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Capacity Development for ICT in Education (CADIE) Project in Teaching and Learning In Gicumbi District

A Case Study of Secondary Schools In Gicumbi District

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Abstract:

Background*: The study aimed to evaluate the effect of the digital literacy skills of secondary school teachers in Gicumbi District, assess the role of the CADIE Project on the integration of ICT tools into the teaching methodologies of secondary school educators in Gicumbi District, analyze the influence of the CADIE Project on student learning in secondary schools in Gicumbi District, and identify the challenges faced by secondary school teachers in implementing ICT-enhanced teaching methods after participating in the CADIE Project in Gicumbi District.*

Methods and Materials*: In conducting this study, the researcher employed a mixture of qualitative research design and targeted three secondary schools, namely, Notre Dame du Bon Conseil, TTC de la Salle Byumba, and Groupe Scolaire Epa Catholique. Teachers, school administrators, and education administrators in local government institutions (sector and district level) were the focus, and simple random and purposive sampling techniques were adopted to select them. Questionnaires and interviews were used for data collection, and descriptive data analysis methods were employed in analyzing the data.*

Results: *The study found that digital literacy influenced students' engagement in learning activities and enabled teachers to effectively integrate technology into instructional practices. Regarding the role of the CADIE Project in the integration of ICT tools into the teaching methodologies of secondary school educators in the Gicumbi District, the study revealed that the CADIE project influenced educators to integrate ICT tools into teaching methods and provided effective training for educators to use ICT tools in teaching. Furthermore, the study found that the CADIE Project enhanced student-learning outcomes in secondary schools in the Gicumbi District by enhancing students' digital literacy skills and improving their ability to collaborate and communicate using ICT tools. The study also identified challenges such as limited infrastructure and limited access to technology resources.*

Conclusion*: The study recommended that infrastructure development should be more comprehensive, and a support system for ICT integration should be established.*

Keywords**:** *CADIE, ICT in education, Technology-based teaching methodology.*

i. Introduction

The integration of Information and Communication Technologies (ICT) in education has been a progressive process, evolving alongside the global trend towards digitalization, which has significantly reshaped the dynamics of teaching and learning. While the roots of ICT in education can be traced back to the widespread adoption of computers in schools in the late 20th century (Selwyn, 2019), recent literature emphasizes the ongoing transformation fueled by the proliferation of digital tools, online resources, and interactive technologies. Scholars argue that in the 21st century, there is an increasing emphasis on equipping students with the necessary skills to thrive in a digitally-driven world, where access to abundant information and proficiency in technology are indispensable (Bower, 2019).

However, despite the potential benefits, the effective incorporation of ICT in education has faced challenges on a global scale. Variations in access to technology, both among students and educators, have resulted in a digital divide that exacerbates existing inequalities. Furthermore, the readiness of teachers to integrate ICT into their pedagogy varies significantly, with

some educators embracing the changes while others face barriers such as a lack of training and support (Ertmer, Ottenbreit-Leftwich, & Tondeur, 2015).

Challenges in introducing ICTs in teaching and learning in South Africa further underscore the complexities of implementing technology-driven educational initiatives (Ostrowick, 2018). Countries like Kenya have implemented ambitious programs, such as the Digital Literacy Program, aimed at integrating ICT into the national curriculum and providing digital devices to primary school learners (Government of Kenya, 2016).

The integration of Information and Communication Technologies (ICT) in education has been central to the Rwandan government's efforts to transform the country into a knowledge-based economy (Republic of Rwanda, 2018). Through initiatives like Vision 2020 and the National Strategy for Transformation (NST1), the government has highlighted the crucial role of ICT in driving economic development and enhancing the quality of education (Republic of Rwanda, 2017). Additionally, the Smart Classrooms Project, in partnership with the Korea International Cooperation Agency (KOICA), focuses on equipping classrooms with ICT tools and fostering digital literacy among both students and teachers (KOICA, 2019). These initiatives reflect Rwanda's commitment to using ICT as a catalyst for educational transformation. However, challenges remain, including the need for ongoing infrastructure development, teacher capacity building, and addressing socio-economic disparities to ensure equitable access to digital resources (Mushimiyimana *et al*., 2022).

The Capacity Development for ICT in Education (CADIE) Project, a collaborative initiative between the Ministry of Education in Rwanda and the Korea International Cooperation Agency (KOICA), was conceived in 2016 to align with the national development strategy. This audacious undertaking aimed at enhancing the utilization of Information and Communication Technologies (ICT) in education, particularly within secondary schools. The project, operated under the Rwanda Education Board's Single Projects Implementation Unit (REB-SPIU) and funded by KOICA, commenced operations in 2019 with a budget of Seven Million US Dollars (USD 7,000,000) for its implementation, scheduled to run from 2019 to 2023. CADIE's overarching mission is to integrate ICT into teaching and learning among secondary school teachers while strengthening learners' 21st-century skills in Rwanda (REB, 2023).

The CADIE Project, as reported by the New Times, operates through four interconnected components designed to enhance ICT integration in Rwandan education. First, it provides training to over 25,000 educators from public and government-aided secondary schools, equipping them with various ICT tools and methodologies to create more engaging and interactive learning experiences. Second, the project focuses on developing 21st-century skills in students, such as critical thinking, problem-solving, collaboration, and creativity, by incorporating ICT tools into the teaching and learning process. Third, CADIE promotes digital literacy among both teachers and students, preparing them for success in a digital world. Finally, the project enhances infrastructure by equipping schools with essential ICT tools, including computers, projectors, and internet connectivity, creating a conducive environment for digital learning (Ufitiwabo, 2023).

The CADIE Project's holistic approach includes comprehensive teacher training, ongoing support through workshops and mentoring, and the development of resources like online training modules, lesson plans, educational software, and digital learning platforms, ensuring teachers have the necessary skills and support to effectively integrate ICT into their teaching practices (REB, 2023). The impact of the CADIE Project has been significant, leading to increased ICT integration in classrooms, improved learning outcomes, and enhanced teacher confidence and competence in using ICT tools, thereby contributing to reducing the digital divide by providing students with access to technology and digital learning resources (REB, 2023).

Given Rwanda's distinctive trajectory in adopting ICT in education, exploring the impact of initiatives like the Capacity Development for ICT in Education (CADIE) Project within this specific context becomes crucial for understanding the broader implications for the digital transformation of teaching and learning in Rwandan secondary schools, mainly in Gicumbi District. The main objective of this study was to assess the Impact of Capacity Development for ICT in Education (CADIE) project in teaching and learning in secondary schools in Gicumbi District. It was guided by the following specific objectives:

i. To evaluate the impact of the digital literacy skills of secondary school teachers in Gicumbi District
ii. To assess the role of the CADIE Project on the integration of ICT tools into the teaching methodologies of secondary school educators in Gicumbi District
iii. To analyze the contribution of the CADIE Project on student learning in secondary schools in Gicumbi District
iv. To identify the challenges faced by secondary school teachers in implementing ICT-enhanced teaching methods in Gicumbi District

ii. Theoretical Framework

In this section, the theories related to the subject study are reviewed and then linked to the study. The theories to be reviewed by are Technological Acceptance Model Theory (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), social learning theory, and cognitive load theory.

1. Technological Acceptance Model Theory

The Technology Acceptance Model (TAM) serves as a fundamental theoretical framework in information systems research, designed to elucidate the factors influencing individuals' acceptance and utilization of technology. This model has become essential for understanding technology adoption, particularly within educational settings, as it has been extensively applied in contemporary research (Venkatesh *et al*., 2016).

Recent studies have leveraged TAM to investigate the acceptance of diverse digital tools, including learning management systems, educational software, and online learning platforms (Al-Emran *et al*., 2018; Hwang *et al*., 2019). These investigations reveal that factors such as user experience, institutional support, and individual attitudes significantly influence the acceptance of educational technologies (Khan *et al*., 2017).

Additionally, in a study conducted by Al-Adawi et al. (2022), the authors extended TAM to include external factors such as self-efficacy and computer anxiety, which further informed the acceptance and integration of technology in higher education. By applying TAM, the CADIE Project can identify factors that facilitate or hinder the adoption of ICT in classrooms, enabling targeted interventions to foster a more supportive environment for technology integration. Ultimately, leveraging TAM can help ensure that the CADIE Project effectively meets its objectives of improving educational practices through the successful implementation of ICT.

2. Unified Theory of Acceptance and Use of Technology (UTAUT)

The Unified Theory of Acceptance and Use of Technology (UTAUT) signifies a major development in the study of technology adoption, with the goal of thoroughly understanding how individuals accept and utilize technology. This model has been further refined and validated in subsequent studies (Venkatesh *et al*., 2012; Venkatesh *et al*., 2024). According to UTAUT, individuals' beliefs regarding the usefulness and ease of use of a technology, along with social influences and the extent of organizational support, collectively shape their intention to adopt the technology. This intention, in turn, serves as a predictor of their actual usage behavior (Venkatesh *et al*., 2016).

Since its inception, UTAUT has been widely applied and extended across various contexts and industries, including education, healthcare, and business. Researchers have modified UTAUT to include additional factors and moderators, enhancing its explanatory power and applicability within specific contexts.

The Unified Theory of Acceptance and Use of Technology (UTAUT) has garnered significant attention in empirical studies, particularly in understanding technology adoption across various contexts. Venkatesh et al. (2016) revisited the UTAUT framework, confirming its robustness in predicting user acceptance of technology in diverse settings, including education and healthcare. In a study by Al-Gahtani et al. (2022), the UTAUT model was employed to analyze the acceptance of e-learning platforms among university students in Saudi Arabia, revealing that performance expectancy and effort expectancy were critical determinants influencing students' intention to use these platforms. In this study investigating the impact of capacity development for ICT use in secondary education, the Unified Theory of Acceptance and Use of Technology (UTAUT) serves as a valuable theoretical lens for understanding the factors influencing teachers' and students' acceptance and utilization of ICT tools. Specifically, UTAUT can help elucidate how perceptions of usefulness and ease of use, social influences from peers and educational stakeholders, and the availability of organizational support shape individuals' intentions to incorporate ICT into teaching and learning practices.

3. Social Learning Theory

Social Learning Theory, originally developed by Albert Bandura, emphasizes that individuals learn through observation, imitation, and modeling behaviors exhibited in their social environments (Bandura, 1977; Akers, 2017). A fundamental concept within Social Learning Theory is observational learning, which refers to the process where individuals acquire new behaviors or skills by watching and imitating others' actions (Bandura, 1977; Wexler, 2021). Through this mechanism, people can gain knowledge, attitudes, and behaviors without needing direct reinforcement or personal experiences. The theory also emphasizes the importance of modeling, where individuals learn by observing the actions of role models, such as parents, teachers, peers, or media figures, whose behaviors are seen as socially desirable or influential (Huang, 2021).

Furthermore, the theory introduces the concept of vicarious reinforcement, where individuals modify their behavior based on the outcomes they observe in others (Gibbons, 2019). Positive experiences of role models are likely to encourage similar behaviors in observers, while negative outcomes may dissuade imitation.

Social Learning Theory posits that learning occurs through a cyclical process involving observation, imitation, and reinforcement (Egan, 2022). Individuals observe others' behaviors, selectively imitate them based on perceived outcomes, and adjust their behaviors according to the consequences they see in those they observe.

Furthermore, Social Learning Theory highlights the importance of role models, such as experienced educators or peers, in influencing attitudes toward technology use. By leveraging these principles, the CADIE Project can enhance its capacity development initiatives by encouraging peer collaboration, sharing best practices, and creating supportive networks that empower both educators and learners to embrace and effectively utilize ICT in teaching and learning processes.

4. Cognitive Load Theory

Cognitive Load Theory (CLT) is a theoretical framework that aims to elucidate how the cognitive architecture of the human mind influences learning and problem-solving processes. Although originally introduced by John Sweller in the late 1980s. Contemporary research has expanded its application and relevance within educational contexts (Meyer & Land, 2020). Cognitive load refers to the mental effort required to process information during learning tasks, and CLT categorizes cognitive load into three types: intrinsic, extraneous, and germane (Paas *et al*., 2010). Intrinsic load is associated with the inherent complexity of a task, extraneous load pertains to the manner in which information is presented, and germane load relates to the cognitive resources dedicated to learning and problem-solving. Recent studies have highlighted the significance of schemas—mental structures that organize and interpret information—in reducing cognitive load and enhancing learning efficiency (Renkl, 2018).

Cognitive Load Theory (CLT) is particularly relevant to the Capacity Development for ICT in Education (CADIE) Project, as it provides insights into how to design and implement effective instructional strategies that optimize learning when integrating technology into teaching. By understanding the limitations of working memory and the different types of cognitive load—intrinsic, extraneous, and germane—educators involved in the CADIE Project can create learning experiences that minimize unnecessary cognitive strain and enhance information retention. The application of CLT principles can guide the development of ICT-related teaching materials and activities that are coherent, well-structured, and aligned with learners' existing knowledge. This approach not only supports teachers in delivering content effectively but also helps students to engage with technology in a way that enhances their learning outcomes and reduces cognitive overload, ultimately leading to a more successful implementation of the CADIE Project's objectives in fostering digital competencies.

iii. Conceptual Framework

In this section, the conceptual review of this study are presented in the following Figure 1, which in details presents the independent variable, dependent variable and intervening variable.

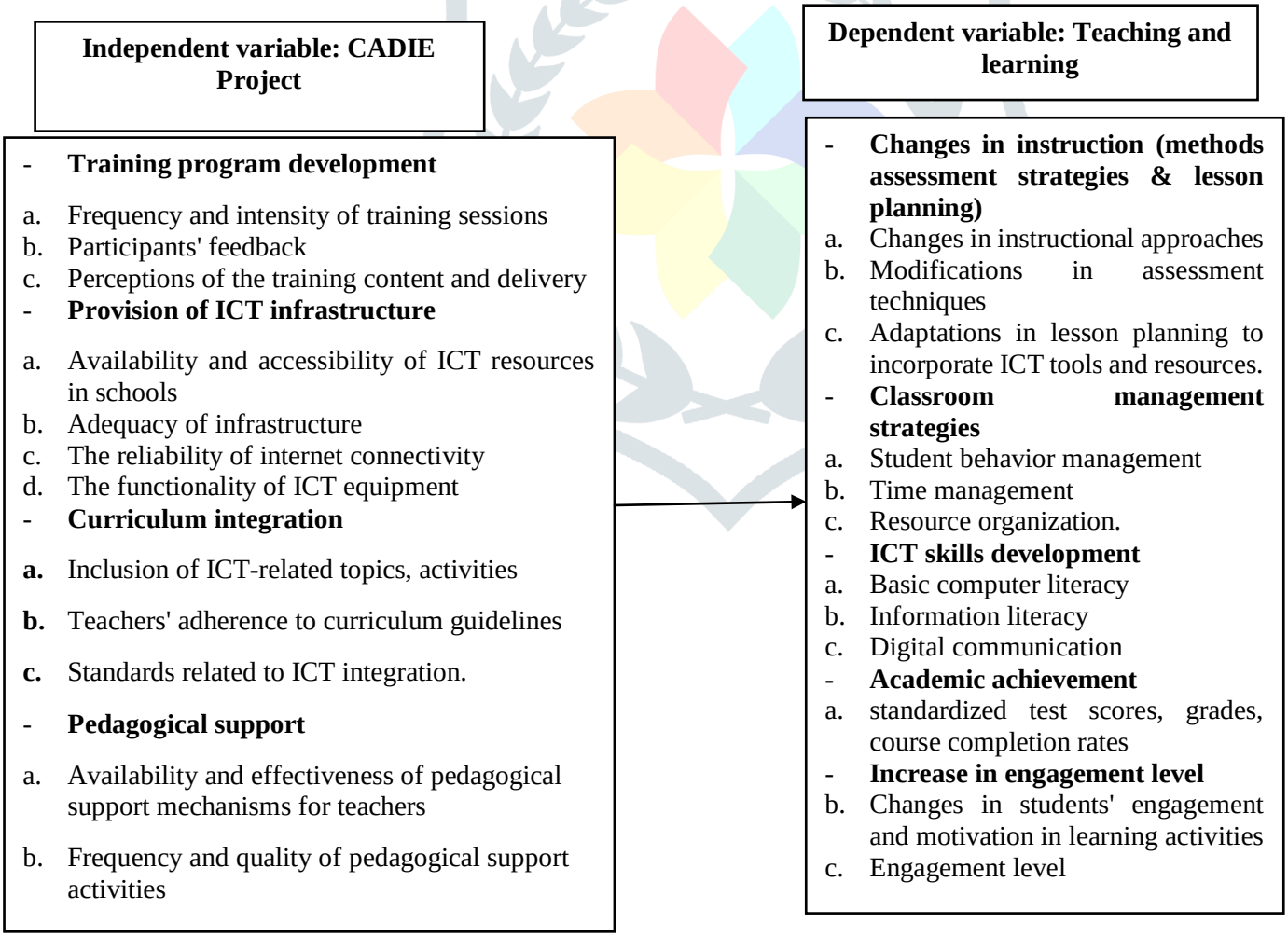

Figure 1: Conceptual framework
Source: Developed and compiled by Researcher, February 2024

The Capacity Development for ICT in Education (CADIE) Project, with its multifaceted components of training program development, ICT infrastructure provision, curriculum integration, and pedagogical support, is intricately linked to the enhancement of teaching and learning outcomes. The effectiveness of training programs, gauged by the frequency and intensity of sessions, participants' feedback, and perceptions of content, directly influences instructional methods, assessment strategies, and lesson planning, driving changes in teaching practices. The availability, adequacy, and functionality of ICT infrastructure, including reliable internet connectivity, are crucial for enabling teachers to integrate ICT tools into the curriculum and adhere to guidelines, which in turn impacts classroom management strategies, such as student behavior and time management. Moreover, the inclusion of ICT in the curriculum and the support provided to teachers through pedagogical mechanisms are essential for fostering ICT skills development among students, encompassing computer literacy, information literacy, and digital communication. These interconnected elements culminate in improved academic achievement, reflected in standardized test scores, grades, and course completion rates, as well as increased student engagement and motivation in learning activities, ultimately highlighting the CADIE Project's pivotal role in transforming educational practices and outcomes.

iv. Research Methodology

Research Design

This study employed a mixed-methods research design to comprehensively assess the impact and efficacy of the Capacity Development for ICT in Education (CADIE) Project in selected secondary schools within the Gicumbi District, Rwanda. The qualitative component involved conducting in-depth interviews and focus group discussions with educators and administrators, providing nuanced insights into the contextual nuances of ICT integration.

Quantitative data were obtained through surveys and academic performance metrics to facilitate the analysis of the project's measurable effects. This mixed-methods approach enhanced the study's robustness, offering a holistic understanding of the CADIE Project's influence on teaching methodologies and student outcomes. The qualitative data illuminated nuanced experiences and challenges, while quantitative measures provided statistically grounded insights. Gicumbi District, where the study was conducted, is part of Rwanda's Northern Province, with Byumba serving as its capital. Encompassing roughly 829 square kilometers, the district is divided into 21 sectors. Based on the recent 5th Population and Housing Census of 2022, the population of Gicumbi District was 448,824 (NISR, 2023).

2. Target Population

The population of a study encompasses the complete set of individuals, objects, or elements that possess the characteristics being investigated by the researcher within a specific research context (Trochim & Donnelly, 2008). It represents the broader group from which the sample is drawn and about which the researcher aims to make inferences or generalizations. The population for this study comprises the educational stakeholders associated with three selected schools: Notre Dame du Bon Conseil, TTC de la Salle Byumba, and Groupe Scolaire Epa Catholique, all situated in the Gicumbi District, Northern Province of Rwanda. The study primarily target educators, administrators, and students from these schools. Additionally, the directors of education at both the district and sector levels in Gicumbi District was included in the population to gain a broader perspective.

Sample Design

In this section, the determination of sample size and the sampling selection techniques are discussed.

Determination of Sample Size

The researcher applied the mathematic formula developed by Yamane (1967) to determine the sample size. And respondents were determined by simple random and stratified sampling techniques. Yamane provided a simplified formula to calculate sample size as follows.

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

Where, n = sample size; N= the population, and e = the margin error which is assumed to be 10% (0.01) in this case;

In the following Table 1 shows the sample size determination per stratum.

Table 1: Sample Size Determination

N/O	Description		Population (N)	Sample size
1	**Notre Dame du Bon Conseil**	Educators	22	18
		Schools Administrators	6	5
		Dean of Studies	1	1
2	**TTC de la Salle Byumba**	Educators	27	21
		Schools Administrators	11	10
		Dean of Studies	1	1
3	**Groupe Scolaire Epa Catholique**	Educators	34	25
		Schools Administrators	4	4
		Dean of Studies	1	1
4	**Public officials**	Director of Education at the sector level	1	1
		Director of Education at the District level	1	1
5	**Total**		**109**	**88**

Source: Field Data, 2024

Sample Selection Techniques

The sampling techniques used to select the sample from the target population were simple random and purposive sampling techniques. The simple random sampling technique was often used when the population was homogenous and when each member could be easily identified and accessed. Purposive sampling on the other hand was used as researchers intentionally chose individuals or cases that possessed certain characteristics or experiences essential to the study, thereby providing in-depth insights into the phenomenon under investigation. Simple random sampling was used to select the sample from educators and students, while purposive sampling was used to select the sample from the school administrators to ensure a representative and diverse selection of participants.

Data Collection Instruments

Under this sub-section the data collection instruments such as questionnaire, interview and documentation were used.

v. Research Findings and Discussion

1. Demographic Identification of the Respondents

Table 2 provides a comprehensive overview of the demographic characteristics of the respondents, including variables such as age, sex, marital status, and educational level. This demographic profile is essential for understanding the background of the participants and contextualizing the subsequent analysis of the study's findings.

Table 2: Demographic Identification of the Respondents

Items	Frequency	Percentage
Sex		
Male	54	61.4
Female	34	38.6
Marital status		
Single	43	48.9
Married	45	51.1

Source: Field Data, July 2024

Sex

The gender distribution of the respondents, as indicated in Table 3, shows a notable gender disparity, with 61.4% of the respondents being male and 38.4% being female. This imbalance reflects broader gender dynamics within the teaching profession in Gicumbi District, potentially influenced by socio-cultural factors and historical patterns in employment.

Marital Status

The marital status distribution of the respondents, as outlined in Table 3, shows a relatively balanced split, with 48.9% being single and 51.1% being married. This near parity suggests a diverse range of personal responsibilities and social dynamics among the secondary school teachers in Gicumbi District. Married teachers, who slightly outnumber their single counterparts, might face different time management challenges and socio-economic pressures.

1. The Impact of the Digital Literacy Skills of Secondary School Teachers in Gicumbi District

Table 4 presents the findings on the effect of digital literacy skills of secondary school teachers in Gicumbi District. This table details how varying levels of digital literacy among teachers impact their ability to integrate ICT tools into their teaching practices, highlighting the relationship between digital skills and the effectiveness of ICT utilization in enhancing educational outcomes.

Table 3: Impact of the Digital Literacy Skills of Secondary School Teachers in Gicumbi District

Items	VH		H	
	N	%	N	%
Influences students' engagement in learning activities	53	60.2	35	39.8
Enable the teacher(s) to effectively integrate technology into instructional practices	9	10.2	79	89.8
Prepare the students for future academic and professional endeavors	54	61.4	34	38.6
Enable the teachers to adapt to teaching methods to accommodate diverse learning styles	18	20.5	70	79.5
Enable the creation of interactive and dynamic learning environments in the classroom	52	59.1	36	40.9

Source: Field data, July 2024

VH stands for Very Higher; H stands for Higher.

Influences Students' Engagement in Learning Activities

Table 4 reveals that 60.2% of respondents rate the effect of digital literacy skills on students' engagement in learning activities as "very high," while 39.8% rate it as "high." This indicates a strong positive correlation between teachers' digital literacy and their ability to foster student engagement. The majority perception of a "very high" impact suggests that well-developed digital skills among educators significantly enhance their capacity to create interactive and stimulating learning environments. This enhanced engagement is likely due to the integration of various ICT tools and resources that make learning more dynamic and relevant to students. Conversely, the 39.8% who rated the effect as "high" still recognize the substantial benefits of digital literacy, though perhaps to a slightly lesser extent. These findings underscore the critical role of digital literacy in modern education, aligning with literature that emphasizes the transformative potential of ICT in increasing student motivation and participation (Hattie, 2009; Zhang *et al*., 2018). Effective use of digital tools not only supports diverse learning styles but also facilitates more personalized and engaging educational experiences (Ertmer & Ottenbreit-Leftwich, 2010).

Enable the Teacher(s) to Effectively Integrate Technology into Instructional Practices

Table 4 indicates that 10.2% of respondents believe that digital literacy skills enable teachers to integrate technology into instructional practices at a "very high" level, while a substantial 89.8% rate this integration as "high." This data highlights a broad consensus on the positive impact of digital literacy on the effective incorporation of technology in teaching. The relatively small proportion of respondents rating it as "very high" suggests that while digital literacy significantly enhances technological integration, there may be limitations or areas where further improvement is needed. This indicates that a majority of teachers recognize substantial benefits from their digital skills in applying technology to instructional methods, which likely leads to more dynamic and effective teaching practices. The high rating reflects the effectiveness of the CADIE Project's training programs in equipping teachers with the necessary skills to leverage technology in their classrooms. This finding is consistent with research emphasizing the importance of digital literacy in enhancing educational practices and supporting the effective use of ICT tools in teaching (Koehler & Mishra, 2009; Tondeur *et al*., 2012). The substantial agreement on the positive impact of digital literacy underscores its critical role in modernizing instructional practices and improving educational outcomes.

Prepare the Students for Future Academic and Professional Endeavors

Table 4 reveals that 61.4% of respondents perceive the impact of digital literacy skills on preparing students for future academic and professional endeavors as "very high," while 38.4% rate it as "high." This distribution indicates a strong belief among teachers in Gicumbi District that digital literacy is crucial for equipping students with the skills needed for success beyond secondary education. The significant proportion rating the effect as "very high" suggests that educators view digital

literacy as a critical component in developing students' future readiness, reflecting the transformative potential of ICT in shaping students' competencies for higher education and the workforce. The high ratings across both categories underscore a consensus on the value of integrating digital skills into the curriculum to foster essential 21st-century skills such as critical thinking, problem-solving, and digital fluency. This perception aligns with the literature, which highlights that digital literacy is instrumental in preparing students for a rapidly evolving digital landscape, enhancing their ability to navigate future academic and professional challenges (Johnson *et al*., 2016; Ng, 2012). These findings suggest that digital literacy is not only seen as a means of improving current academic performance but also as a foundational element for long-term success in a digital world.

Enable the Teachers to Adapt to Teaching Methods to Accommodate Diverse Learning Styles

Table 4 illustrates that 20.5% of respondents consider the impact of digital literacy skills on teachers' ability to adapt their teaching methods to accommodate diverse learning styles as "very high," while 79.5% rate it as "high." This distribution reveals a notable consensus among secondary school teachers in Gicumbi District on the significant role of digital literacy in enhancing instructional adaptability. The majority rating it as "high" indicates a strong recognition of digital literacy's effectiveness in enabling teachers to diversify their pedagogical approaches, thus better addressing varied student needs and learning preferences. However, the relatively smaller proportion of respondents rating it as "very high" suggests that while digital literacy substantially improves instructional adaptability, there may still be challenges or limitations in fully realizing its potential. This pattern underscores the importance of continuous professional development and support to optimize the use of digital tools for personalized learning. The findings highlight that while digital literacy is crucial for accommodating diverse learning styles, further enhancements in training and resources may be necessary to fully leverage this capability in educational settings.

Enable the Creation of Interactive and Dynamic Learning Environments in the Classroom

Table 4 demonstrates that 59.1% of respondents believe digital literacy skills significantly enable the creation of interactive and dynamic learning environments in the classroom, rating this effect as "very high," while 40.9% rate it as "high." This distribution underscores a robust acknowledgment of digital literacy's pivotal role in enhancing the interactivity and dynamism of classroom settings. The substantial majority rating it as "very high" indicates a strong perception that digital skills enable teachers to leverage technology effectively to foster engaging and participatory learning experiences. This perception aligns with the broader educational literature, which emphasizes that the integration of digital tools can transform traditional teaching methods by making learning more interactive and responsive to students' needs (Hattie, 2009; Martin *et al*., 2019). The high ratings reflect the positive impact of digital literacy on improving student engagement and interaction, which is critical for developing a more engaging and effective learning environment. However, the 40.9% who rated it as "high" also suggest that while digital literacy is influential, there may still be room for enhancement in fully realizing its potential to create dynamic learning experiences.

The Role of the CADIE Project on the Integration of ICT Tools into the Teaching Methodologies of Secondary School Educators in Gicumbi District

Section 4 explores the role of the CADIE Project in facilitating the integration of ICT tools into the teaching methodologies of secondary school educators in Gicumbi District. Table 5 presents the findings on how the CADIE Project has influenced the adoption and utilization of ICT tools by teachers, reflecting the project's impact on modernizing teaching practices and enhancing educational delivery.

Table 4: The Role of the CADIE Project on the Integration of ICT Tools into the Teaching Methodologies of Secondary School Educators in Gicumbi District

Items	VH		H		M		L		VL	
	N	%	N	%	N	%	N	%	N	%
Influenced educators to integrate ICT tools into teaching methods.	45	51.1	43	48.9	-	-	-	-	-	-
Provides effective training for educators to use ICT tools in teaching.	52	59.1	36	40.9	-	-	-	-	-	-
Educators feel more confident in using ICT tools for teaching	43	48.9	18	20.5	9	10.2	18	20.5	-	-
Encouraged educators to innovate with ICT tools in teaching.	16	18.2	18	20.5	-	-	45	51.1	9	10.2
Increased the use of ICT tools in day-to-day teaching practices.	52	59.1	36	40.9	-	-	-	-	-	-

Increased collaboration among students through ICT-enabled activities.	72	81.8	16	18.2	-	-	-	-	-	-	

Source: Field data, July 2024

VH stands for Very Higher, H stands for Higher, M stands for Moderate, L stands for Lower while VL stands for Very Lower.

Table 5 indicates that the majority of respondents perceive the CADIE Project as having a significant impact on the integration of ICT tools into teaching methodologies. Specifically, 51.1% of respondents rate this influence as "very high," while 48.9% rate it as "high." This distribution reflects a strong consensus on the CADIE Project's effectiveness in encouraging educators to adopt ICT tools in their teaching practices. The near-even split between those rating the influence as "very high" and those rating it as "high" underscores the project's substantial role in promoting technological integration, while also suggesting areas for further improvement. This indicates that while a majority of educators recognize and appreciate the CADIE Project's role in enhancing their teaching methods through ICT, there may be varying degrees of implementation success or additional support needed to fully realize the project's goals. The findings align with existing literature on the impact of targeted ICT initiatives on educational practices. Research highlights that projects like CADIE, which provide comprehensive training and support, significantly enhance educators' ability to integrate technology into their teaching (Harris *et al*., 2010; Tondeur *et al*., 2012). Effective integration of ICT tools has been shown to improve teaching methodologies by making learning more interactive and engaging, which can lead to better educational outcomes (Ertmer & Ottenbreit-Leftwich, 2010).

Educators Feel More Confident in Using ICT Tools for Teaching

Table 5 indicates that 48.9% of respondents feel "very confident" in using ICT tools for teaching as a result of the CADIE Project, while 20.5% feel "confident," and 10.2% and 20.5% rate their confidence as "moderate" and "low," respectively. This distribution reveals that nearly half of the educators surveyed have achieved a high level of confidence in their ICT skills due to the project, reflecting its effectiveness in enhancing their technological competence. The considerable proportion who rated their confidence as "very high" underscores a significant positive outcome of the CADIE Project in building educators' self-efficacy with ICT tools. However, the presence of 30.7% of respondents who rated their confidence as "moderate" or "low" highlights that there are still challenges to be addressed. These mixed levels of confidence suggest variability in the effectiveness of the training and support provided by the CADIE Project, pointing to the need for ongoing professional development and tailored support to address individual educators' needs.

The literature supports these findings, emphasizing that confidence in using ICT tools is crucial for successful technology integration in teaching (Ertmer & Ottenbreit-Leftwich, 2010; Tondeur *et al*., 2012). Effective training programs are known to significantly improve teachers' confidence and competency in technology use, which in turn enhances their instructional practices (Harris *et al*., 2010).

Encouraged Educators to Innovate with ICT Tools in Teaching

Table 5 reveals a notable disparity in educators' perceptions of the CADIE Project's effectiveness in encouraging innovation with ICT tools. Specifically, only 18.2% of respondents rate this encouragement as "very high," and 20.5% rate it as "high," while a significant majority, 51.1%, rate it as "low," and 10.2% rate it as "very low." This distribution indicates that although a minority of educators perceive strong support for innovation through the project, the majority feels that the CADIE Project has had a limited impact in fostering innovative practices with ICT tools. The predominance of lower ratings suggests that the project's support for creative application of technology might not be as robust or effective as intended, potentially highlighting gaps in the training or resources provided.

These findings are consistent with literature that suggests while ICT training programs often succeed in improving basic technological skills, they may struggle to inspire sustained innovation among educators (Ertmer & Ottenbreit-Leftwich, 2010; Tondeur *et al*., 2012). Effective programs typically need to go beyond basic training to include elements that actively promote and support pedagogical innovation (Harris *et al*., 2010).

Increased the Use of ICT Tools in Day-to-Day Teaching Practices

Table 5 indicates a strong positive assessment of the CADIE Project's impact on increasing the use of ICT tools in daily teaching practices. Specifically, 59.1% of respondents rated this increase as "very high," and an additional 40.9% rated it as "high." This overwhelming majority signifies that the CADIE Project has been highly effective in promoting the adoption and utilization of ICT tools among secondary school educators. The high ratings suggest that the project has successfully addressed barriers to ICT integration, such as lack of resources or training, and has significantly enhanced the frequency with which educators incorporate technology into their instructional routines.

This widespread use of ICT tools likely contributes to more dynamic and interactive learning environments, reflecting a major achievement of the CADIE Project. These findings align with the broader literature on effective technology integration in education, which underscores the importance of targeted interventions in increasing technology use (Harris, Mishra, & Koehler, 2010; Tondeur *et al*., 2012). Effective ICT training programs are known to significantly enhance teachers' ability to

incorporate technology into their teaching practices, resulting in more frequent and innovative use of digital tools (Ertmer & Ottenbreit-Leftwich, 2010).

3. The Contribution of the CADIE Project on Student Learning in Secondary Schools in Gicumbi District

Table 6 presents an in-depth analysis of the influence of the CADIE Project on student learning within secondary schools in Gicumbi District. The findings captured in this table explore various dimensions of how the project has impacted educational outcomes and student engagement through its ICT integration efforts.

Table 5: The Ccontribution of the CADIE Project on Student Learning in Secondary Schools in Gicumbi District

Items	VH		H	
Enhanced students' digital literacy skills.	27	30.7	61	69.3
Improved students' ability to collaborate and communicate using ICT tools.	43	48.9	45	51.1
Students feel more prepared for future academic and professional endeavors	35	39.8	53	60.2
Increased student engagement and participation in classroom activities.	44	50	44	50
Made learning more enjoyable and interactive.	43	48.9	45	51.1
Influenced students' critical thinking and problem-solving skills.	36	40.9	52	59.1
Feel empowered to explore and innovate using ICT tools	52	59.1	36	40.9
Develop a greater appreciation for technology's role in their education.	61	69.3	27	30.7

Source: Field data, July 2024

VH stands for Very Higher, H stands for Higher.

Enhance Students' Digital Literacy Skills

Table 6 reveals that the CADIE Project has significantly influenced students' digital literacy skills in secondary schools within Gicumbi District. Specifically, 69.3% of respondents rated this enhancement as "high," and 30.7% rated it as "very high." This distribution indicates a strong positive impact, with a majority of educators acknowledging substantial improvements in students' ability to navigate and utilize digital tools effectively. The predominance of high ratings suggests that the project has been successful in advancing students' digital literacy, which is crucial for their academic and future professional endeavors.
This finding is consistent with existing literature that emphasizes the importance of ICT initiatives in developing digital literacy skills among students. Effective ICT programs have been shown to enhance students' technological competencies and prepare them for the demands of the modern digital landscape (Voogt & Roblin, 2012; Ertmer & Ottenbreit-Leftwich, 2010).

Improved Students' Ability to Collaborate and Communicate Using ICT Tools

Table 6 indicates that the CADIE Project has significantly improved students' ability to collaborate and communicate using ICT tools in secondary schools within Gicumbi District. Notably, 48.9% of respondents rated this improvement as "very high," and 51.1% rated it as "high." This majority suggests a strong positive impact of the project on enhancing students' collaborative and communicative skills through ICT, reflecting an effective integration of technology in fostering essential 21st-century skills. The near-universal endorsement of the project's effectiveness in this domain underscores its success in equipping students with valuable skills necessary for both academic and professional settings. These findings align with contemporary literature emphasizing the role of ICT in enhancing collaborative and communicative competencies. Recent studies highlight how technology integration in education promotes collaborative learning environments, enabling students to work together more effectively and communicate more proficiently (Harris & Hofer, 2015; Trucano, 2017). These improvements are crucial as collaboration and communication are fundamental skills for academic success and future career opportunities.

Students Feel More Prepared for Future Academic and Professional Endeavors

Table 6 demonstrates that the CADIE Project has had a notable impact on how well students feel prepared for future academic and professional endeavors in secondary schools within Gicumbi District. According to the findings, 60.2% of respondents rated this aspect as "high," and 39.8% rated it as "very high." This near-universal positive assessment indicates that the project has been effective in equipping students with skills and confidence necessary for their future pursuits. The strong endorsement suggests that the CADIE Project has successfully aligned its ICT integration strategies with the needs of students, preparing them to face academic and professional challenges with greater assurance.
This result is consistent with recent literature that underscores the significance of ICT in preparing students for future success. Studies have shown that integrating technology into education enhances students' readiness for higher education and the

workforce by developing critical skills such as digital literacy and problem-solving (Kozma, 2017; Zheng *et al*., 2016). The CADIE Project's focus on enhancing ICT skills thus contributes significantly to students' preparedness.

Increased Student Engagement and Participation in Classroom Activities

Table 6 reveals that the CADIE Project has had a significant effect on increasing student engagement and participation in classroom activities within secondary schools in Gicumbi District. Specifically, 50% of respondents rated this influence as "very high," while the remaining 50% rated it as "high." This balanced distribution of ratings indicates that the project has effectively fostered a more engaging and participatory learning environment, with a clear majority of educators acknowledging its positive impact. The equal split in ratings suggests that while the project has been broadly successful in enhancing student involvement, there may be varying degrees of effectiveness across different schools or contexts.

This finding aligns with existing literature that highlights the role of ICT in boosting student engagement and participation. Research consistently shows that technology-enhanced learning environments can lead to higher levels of student interaction and motivation by making learning activities more dynamic and interactive (Wang *et al*., 2015; Chen & Bryer, 2018). The CADIE Project's emphasis on integrating ICT tools appears to have created a more stimulating educational experience for students, thereby increasing their engagement.

Made Learning More Enjoyable and Interactive

Table 6 illustrates that the CADIE Project has been influential in making learning more enjoyable and interactive for students in secondary schools within Gicumbi District. The findings reveal that 51.1% of respondents rated this impact as "high," while 48.9% rated it as "very high." This nearly even split underscores a strong consensus among educators that the project has effectively enhanced the learning experience by incorporating ICT tools, thereby fostering a more engaging and enjoyable educational environment. The high percentage of "very high" ratings indicates a particularly strong positive reception, while the remaining respondents still acknowledge significant improvements in the interactivity and enjoyment of learning.

This result is consistent with literature emphasizing the benefits of ICT in creating dynamic and engaging learning environments. Research has shown that integrating technology into education not only increases student engagement but also makes learning activities more enjoyable and interactive, leading to better academic outcomes and student satisfaction (Hsu *et al*., 2017; Lai & Hwang, 2015). The CADIE Project's approach aligns with these findings by leveraging technology to enhance the learning experience.

Influenced Students' Critical Thinking and Problem-Solving Skills

Table 6 reveals that the CADIE Project has had a significant impact on enhancing students' critical thinking and problem-solving skills in secondary schools in Gicumbi District. Specifically, 59.1% of respondents rated this influence as "higher," while 40.9% rated it as "very higher." This distribution indicates a broad consensus among educators that the project has substantially contributed to the development of these crucial cognitive skills through the integration of ICT tools into the curriculum. The predominance of "higher" ratings underscores the project's effectiveness in fostering these skills, which are essential for academic success and future professional endeavors.

This finding is supported by existing literature, which highlights the positive effects of ICT on cognitive skills development. Studies have shown that technology-enhanced learning environments can significantly improve students' abilities in critical thinking and problem-solving by providing interactive and diverse learning experiences (Huang *et al*., 2016; Li & Ma, 2018). For instance, Huang *et al*. (2016) found that students who engaged with technology-rich educational tools exhibited enhanced problem-solving abilities and critical thinking skills.

Feel Empowered to Explore and Innovate Using ICT Tools

Table 6 indicates that the CADIE Project has significantly empowered students in secondary schools in Gicumbi District to explore and innovate using ICT tools. Notably, 59.1% of the respondents rated this influence as "very higher," while 40.9% rated it as "higher." This majority reflects a robust perception that the project has effectively enhanced students' abilities to engage with and utilize ICT tools creatively and independently. The high ratings suggest that the integration of these technologies has facilitated an environment where students feel confident and motivated to explore new ideas and solutions.

This finding aligns with existing literature on the impact of ICT in education, which underscores the role of technology in fostering creativity and innovation among students. Research has demonstrated that exposure to ICT tools can significantly boost students' self-efficacy in exploring and experimenting with new technologies (Hsieh *et al*., 2018; Tondeur *et al*., 2017). For instance, Hsieh *et al*. (2018) found that students who regularly used ICT tools reported increased confidence in their ability to use technology innovatively.

Develop a Greater Appreciation for Technology's Role in Their Education

Table 6 reveals that the CADIE Project has significantly fostered a greater appreciation for technology's role in education among students in secondary schools in Gicumbi District. A substantial majority of respondents, 69.3%, rated this influence as "very higher," while 30.7% rated it as "higher." This distribution indicates that the majority of students have developed a strong recognition of the value of technology in their educational experience. This result suggests that the project's efforts to integrate technology into the learning process have not only provided students with practical skills but also enhanced their understanding of technology's broader educational benefits.

The findings are consistent with literature emphasizing the positive impact of technology on students' attitudes towards learning. Studies have demonstrated that technology integration in education can increase students' engagement and appreciation for the learning process (Hernandez & De La Fuente, 2016; Koehler & Mishra, 2015). Hernandez and De La Fuente (2016) found that students exposed to technology in educational settings often develop a more profound appreciation for its role, which can lead to enhanced motivation and learning outcomes.

The Challenges Faced by Secondary School Teachers in Implementing ICT-Enhanced Teaching Methods after Participating in the CADIE Project in Gicumbi District

Table 7 presents the findings on the challenges faced by secondary school teachers in implementing ICT-enhanced teaching methods after participating in the CADIE Project in Gicumbi District.

Table 6: The challenges

Items	VH		H		M		L		VL	
					N	%	N	%	N	%
Limited access to technology resources.	36	40.9	36	40.9	-	-	16	18.2	-	-
Short periods of time of the training	8	9.1	72	81.8	-	-	-	-	8	9.1
Difficulties in quickly integrating the ICT in their teaching methodology effectively	27	30.7	27	30.7	18	20.5	16	18.2	-	-
Technical issues and troubleshooting when using ICT tools in the classroom.	52	59.1	36	40.9	-	-	-	-	-	-
Infrastructure limitations	88	100	-	-	-	-	-	-	-	-

Source: Field data, July 2024

VH stands for Very Higher, H stands for Higher, M stands for Moderate, L stands for Lower while VL stands for Very Lower.

Limited Access to Technology Resources

Table 7 highlights the challenge of limited access to technology resources as reported by secondary school teachers in Gicumbi District after their participation in the CADIE Project. Specifically, 40.9% of the respondents rated this challenge as very high, another 40.9% rated it as high, while 18.2% rated it as lower. This indicates a significant perception of technology resource limitations among a substantial proportion of teachers. The high ratings suggest that despite the CADIE Project's efforts to enhance ICT integration, the availability and accessibility of technological tools and resources remain substantial barriers. These constraints might affect the teachers' ability to fully leverage the ICT training provided, ultimately impacting their capacity to implement ICT-enhanced teaching methods effectively (UNESCO, 2016; Chigona & Chigona, 2015). Limited access to resources could include issues such as inadequate hardware, insufficient software, or lack of reliable internet connectivity, which collectively hinder the practical application of digital tools in the classroom (Krumsvik, 2018; Johnson *et al.*, 2016).

Short Periods of Time of the Training

Table 7 reveals that a significant proportion of secondary school teachers in Gicumbi District view the short duration of training provided by the CADIE Project as a notable challenge. Specifically, 81.8% of the respondents rated the short periods of training as a major issue, with 9.1% rating it very high and another 9.1% rating it as very low. This distribution indicates a widespread concern regarding the adequacy of the training duration.

The overwhelming majority's assessment underscores a perceived inadequacy in the depth and duration of the training, which could be insufficient to fully equip educators with the comprehensive skills required for effective ICT integration. Short

training periods may lead to superficial understanding and limited practical application, potentially hampering the effective integration of ICT tools into teaching practices (Hennessy *et al*., 2015; Ertmer & Ottenbreit-Leftwich, 2015). This concern aligns with literature suggesting that prolonged and in-depth training is crucial for meaningful technology integration and sustained pedagogical change (Mouza *et al*., 2016; Kivunja, 2015).

Difficulties in Quickly Integrating the ICT in Their Teaching Methodology Effectively

Table 7 highlights that difficulties in quickly integrating ICT into teaching methodologies are perceived as a significant challenge by a substantial proportion of secondary school teachers in Gicumbi District. Specifically, 30.7% of respondents rated this challenge as very high, with an equal percentage rating it as high. Additionally, 20.5% rated it as moderate, while 18.2% rated it lower. This distribution indicates that a notable portion of educators struggles with the swift integration of ICT tools into their pedagogical practices, reflecting concerns about the adaptability of these tools within existing teaching frameworks. The equal distribution of responses between very high and high ratings suggests that these difficulties are prevalent and potentially impactful. The complexity of integrating new technologies rapidly often leads to inconsistent implementation and diminished effectiveness, affecting overall educational outcomes (Bennett *et al*., 2018; Wastiau *et al*., 2015). This challenge is corroborated by literature indicating that rapid technology integration can overwhelm educators, particularly if they lack adequate support and resources (Davis *et al*., 2018; Tondeur *et al*., 2017).

Technical Issues and Troubleshooting When Using ICT Tools in the Classroom

Table 7 reveals that technical issues and troubleshooting during ICT tool usage in the classroom are perceived as a significant challenge by the majority of secondary school teachers in Gicumbi District. Specifically, 59.1% of respondents rated this challenge as very high, and an additional 40.9% rated it as high. This high proportion indicates that technical difficulties are a pervasive problem, potentially hindering the effective use of ICT tools in educational settings. The prevalence of this challenge underscores the importance of robust technical support and proactive maintenance strategies to mitigate disruptions in the teaching process. Such issues often detract from instructional time and can lead to frustration among educators, thereby impacting the overall quality of teaching and learning (Hew & Brush, 2015; Ertmer & Ottenbreit-Leftwich, 2016). This concern aligns with the literature highlighting that inadequate technical support is a barrier to effective ICT integration, emphasizing the need for comprehensive support systems and training for educators (Ertmer, 2019; Murphy & Faris, 2016).

Infrastructure Limitations

Table 7 illustrates a critical challenge faced by secondary school teachers in Gicumbi District regarding the implementation of ICT-enhanced teaching methods: infrastructure limitations. Notably, 100% of respondents rated infrastructure limitations as a very high challenge. This unanimous consensus highlights that inadequate physical infrastructure—such as insufficient hardware, unreliable internet connectivity, and inadequate classroom facilities—is a substantial barrier to the effective integration of ICT tools in education. This finding underscores a pervasive issue that directly impacts the ability of educators to utilize ICT tools effectively. The literature consistently supports this view, indicating that without appropriate infrastructure, the benefits of ICT in education are severely undermined (Hennessy, 2016; To, 2019).

Schools with inadequate infrastructure struggle to provide consistent and reliable access to technology, which impedes both teaching and learning processes (Lai & Bower, 2019). This infrastructure gap often leads to uneven implementation and utilization of ICT resources, contributing to the digital divide and affecting educational equity.

v. Conclusion

This study conducted under the title, Capacity Development for ICT in Education (CADIE) Project and Teaching and Learning in Gicumbi District, A Case Study of Secondary Schools in Gicumbi District. The study focused on three schools namely, Notre Dame du Bon Conseil, TTC dela sale Byumba and Groupe Scholaire Epa Catholique. The study objectives are: firstly, to evaluate the effect of the digital literacy skills of secondary school teachers in Gicumbi District. Secondly to assess the role of the CADIE Project on the integration of ICT tools into the teaching methodologies of secondary school educators in Gicumbi District. Thirdly to analyze the influence of the CADIE Project on student learning in secondary schools in Gicumbi District, fourthly is to identify the challenges faced by secondary school teachers in implementing ICT-enhanced teaching methods after participating in the CADIE Project in Gicumbi District.

On the effect of digital literacy skills on secondary school teachers in the Gicumbi District, the study reveal the following effects: digital literacy influences students' engagement in learning activities, it enable the teacher(s) to effectively integrate technology into instructional practices and also it prepare the students for future academic and professional endeavors. Furthermore, the study reveal that. Digital literacy enable the teachers to adapt to teaching methods to accommodate diverse learning styles and also enable the creation of interactive and dynamic learning environments in the classroom.

On the role of the CADIE Project in the integration of ICT tools into the teaching methodologies of secondary school educators in the Gicumbi District, the study reveal that: CADIE project influenced educators to integrate ICT tools into teaching methods, it provides effective training for educators to use ICT tools in teaching and also it make the educators feel more

confident in using ICT tools for teaching. Additionally, CADIE project increased the use of ICT tools in day-to-day teaching practices as well as increased collaboration among students through ICT-enabled activities.

Regarding the influence of the CADIE Project on student learning outcomes in secondary schools in the Gicumbi District, the study find out the following, it enhanced students' digital literacy skills, improved students' ability to collaborate and communicate using ICT tools, make students feel more prepared for future academic and professional endeavors and it increased student engagement and participation in classroom activities. Additionally, it made learning more enjoyable and interactive, influenced students' critical thinking and problem-solving skills, feel empowered to explore and innovate using ICT tools and finally, develop a greater appreciation for technology's role in their education.

Lastly the study finds the challenges faced by secondary school teachers in Gicumbi District in implementing ICT-enhanced teaching methods after participating in the CADIE Project which follows: Limited access to technology resources, Short periods of time of the training, and Difficulties in quickly integrating the ICT in their teaching methodology effectively. Study also reveal that technical issues and troubleshooting when using ICT tools in the classroom and Infrastructure limitations are also the challenges.

vi. References

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