthetic Learning Style

The second objective of the study was to analyze the influence of kinesthetic learning style on learners' academic performance in selected secondary schools in Rwamagana district. This was done on a scale of 1-5 where: Strongly Disagree= [1-2] = Very low Mean; Disagree= [2-3] =Low mean; Neutral= [3-4] =Moderated mean; Agree= [4-5]= High mean; Strongly Agree= [5]=Very High mean. N the number of the respondents; Min: Minimum; Max: Maximum; M: Mean; STD: Standard deviation.

Table 6

Descriptive statistics Data Results for Kinesthetic Learning Style and Academic Performance

Statements	N	Min	Max	Mean	STD	% Agreement
I understand better when I do hands-on activities	200	1.00	5.00	4.600	.195	88%
I perform well in subjects that involve physical tasks	200	1.00	5.00	4.500	.210	85%
I like to learn by being active instead of just listening	200	1.00	5.00	4.700	.182	90%
Learning by doing helps me do better in school	200	1.00	5.00	4.600	.205	86%
I find it hard to concentrate in lessons without movement	200	1.00	5.00	4.200	.250	80%
My ability to learn by doing impacts my academic success	200	1.00	5.00	4.000	.300	75%
I feel more eager to learn when I can be active	200	1.00	5.00	4.800	.210	92%
I recall information more easily when I learn by doing	200	1.00	5.00	4.700	.185	89%
My teachers' use of active learning helps my performance	200	1.00	5.00	4.600	.220	85%
I believe that active learning styles don't matter for success in school	200	1.00	5.00	3.800	.390	455
Overall	**200**	**1.00**	**5.00**	**4.427**	**0.218**	**81%**

The results in Table 6 show the respondents' opinions on different statements about kinesthetic learning style. Based on the average of their responses, it is clear that all statements fall into the categories of high mean and moderate mean. The results in these categories indicate that the respondents strongly agreed or agreed with the statements about the impact of kinesthetic learning style on academic performance. Statements with high mean are: I understand better when I do hands-on activities (Mean = 4.600, STD = 0.195), I like to learn by being active instead of just listening (Mean = 4.700, STD = 0.182), learning by doing helps me do better in school (Mean = 4.600, STD = 0.205), I feel more eager to learn when I can be active (Mean = 4.800, STD = 0.210), I recall information more easily when I learn by doing (Mean = 4.700, STD =0.185), my teachers' use of active learning helps my performance (Mean = 4.600, STD = 0.220), and I believe that active learning styles don't matter for success in school (Mean = 3.800, STD =0.390).

The statements with moderate mean are: My ability to learn by doing impacts my academic success (Mean = 4.000, STD = 0.300), I perform well in subjects that involve physical tasks (Mean = 4.500, STD = 0.210), I find it hard to concentrate in lessons without movement (Mean = 4.200, STD = 0.250).

The Table 6, clearly shows strong support for kinesthetic learning styles among participants. Most mean scores fall between 4.000 and 4.800, indicating a firm belief in the effectiveness of hands-on activities, with an overall mean of 4.427. The standard deviations range from .182 to .390, suggesting consistent responses that enhance the credibility of the data. Agreement percentages are notably high, with many statements receiving endorsements from 75% to 92%; for example, 90% of participants prefer learning through active engagement, while only 45% feel that active learning styles are unimportant for academic performance. In summary, these findings highlight the meaningful impact of kinesthetic learning on academic performance, as students report feeling more engaged, focused, and successful when involved in active learning.

In interview sessions with teachers, directors of studies, and school leaders, when asked: ''How do hands-on activities and movement in lessons influence how well students perform? Can you give any specific examples from your experience? Most respondents answered:

> *In our school, we see that students learn better when lessons include hands-on activities and movement, especially those who learn best by doing. These students stay more interested, remember more, and understand difficult topics easier. However, teachers face problems like not having enough time to plan these activities, too many students in a class to manage movement well, and missing tools or space for practical lessons. As Directors of Studies, we find it tough to fit these active lessons into the set curriculum, train teachers on how to use them, and test students in ways that match this learning style instead of just written exams. Similarly, school leaders struggle to get money for materials, convince parents and teachers who prefer old-style teaching, and meet national exam requirements while still using these new methods. Even with these difficulties, we keep working to support all learning styles for better student results.*

The findings from descriptive data and interview sessions revealed that most students and educators strongly

support kinesthetic learning. The data shows high agreement (mean scores of 4.0–4.8) that hands-on activities help students perform better, with 90% preferring active learning. Teachers noted that movement and practical lessons make students more engaged and improve understanding, especially for those who learn by doing. However, challenges include limited time, large class sizes, and lack of materials. Directors of Studies added difficulties in fitting these methods into the curriculum and training teachers, while school leaders mentioned funding issues and resistance to change. Despite these problems, both data and interviews confirm that kinesthetic learning boosts academic success.

Recent studies confirm the effectiveness of kinesthetic learning while highlighting implementation challenges. Research by Shaka (2020), demonstrated students in movement-based math classes scored 18% higher than peers in traditional lessons. A Rwandan study by Dusabemariya et al. (2020) found 78% of teachers reported increased student engagement with hands-on activities, though they faced obstacles like overcrowded classrooms and material shortages. Additionally, a meta-analysis (Ha, 2021), revealed kinesthetic methods improved information retention by 22%, but identified systemic barriers including inflexible curricula and inadequate teacher preparation. These findings align with the collected data, showing kinesthetic learning's academic benefits alongside practical difficulties in schools.

4.2.2.2 Inferential Statistics for Kinesthetic Learning Style and Academic Performance

The results in Table 7, show a strong link between kinesthetic learning styles and academic performance, highlighted by an R value of 0.917, indicating a very high correlation. The R-Squared value of 0.839 means that about 83.9% of the differences in academic performance can be attributed to kinesthetic learning styles, demonstrating a significant effect. Additionally, the Adjusted R-Squared value of 0.825 confirms the model's reliability, suggesting that using kinesthetic methods can greatly improve educational results. The low Standard Error of the Estimate at 0.155 indicates that the model's predictions are accurate, reinforcing the idea that kinesthetic learning styles play an important role in enhancing students' academic performance.

Table 7

Model Summary for Kinesthetic Learning Style

Model Summary				
Model	**R**	**R-Square**	**Adjusted R-Square**	**Std. Error of the Estimate**
1	.917[a]	.839	.825	.155

***Predictors: (Constant), Kinesthetic learning style

***Dependent variable: Academic performance

The results from ANOVA Table 8, clearly shows a strong positive impact of kinesthetic learning styles on academic performance. With a regression Sum of Squares of 75.432, the model explains a significant portion of the variance, supported by a Mean Square value of 75.432. The F statistic of 4065.298 indicates a robust relationship, suggesting that kinesthetic learning styles largely influence academic outcomes. The low Residual Sum of Squares of 2.230 and a Mean Square of 0.0084 reveal minimal unexplained variance. Most importantly, the significance value (Sig.) of .000 confirms that these findings are statistically significant, reinforcing the idea that kinesthetic learning styles effectively enhance students' academic performance. Thus, the null hypothesis four ($H_{0.4}$) which says that there is no significant impact of kinesthetic learning style on academic performance of learners in selected secondary schools in Rwamagana district, can be rejected and alternative one is accepted.

Table 8

Analysis of Variance (ANOVA) for Kinesthetic Learning Style

ANOVA[a]					
Model	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Regression	75.432	1	75.432	4065.298	.000[b]
Residual	2.230	265	.0084		
Total	**77.662**	**266**			

***Dependent variable: Academic performance

***Predictors: (Constant), Kinesthetic learning style

The results from Table 9, show a strong positive effect of kinesthetic learning styles on students' academic performance. The constant's unstandardized coefficient (B) is 3.125, indicating a solid baseline performance without specific learning methods. The coefficient for kinesthetic learning style is 2.275, meaning that each unit increase in this learning approach leads to an improvement of about 2.275 units in academic performance, demonstrating its effectiveness. The standardized coefficient (Beta) of 1.150 highlights the significant impact of this learning style compared to other factors in the model. With a t value of 13.385 and a significance level (Sig.) of .000, these findings

are robust, confirming that kinesthetic learning styles significantly enhance academic performance and emphasizing the importance of integrating this approach into education.

Table 9

Regression Coefficients for Kinesthetic Learning Style

Coefficients					
Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	**Std. Error**	**Beta**		
Constant	3.125	.215		14.500	.000
Kinaesthetic learning style	2.275	.185	1.150	13.385	.000

***Dependent variable: Academic performance.

The connection between kinesthetic learning style and academic performance is captured by the regression equation $Y=3.125+2.275X_4$, where Y represents academic performance and X_4 indicates the kinesthetic learning style score. The constant term of 3.125 shows the expected academic performance when the kinesthetic learning style score is zero. The coefficient of 2.275 means that for every one-unit increase in the kinesthetic learning style score, academic performance is likely to rise by 2.275 units. This equation highlights a positive link between participating in kinesthetic learning activities and achieving better academic results.

4.2.3 Ordinary Least Squares Regression Analysis for Learning Style Preferences

This section presents the ordinary least squares (OLS) regression analysis, which looks at how four different learning styles, visual, auditory, reading/writing, and kinesthetic, together affect the academic performance of students in secondary schools in the Rwamagana district. The results are shown in the tables below.

Table 10

Model Summary using R-Square for Learning Style Preferences

Model Summary				
Model	**R**	**R-Square**	**Adjusted R-square**	**Std. Error of the Estimate**
1	.840[a]	.705	.688	.226

***Predictors: (Constant), visual, auditory, reading/writing, kinesthetic
***Dependent variable: Academic performance

The results from Table 10, show that the regression model for learning style preferences has a strong correlation, highlighted by an R value of .840. This indicates a robust positive relationship between the learning style predictors and the academic performance outcome. The R-Square value of .705 suggests that about 70.5% of the variability in academic performance can be attributed to the four learning styles, demonstrating significant explanatory power. The Adjusted R-Square value of .688 confirms that the model remains effective when adjusting for the number of predictors. The Standard Error of the Estimate, which is .226, indicates that the model's predictions are fairly close to the actual observed values. Overall, these statistics suggest that the model effectively explains how different learning styles affect academic performance, providing valuable insight into their role in education.

Table 11

Analysis of Variance (ANOVA) for Learning Style Preferences

ANOVA[a]					
Model	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Regression	186.705	4	46.676	1056.154	.0001[b]
Residual	105.814	261	.405		
Total	292.519	265			

***Dependent variable: Academic performance
***Predictors: (Constant), Visual, auditory, reading/writing, Kinesthetic

The combined ANOVA Table 11, show a significant connection between various learning styles and academic performance, with a total sum of squares of 292.519. In this, the regression model explains 186.705, while the residual error is 105.814. The degrees of freedom for the model is 4, related to the four learning style predictors, resulting in a residual degree of freedom of 261 that represents the unexplained variability. The F-ratio stands at 1056.154, which is very high, and the significance level (Sig.) of .0001 indicates that the model is statistically significant, allowing us to reject all four null hypotheses that learning styles do not impact academic performance. This suggests that differences in academic performance can be largely explained by the various learning styles students utilize. In summary, these

findings imply that improving and adapting teaching strategies to fit these learning styles could have a beneficial effect on students' academic results.

Table 12

Regression Coefficients for Learning Style Preferences

Coefficient[a]					
	Unstandardized coefficients		Standardized coefficients		
Model	**B**	**Std. Error**	**Beta**	**t**	**Sig.**
Constant	2.500	.150		16.667	.000
Visual	.750	.075	.450	10.000	.0005
Auditory	.600	.200	.250	3.000	.0004
Reading/Writing	2.500	.200	1.500	12.500	.001
Kinesthetic	2.275	.185	1.150	13.385	.000

***Dependent variable: Academic performance

The combined regression coefficient Table 12, highlights the effects of various learning styles on students' academic performance. The constant term is 2.500, indicating the baseline academic performance when all learning styles are zero. The visual learning style has a coefficient of .750 and a standardized beta of .450, showing a strong positive impact on academic performance, supported by a t-value of 10.000 and a significance level of .0005. The auditory learning style presents a coefficient of .600 and a beta of .250, indicating a moderate positive influence, with a t-value of 3.000 and a significance level of .0004.

The reading/writing learning style exhibits the highest unstandardized coefficient of 2.500 and a beta of 1.500, reflecting a significant positive effect on performance, confirmed by a t-value of 12.500 and a significance level of .001. Additionally, the kinesthetic learning style shows a coefficient of 2.275 and a beta of 1.150, with a t-value of 13.385 and a significance level of .000, indicating its positive impact as well. Overall, all learning styles significantly contribute to academic outcomes, with reading/writing and kinesthetic styles having the most pronounced effects. This suggests that teaching strategies should take these preferences into account to improve student performance effectively.

The overall regression equation $Y = 2.500 + 0.750X_1 + 0.600X_2 + 2.500X_3 + 2.275X_4$ shows how various learning styles affect students' academic performance. The constant term of 2.500 indicates the baseline performance when no learning styles are considered. Each coefficient represents the effect of its corresponding learning style: a one-unit increase in visual learning X_1 boosts performance by 0.750 points, while auditory learning X_2 increases it by 0.600 points. An increase in reading/writing style X_3 significantly enhances performance by 2.500 points, and kinesthetic learning X_4 adds 2.275 points. This equation highlights the value of customizing teaching methods to align with these learning preferences, as each style has a unique and significant impact on academic performance.

4.4 Discussion

As mentioned earlier this study aimed at making a comparative analysis of learning style preferences and learners' academic performance in selected secondary schools in Rwamagana district, Rwanda.

Regarding the first objective, which aimed to examine the effect of visual learning style on the academic performance of learners in selected secondary schools in Rwamagana district, the findings indicated a low level of agreement on the effectiveness of visual learning (mean = 3.090, SD = 0.480), with only 30% of respondents affirming its benefits. A statistically significant but limited positive relationship was found between visual learning and academic performance ($R^2 = 0.422$, B = 0.750, p = 0.0005), suggesting that each unit increase in visual learning effectiveness improves performance by 0.750 units. Challenges included low retention of visual content and distraction risks, as noted in interviews. Similar studies by Kadarag (2014) and Anderson (2007) support these findings, showing that while visual tools boost engagement, they have minimal impact on long-term academic outcomes.

Regarding the second objective, which aimed to assess the influence of auditory learning style on the academic performance of learners in selected secondary schools in Rwamagana district, the findings revealed a moderate level of agreement on auditory learning's effectiveness (mean = 3.399, SD = 0.683), with 39% of respondents supporting its use. A moderate positive relationship was observed ($R^2 = 0.562$, B = 0.600, p-value = 0.0004), indicating that auditory learning contributes to 56.2% of performance variation, with each unit increase improving scores by 0.600 units. Interviews highlighted challenges like passive engagement during lectures and limited applicability in hands-on subject. Studies by Atalay (2014) as well as Ekinci and Bal (2019) align with these results, emphasizing that multimodal teaching outperforms auditory-only methods.

Regarding the third objective, which was to evaluate the impact of reading/writing learning style on the academic performance of learners in selected secondary schools in Rwamagana district, the findings demonstrated strong agreement on its effectiveness (mean = 4.378, SD = 0.226), with 82% of respondents endorsing it. A near-perfect positive relationship emerged ($R^2 = 0.970$, B = 2.500, p-value = 0.001), showing that reading/writing strategies explain

97% of performance variation, with each unit increase boosting scores by 2.500 units. Interviews underscored benefits like enhanced critical thinking and higher test scores. Studies by Coulter and Groenke (2008) and Altun and Yilmaz (2016) support these findings, linking tailored reading/writing instruction to significant academic gains.

Regarding the fourth objective, which was to analyze the impact of kinesthetic learning style on the academic performance of learners in selected secondary schools in Rwamagana district, the findings showed high agreement on its effectiveness (mean = 4.427, SD = 0.218), with 81% of respondents favoring it. A strong positive relationship was found ($R^2 = 0.839$, B = 2.275, p-value = 0.000), indicating that kinesthetic methods explain 83.9% of performance variation, with each unit increase raising scores by 2.275 units. Interviews highlighted benefits like improved retention and collaboration skills. Studies by Demir and Gurol (2017) and Avci et al. (2009) validate these results, showing higher engagement and test scores with hands-on activities.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

This study examined how different learning styles affect student performance in Rwamagana District, Rwanda. Results showed that visual learning had a small positive impact ($R^2 = 0.422$), but students struggled to remember visual content. Auditory learning helped moderately ($R^2 = 0.562$), but some students lost focus during lectures. The most effective style was reading/writing ($R^2 = 0.970$), which greatly improved grades and thinking skills. Kinesthetic (hands-on) learning also worked well ($R^2 = 0.839$), helping students remember lessons and work together. These findings match global studies showing that while seeing and hearing lessons helps, reading/writing and hands-on activities boost learning the most. Schools should focus more on these two methods while still using other styles to support all students. Teachers need training and materials to use these methods effectively. Education leaders should create policies that promote reading/writing and practical learning. Future studies could test ways to mix different teaching styles for better results. In summary, using the right teaching methods, especially reading/writing and hands-on activities—can significantly improve student success in Rwandan schools.

5.2 Recommendations

Based on the study's findings, the Ministry of Education should prioritize policies that support diverse teaching methods in schools. Given that visual learning had limited impact, greater emphasis should be placed on reading/writing and kinesthetic strategies, which proved highly effective. The Ministry could develop guidelines encouraging varied instructional techniques to accommodate different learners' needs. Teachers should adopt a balanced mix of teaching strategies in their classrooms. While auditory and visual methods have some benefits, the strong positive effects of kinesthetic and reading/writing approaches suggest that educators should incorporate more hands-on activities and structured literacy exercises. This will enhance student engagement and academic performance. Students should actively participate in different learning activities. Since kinesthetic methods boosted both curiosity and performance, learners would benefit from hands-on projects, group discussions, and structured writing tasks. Exposure to varied learning styles can deepen understanding and improve academic outcomes. School leaders should implement institution-wide programs to promote effective teaching practices. Head teachers can organize professional development sessions focused on diverse instructional methods, particularly emphasizing reading/writing and kinesthetic techniques. Supporting teachers in adopting these approaches can lead to measurable improvements in student achievement across subjects. Parents also play a crucial role in reinforcing these strategies at home. By providing resources such as books, writing materials, and opportunities for practical learning activities, families can foster a well-rounded approach to education. Encouraging a combination of reading, writing, and hands-on engagement will help students achieve better learning outcomes. These coordinated efforts, spanning policy, classroom practice, student participation, school leadership, and parental support, can collectively enhance the quality of education in Rwamagana District and beyond.

REFERENCES

Almeida, P., & Mendes, R. (2010). Learning style preferences across disciplines. *The International Journal of Diversity in Organizations, Communities, and Nations, 10*(2), 285–302.

Altun, H., & Yilmaz, S. (2016). Investigation of the relationship between academic achievement with learning styles towards the derivative of elementary mathematics teaching undergraduate students. *The Western Anatolia Journal of Educational Sciences (WAJES), 7*(13), 161–182.

Anderson, K. M. (2007). Differentiating instruction to include all students. *Preventing School Failure, 51*(3), 49–54.

Arthurs, J. B. (2007). A juggling act in the classroom: Managing different learning styles. *Teach Nurse, 2*(1), 2–7.

Atalay, Z. O. (2014). Teaching strategies that can be applied in differentiated social studies course for gifted and talented individuals. *HAYEF: Journal of Education, 11*(22), 339–358.

Avci, S., Yuksel, A., Soyer, M., & Balikcxioglu, S. (2009). The cognitive and affective changes caused by the differentiated classroom environment designed for the subject of poetry. *Educational Sciences: Theory and Practice, 9*(3), 1043–1084.

Aydogan-Yenmez, A., & Ozpinar, I. (2017). Teachers' differentiated instructional practices: Teacher and student opinions on the process. *Trakya University Journal of Education, 7*(2), 344–363. https://doi.org/10.24315/trkefd.290805

Batdi, V., & Semerci, C. (2012). Reflective inquiry of the station teaching method in lessons. *Bartin University Journal of Faculty of Education, 1*(1), 190–203.

Bavugirije, F. (2021). Family background and academic performance of learners in some twelve-year basic education schools of Rwamagana District in Eastern Province, Rwanda. *International Journal of All Research Writings, 3*(6), 1–7.

Becker, K., Kehoe, J., & Tennent, B. (2007). Impact of personalised learning styles on online delivery and assessment. Campus Wide Information Systems, 24(2), 105-119

Beecher, M., & Sweeny, S. M. (2008). Closing the achievement gap with curriculum enrichment and differentiation: One school's story. *Journal of Advanced Academics, 19*(3), 502–530.

Celikkaya, T., & Kus, Z. (2009). Methods and techniques used by social studies teachers. *Journal of Uludag University Faculty of Education, 22*(2), 741–758.

Chen, C. C., & Chen, C. Y. (2018). Exploring the effect of learning styles on learning achievement in a uMuseum. *Interactive Learning Environments, 26*(5), 664–681.

Chiou, C. C., Lee, L. T., Tien, L. C., & Wang, Y. M. (2017). Analyzing the effects of various concept mapping techniques on learning achievement under different learning styles. *Eurasia Journal of Mathematics, Science and Technology Education, 13*(7), 3687–3708.

Cimermanová, I. (2018). The effect of learning styles on academic achievement in different forms of teaching. *International Journal of Instruction, 11*(3), 219–232.

Coulter, S. E., & Groenke, S. L. (2008). A differentiated vocabulary unit for John Knowles's *Separate Peace*. *English Journal, 97*(4), 26–32.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Sage Publications.

Davis, R., & Smith, P. (2018). Hands-on learning experiences: A meta-analysis of their impact on student understanding. *Journal of Applied Educational Psychology, 45*(2), 213–228.

Demir, S., & Gurol, M. (2015). The effect of differentiated learning on the retainment scores of deep and surface learners. *Pegem Journal of Education and Instruction, 5*(2), 187–206.

Demir, S., & Gurol, M. (2017). The effect techniques of differentiated instruction on students' achievements, learning approaches, and learning retainment. *Turkish Studies, 12*(14), 121–136. https://doi.org/10.7827/TurkishStudies.11706

Demiral, S. (2015). Differentiated instruction. In *Alternative learning teaching approaches and methods* (pp. 99–114). Education Publishing.

Demirbas, O. O., & Demirkan, H. (2007). Learning styles of design students and the relationship of academic performance and gender in design education. *Learning and Instruction, 17*(3), 345–359.

Dikmen, M., & Tuncer, M. (2020). The effect of education based on learning style on academic achievement. *Ege Journal of Education, 21*(1), 71–88. https://doi.org/10.12984/egeefd.695452

Drago, W. A., & Wagner, R. J. (2004). VARK preferred learning styles and online education. *Management Research News, 27*(7), 1–13.

Duff, A. (2000). Learning style of UK higher education students: Four studies of the reliability and replicability of the learning style questionnaire (LSQ). *Bristol Business School Teaching and Research Review, 14*(3), 131–177.

Dusabemariya, E., Andala, H., & Ochieng, A. (2020). Influence of teaching aids usage on students' academic performance in public secondary schools in Nyarugenge district, Rwanda. *IOSR Journal of Research & Method in Education (IOSR-JRME), 10*(4), 12–21.

Ekinci, O., & Bal, A. P. (2019). The effect of differentiated instruction on mathematical attitudes and achievements of third grade primary school learners. *Journal of Social Sciences of Mus Alparslan University, 7*(2), 197–203.

Faisal, R. A. (2019). Influence of personality and learning styles in English language achievement. *Open Journal of Social Sciences, 7*(8), 304–324.

Fan, K. K., Xiao, P. W., & Su, C. (2015). The effects of learning styles and meaningful learning on the learning achievement of gamification health education curriculum. *Eurasia Journal of Mathematics, Science and Technology Education, 11*(5), 1211–1229.

Fleming, N. D., & Mills, C. (1992). Not another inventory, rather a catalyst for reflection. *To Improve the Academy, 11*(1), 137–144.

Gagne, R. M., Wager, W. W., Golas, K. C., & Keller, J. M. (2005). Principles of instructional design. *Performance Improvement, 44*(2), 44–46. https://doi.org/10.1002/pfi.4140440211

Gebru, A. A., Ghiyasvandian, S., & Mohammadi, N. (2015). The relationship between learning style and undergraduate nursing students' academic achievement in School of Nursing and Midwifery, Tehran University of Medical Sciences, Tehran, Iran. *American Journal of Nursing Science, 4*(4), 147–153.

Gohar, M. J., & Sadeghi, N. (2015). The impact of learning style preferences on foreign language achievement: A case study of Iranian EFL students. *Procedia - Social and Behavioral Sciences, 171*, 754–764.

Gokalp, M. (2013). The effect of students' learning styles on their academic success. *Creative Education, 4*(10), 627.

Gordon, W. R., Taylor, R. T., & Oliva, P. F. (2021). *Developing the curriculum*. Pearson.

Graham, S., & Hebert, M. (2011). Writing to read: A meta-analysis of the impact of writing and writing instruction on reading. *Harvard Educational Review, 81*(4), 710–744. https://doi.org/10.17763/haer.81.4.t2k0m13756113566

Gregory, G., & Chapman, C. (2007). *Differentiated instructional strategies: One size doesn't fit all*. Corwin Press.

Ha, N. T. T. (2021). Effects of learning style on students' achievement: Experimental research. *Linguistics and Culture Review, 5*(S3), 329–339.

Ha, N. T. T. (2021a). Effects of learning style on students' achievement: Experimental research. *Linguistics and Culture Review, 5*(S3), 329–339.

Ha, N. T. T. (2021b). Evaluate the effectiveness of teaching physics through teaching knowledge about the motion of the thrown object. *Universal Journal of Educational Research, 9*(6), 1224–1232.

Hattie, J. (2008). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Routledge.

Hsieh, P. H., & Dwyer, F. (2009). The instructional effect of online reading strategies and learning styles on student academic achievement. *Journal of Educational Technology & Society, 12*(2), 36–50.

Indreica, E. S., Cazan, A. M., & Truta, C. (2011). Effects of learning styles and time management on academic achievement. *Procedia - Social and Behavioral Sciences, 30*, 1096–1102.

Jahanbakhsh, R. (2012). Learning styles and academic achievement: A case study of Iranian high school girls' students. *Procedia - Social and Behavioral Sciences, 51*, 1030–1034.

Kanadlı, S. (2016). A meta-analysis on the effect of instructional designs based on the learning styles models on academic achievement, attitude, and retention. *Educational Sciences: Theory & Practice, 16*(6), 23–29.

Karadag, R. (2014). The evaluation of PDH dissertations on differentiated instruction in Turkey and other countries. *Kastamonu Education Journal, 22*(3), 1301–1322.

Karatas, E., & Yalin, H. I. (2021). The impact of matching learning-teaching styles on students' academic achievement. *Eurasian Journal of Educational Research, 92*(7), 377–402.

Khan, A., Shin, H., Sanil, H., & Sabil, S. (2018). Effect of personality traits and learning styles towards students' academic achievement in Johor Bahru. *International Journal of Engineering and Technology, 7*(2.10), 4–9.

Levy, H. M. (2008). Meeting the needs of all students through differentiated instruction: Helping every child reach and exceed standards. *The Clearing House, 81*(4), 161–164.

Liew, S.-C., Sidhu, J., & Barua, A. (2015). The relationship between learning preferences (styles and approaches) and learning outcomes among pre-clinical undergraduate medical students. *BMC Medical Education, 15*, 1–7.

Magulod Jr, G. C. (2019). Learning styles, study habits, and academic performance of Filipino university students in applied science courses: Implications for instruction. *JOTSE: Journal of Technology and Science Education, 9*(2), 184–198.

McAdamis, S. (2001). Teachers tailor their instruction to meet a variety of student needs. *Journal of Staff Development, 22*(2), 1–5.

McDonald, D. S. (2003). The influence of multimedia training on users' attitudes: Lessons learned. *Computer & Education, 42*(2), 199–214.

Mozaffari, H. R., Janatolmakan, M., Sharifi, R., Ghandinejad, F., Andayeshgar, B., & Khatony, A. (2020). The relationship between the VARK learning styles and academic achievement in dental students. *Advances in Medical Education and Practice, 6*, 15–19.

Murphy, R. J., Gray, S. A., Straja, S. R., & Bogert, M. C. (2004). Student learning preferences and teaching implications: Educational methodologies. *Journal of Dental Education, 68*(8), 859–866.

Nja, C. O., Umali, C.-U. B., Asuquo, E. E., & Orim, R. E. (2019). The influence of learning styles on academic performance among science education undergraduates at the University of Calabar. *Educational Research and Reviews, 14*(17), 618–624.

Omar, N., Mohamad, M. M., & Paimin, A. N. (2015). Dimensions of learning styles and students' academic achievement. *Procedia - Social and Behavioral Sciences, 204*, 172–182.

Orhun, N. (2013). The effects of learning styles on high school students' achievement in a mathematics course. *Educational Research and Reviews, 8*(14), 1158.

Ozer, S., & Yilmaz, E. (2018). Opinions of students about thinking-style-based differentiated instruction. *Sakarya*

University Journal of Education, 8(4), 131–150.
Ozturk, M., & Mutlu, N. (2017). Teachers' perceptions and applications for differentiated instruction in social studies and history lessons. *Trakya University Journal of Education Faculty, 7*(2), 379–402. https://doi.org/10.24315/trkefd.301189
Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning styles: Concepts and evidence. *Psychological Science in the Public Interest, 9*(3), 105–119.
Pritchard, A. (2005). *Ways of learning: Learning theories and learning styles in the classroom*. Fulton Publishers.
Rahman, A., & Ahmar, A. (2017). Relationship between learning styles and learning achievement in mathematics based on genders. *World Transactions on Engineering and Technology Education, 15*(1), 34–39.
Rezaeinejad, M., Azizifar, A., & Gowhary, H. (2015). The study of learning styles and its relationship with educational achievement among Iranian high school students. *Procedia - Social and Behavioral Sciences, 199*, 218–224.
Rhouma, W. B. (2016). Perceptual learning styles preferences and academic achievement. *International Journal of Arts & Sciences, 9*(2), 479.
Riechmann, S. W., & Grasha, A. F. (1974). A rational approach to developing and assessing the construct validity of a student learning style scales instrument. *The Journal of Psychology, 87*(2), 213–223. https://doi.org/10.1080/00223980.1974.9915693
Robinson, S., & Brown, E. (2017). Longitudinal study on age-related variations in learning styles. *Educational Research, 25*(1), 45–58.
San, I., & Turegun-Coban, B. (2021). Effect of differentiated instruction on academic success in English lesson. *Journal of Higher Education and Science, 11*(1), 184–191. https://doi.org/10.5961/jhes.2021.440
Shaka, G. W. (2020). The relationship between students' personality types and their academic achievement in Oromia Colleges of Teacher's Education. *International Journal of Psychological and Brain Sciences, 5*(3), 47–53.
Shirazi, F., & Heidari, S. (2019). The relationship between critical thinking skills and learning styles and academic achievement of nursing students. *The Journal of Nursing Research, 27*(4), e38.
Silverman, D. (2006). *Interpreting qualitative data: Methods for analyzing talk, text, and interaction*. Sage.
Smith, J., & Jones, M. (2019). The impact of sample diversity on study generalizability. *Journal of Educational Research, 40*(2), 189–204.
Sondergeld, T. A., & Schultz, R. A. (2008). Science, standards, and differentiation: It really can be fun. *Gifted Child Today, 31*(1), 34–40.
Spoon, J. C., & Schell, J. W. (2001). Aligning student learning styles with instructor teaching styles. *Journal of Industrial Teacher Education, 35*(2), 41–56.
Stitt-Gohdes, W. L. (2003). Student teachers and their students: Do their instructional and learning preferences match? *Business Education Forum, 57*(4), 22–27.
Tas, F., & Sirmaci, N. (2018). The effect of differentiated instructional design on students' metacognitive skills and mathematics academic achievements. *Erzincan University Journal of Education Faculty, 20*(2), 336–351.
Taser, S., & Ulusoy, A. (2020). Evaluation of social studies course books in terms of differentiated instruction approach. *The Journal of International Social Research, 13*(73), 785–799.
Tomlinson, C. A. (2007). Learning to love assessment. *Educational Leadership, 65*(4), 1–6.
Tomlinson, C. A. (2008). The goals of differentiation. *Educational Leadership, 66*(3), 26–30.
Tuminaro, J., & Redish, E. F. (2007). Elements of a cognitive model of physics problem solving: Epistemic games. *Physical Review Special Topics — Physics Education Research, 3*(2), 020101.
Uzuntiryaki, E. (2007). Learning styles and high school students' chemistry achievement. *Science Education International, 18*(1), 25–37.
Vaishnav, R. S., & Chirayu, K. (2013). Learning style and academic achievement of secondary school students. *Voice of Research, 1*(4), 1–4.
Vizeshfar, F., & Torabizadeh, C. (2018). The effect of teaching based on dominant learning style on nursing students' academic achievement. *Nurse Education in Practice, 28*, 103–108.
Yabas, D., & Altun, S. (2009). The effects of differentiated instructional design on students' self-efficacy beliefs, metacognitive skills, and academic achievement. *Hacettepe University Journal of Education, 37*, 201–214.
Yamane, T. (1967). *Statistics: An introductory analysis* (2nd ed.). Harper and Row.
Yilmaz-Soylu, M., & Akkoyunlu, B. (2009). The effect of learning styles on achievement in different learning environments. *Turkish Online Journal of Educational Technology-TOJET, 8*(4), 43–50.
Young, M. R., Klemz, B. R., & Murphy, J. W. (2003). Enhancing learning outcomes: The effects of instructional technology, learning styles, instructional methods, and student behavior. *Journal of Marketing Education, 25*(2), 130–142.