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Influence of Principal's Communication Skills on the Development and Adoption of Green Technologies in Secondary Schools in Kiambu County, Kenya

Authors: [1]Patrick Wakaba Mathu**,** [2]Momanyi Marcella and [3]Celestine Ndanu Mwaniki
[1,2&3]The Catholic University of Eastern Africa. **Website.** www.cuea.edu
Correspondence: Patrick Wakaba Mathu. **E-mail:** pmathu2012@gmail.com

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Abstract: *This study aimed at determining the influence of school principals' communication skills on the adoption and development of green technologies in public secondary schools in Kiambu County, Kenya. The research questions addressed was how do principal's communication skills influence the development and adoption of green technologies in secondary schools in Kiambu County, Kenya? Grounded in Transformational Leadership Theory, the study used a mixed-methods approach with a convergent parallel design, combining cross-sectional survey and phenomenology. The target population was 292 public secondary schools, 292 principals, 6074 teachers, and 359,860 students, 16 sub-county directors and one county director from the Ministry of Education in Kiambu County. A sample of 167 principals, 181 teachers, 192 students, and 17 directors was selected using stratified random and multistage sampling. Data were collected via questionnaires, interviews, and focus group discussions. SPSS software version 2023 was used for quantitative data analysis, while qualitative data were analysed through content analysis. The study findings revealed that green technology adoption is limited, with water harvesting and energy-efficient jikos being the most common. Principals demonstrated moderate communication skills. Results further showed a significant and positive (β2=0.444, p=0.000) influence of principals' communication on green technology development and adoption secondary schools in Kiambu County, Kenya. The study further concludes that principal's communication has a positive and significant influence on the the development and adoption of green technologies in public secondary schools in Kiambu County, Kenya. Recommendations includes communication training, regular updates and feedback mechanisms develop comprehensive communication plans, monitor and evaluate communication efforts and utilize diverse communication channels to enhance principal communication skill on green technologies.*

Key words: *Communication Skills, Development, Adoption, Green Technologies, Schools*

1.1 Background of the Study

It is crucial for educational leaders to recognize that their institutions can play a pivotal role in not only fostering eco-consciousness among students but also in driving positive environmental change on a larger scale, making schools integral hubs for sustainable development in their respective communities (Desfandi, Maryani & Disman 2016). This is also consistent with the seventh global Sustainable Development Goal (SDG), which aims to guarantee universal access to sustainable reliable, affordable energy. Equally pertinent is SDGs 13, 14, and 15 stress climate action, marine conservation, and land

sustainability, respectively. Incorporating these goals into school leadership and green technology adoption will enhances environmental stewardship in education (UN, 2015).

Organizations often leverage green technologies in order to achieve their sustainability goals (Abid, Ceci, Ahmad & Aftab, 2022). Green Technologies refer to initiatives such as renewable energy sources, paperless technologies, and recycling, waste reduction strategies, water harvesting and eco-friendly infrastructures which are meant to enhance sustainability (Pramanik et al., 2021). The development of new processes and systems under green process innovation involves the integration of cutting-edge technologies, including sustainable water management, closed-loop systems, sustainable energy solutions and processes that prioritize energy efficiency, (Awan, Arnold & Gölgeci, 2020). This symbiotic relationship enhances the adoption of green technologies, creating a cycle of continuous improvement in environmental practices within organizations. As a result, businesses gain a competitive advantage by reducing costs, improving brand reputation, and responding to governmental incentives, fostering a commitment to environmental stewardship (Awan, Arnold & Gölgeci, 2020).

Leadership communication refers to the process of conveying a vision, influencing others, and fostering collaboration through effective verbal and nonverbal interactions (Northouse, 2018). Effective leadership communication is essential in the success and growth of both leaders and organizations. Bergman (2020) contends that leaders must be adept communicators to achieve professional success. Leadership communication involves the systematic and meaningful sharing of information through excellent communication skills, encompassing both speaking and listening with understanding (Enyioko, 2021). Leaders who master the art of communication inspire their teams, foster better understanding, and instill shared values and principles (Pascoe, 2021). The communication process, involving strategy development, precise writing, and effective speaking, is crucial for navigating challenges and achieving organizational goals (Pascoe, 2021).

Transparent and persuasive communication by leaders fosters a culture of sustainability, acknowledging team efforts and reducing resistance to change (Hsu et al., 2019; Rajakaruna & Hettiarachchi, 2017). As Müller, Lude and Hancock (2020) leaders must embody the roles of an architect in designing sustainable educational practices, a change agent in driving the adoption of sustainable technologies, a coach in guiding others toward sustainable behaviors, a storyteller and meaning enabler in effectively conveying the importance of environmental stewardship. Leaders spend a substantial amount of their time engaging in various communication modes. Communication is not only about the delivery of information but also ensuring that the message is accepted, understood, and aligned with the intended purpose (Demirdag, 2022). Competent communicators possess a combination of knowledge, motivation, skills, and behavior, enabling them to use communicative resources effectively. Effective leadership communication goes beyond the transmission of messages; it involves respectful treatment of employees, influencing their behavior positively, and fostering organizational success (Pascoe, 2021). Transformational leaders, in particular, leverage effective communication strategies, including charisma, to motivate employees and drive appropriate organizational behavior (Minger, 2017). Leadership communication, therefore, becomes instrumental in raising awareness and addressing concerns, bridging the gap between organizational goals and public understanding. The success of sustainability efforts relies on how well leaders communicate, inform, and inspire action among employees and the public (Gunster, 2017).

1.2 Statement of the problem

According to UNESCO (2018), many schools in developing countries, including those in Kiambu County, face challenges such as energy inefficiency, high energy costs, unreliable power supply, and limited access to clean water and proper infrastructure. The lack of green technologies in schools exacerbates these issues, putting a strain on educational institutions and compromising the quality of students' learning experiences (Ondieki, 2022). This has raised concerns and complains among stakeholders, including students, teachers, parents and the broader community, who are alarmed by the increasing environmental and financial burdens. Studies by Rajakaruna and Hettiarachchi (2017), Ojo and Fauzi (2020), Kangeri (2021), and Korir, Ouma, and Oketch (2023) highlight the need for effective leadership to drive sustainable practices, but methodological limitations and geographical disparities limit their relevance to Kenya's socio-economic context. The high cost of running schools, environmental issues, lack of reliable power sources, water scarcity, and inadequate sanitation facilities as well as these gaps motivated this study. The study aimed to investigate the influence of principals' leadership competences on the development and adoption of green technologies in Kiambu's public secondary schools.

1.3 Research Questions

How do principal's communication skills influence the development and adoption of green technologies in secondary schools in Kiambu County, Kenya?

1.4 Research Hypothesis

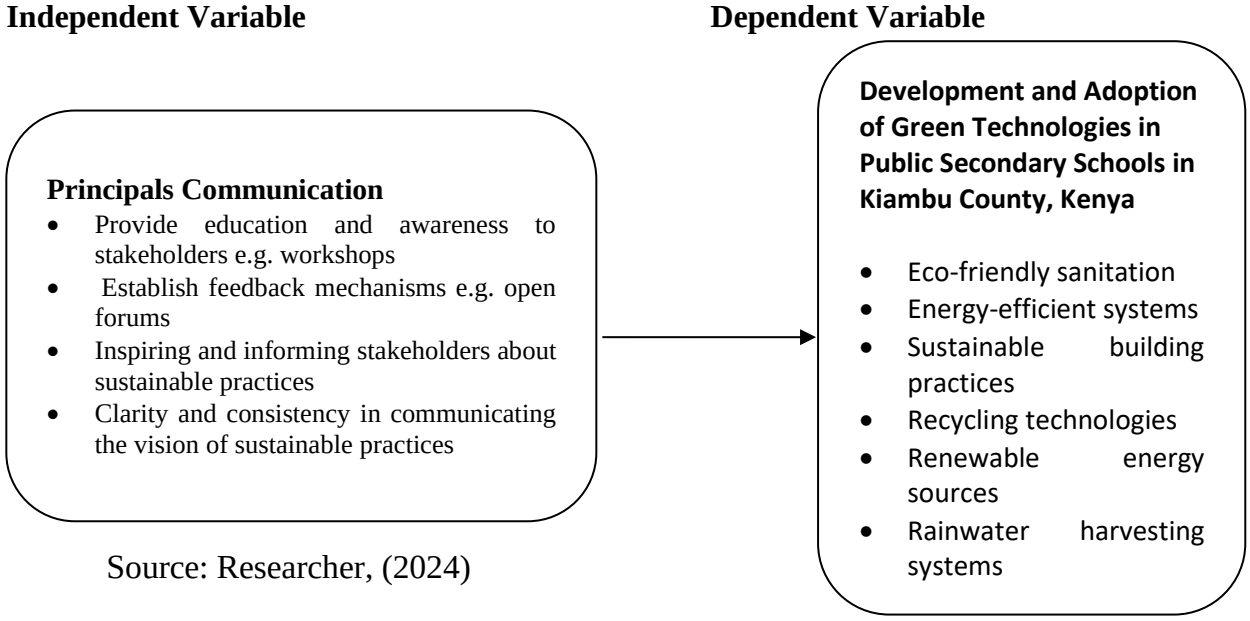
H_o: There is no statistically significant influence of principal's communication skills on the development and adoption of green technologies in public secondary schools in Kiambu County, Kenya.

1.5 Theoretical Framework

This study was anchored and informed by transformational leadership theory which was proposed by Burns MacGregor in the year 1978. The theory suggests that successful leaders energize and cheer their followers by crafting a compelling vision for the future and encouraging individuals to achieve their full potential, for the collective benefit of the organization. Transformational leaders can greatly influence organizational results by clearly expressing an inspiring vision, encouraging intellectual growth, offering personalized support, and acting as positive examples for their teams (Sun & Henderson, 2017). Transformational leadership focuses on inspiring leaders to foster creativity and introduce new ways of thinking to bring about profound changes, new course of growth and success for the organization (Bass, 1985). Principals exhibiting transformational qualities, such as visionary thinking, articulating a compelling vision of sustainability, individualized consideration and supporting staff, are pivotal in promoting green technologies initiatives. In the context of this study transformational leadership theory provides a useful lens for examining how principals' abilities to inspire, empower, and motivate stakeholders can facilitate development and adoption of green technologies by Kiambu County's public secondary schools.

1.6 Conceptual Framework

Figure 1 **The influence of Principals' Communication Skills on Development and Adoption of Green Technologies**



Source: Researcher, (2024)

Figure I illustrate the influence of the independent variable which entails principals' communication skills on how they influence adoption of green technologies in schools, which is the dependent variable. Renewable energy sources, recycling technologies, sustainable building practices, eco-friendly sanitation, energy-efficient systems, as well as rain water harvesting systems depend on principal's communication skills. The communication skills of school principals is vital in influencing the adoption of green technologies in schools. Principals who effectively inspire and inform stakeholders about sustainable practices create a culture of environmental awareness and action of members of the school community. Furthermore, providing feedback and ensuring clarity and consistency in communicating the vision of sustainable practices enhance stakeholders' understanding and commitment, thus facilitating the adoption of green technologies in the school.

1.7 Review of Related Literature

A study conducted by Darko, Chan, Ameyaw, He, et al. (2017) aimed to explore key issues influencing the adoption of GBTs in the United States. Employing a questionnaire survey with 33 green building experts, the researchers identified critical barriers, major drivers, and effective strategies for GBTs adoption. Questionnaires were subjected to both validity and reliability test. Resistance to change, higher costs and lack of knowledge were identified as significant barriers, while water and energy efficiency, along with company image, were major drivers. Notably, the study underscored the pivotal role of communication, so as ensures informed decision-making and maximizes the potential benefits while minimizing any associated risks of GBTs. The findings stressed that stakeholders armed with accurate information were more likely to adopt GBTs, highlighting the necessity for robust research, increased funding, and dedicated communication strategies to foster GBTs adoption. The study underscores the need for comprehensive communication, including research dissemination, national databases, and dedicated websites, to facilitate informed decision-making and promote adoption of green technologies (Darko et

al., 2017). However, the study focused on building experts in a developed country while this study focused on school principals in a developing country, Kenya.

Hoffstaedter (2020) conducted a study on external and internal communication for sustainable development at Gnosjö in Sweden. The aim was to analyze how communication influences sustainable development within the organization. The study utilized micro-ethnography methods, including participant observation and semi-structured interviews with Swedish employees at Gnosjö municipality. The study population was 900 employees in Gnosjö municipality but the study sample size consisted of only 45 employees in town hall of Gnosjö and other informants in the fields of communication and sustainability. Data were collected from the municipality's official documents and ongoing projects. Findings indicated that effective communication, particularly leadership communication, is crucial for implementing sustainability initiatives. Leaders are crucial in guiding and educating employees, warning the public about environmental dangers, and persuading stakeholders to adopt green technologies and practices. However, the study relied solely on interview and observation methods which might have introduced biases stemming from participants' subjectivity and researchers' interpretations, potentially compromising the objectivity of findings. The use of questionnaires in this study helped to close these gaps.

The study conducted by Khan, Saqib, Abbasi, Mikhaylov and Pinter (2023) aimed to explore the ties between green leadership, the dissemination of environmental knowledge, and sustainable outcomes in Pakistan's manufacturing sector. Using a quantitative approach, the research gathered insights from 257 employees in SMEs manufacturing enterprises in Pakistan. Data analysis was via partial least squares and structural equation modeling. The study revealed a strong positive impact of green leadership on the sharing of environmental knowledge, and it also highlighted a favorable link between knowledge sharing and the sustainable performance of firms. The study emphasized the importance of clear, visionary communication by leaders to drive the adoption of green technologies and boost sustainability initiatives within organizations. The research was centered on the manufacturing industry, which contrasts with the education sector, or specifically secondary schools that was the main focus of the present study.

A study conducted by Sidney, Wang, Nazir, Ferasso and Saeed (2022) aimed to explore the interplay between environmentally-focused transformational leadership, eco-friendly human resource practices, and the creative output of employees with respect to sustainability, and green process engagement in the context of electronic companies in Kinshasa, Congo. The research utilized a questionnaire survey method with a sample size of 150 employees from electronic companies and SmartPLS software was used for analysis. The study results indicated that green transformational leadership positively influence green process engagement, the employees' green creativity and green human resources management. Through inspirational motivation and cognitive stimulation, transformational leaders foster a conducive environment for employees to generate innovative ideas that align with environmental sustainability goals. However, the study focused on electronic companies which are different from education sector, specifically secondary schools which was the primary emphasis of this research.

Fegher (2023) study aimed to formulate a targeted communication strategy for climate change in Kenya, specifically addressing policymakers, the media, civil society organizations, and the general public. The research utilized a qualitative content analysis approach based on existing literature. The research results indicated the importance of clear and concise language in conveying information on climate change. The

communication strategy aimed to bridge the awareness and action gap so as to mitigate and adapt to sustainable practices, emphasizing the importance of connecting with people's values and interests. Never the less the study focused on communication strategy whiles our study will focus on leadership communication and how it influences adopting and development of green technologies by schools.

1.8 Research Methodology

The study used a mixed methodology approach specifically the convergent parallel design which according to Creswell & Plano (2022) involves simultaneous collection of qualitative and quantitative data, with equal emphasis on both methods. The study target population comprised of all 292 public secondary schools, 292 principals, 6074 teachers and 359,860 students of all public secondary schools in Kiambu County, Kenya. Furthermore, the study populations also included 15 sub-county directors and 1 county director all from the Ministry of Education in Kiambu County, Kenya. (TSC, 2024) The study used both probability and non-probability sampling method. The study determined the sample size of the schools, teachers, students and principals using Pagano and Gauvreau (2018) formula. The sample size was as follows; 167 schools, 167 principals, 362 teachers, 16 directors and 384 students. The study used different sampling methods for different target participants as they have different attributes as described in subsequent sections. Stratified random sampling was employed as the sampling method for schools, principals and teachers. To sample students that participated in a focus group discussion (FGDs), the study used multistage sampling. The study carried out a census of all 16 MOE county directorates since their population is small. The researcher adjusted the sample size of teachers and students with a factor of 2 due to the fact that their original sample size was big due to logistic constrains and they were not the main study participants. The final study sample size was 167 principals, 181 teachers, 192 students and 17 directors of MOE. Thus, the total sample size was 556 study participants. Sampling matrix is shown in table 1.

Table 1 ***Sample Matrix***

Type of Respondents	**Population**	**Sample Size**	**Adjusted Sample Size**	**Sampling Method**	**%**
Principals	292	167	167	Stratified random sampling	30.03%
Teachers	6074	362	181	Stratified random sampling	32.55%
Students	359,860	384	192	Multistage sampling	34.53%
MOE Directors	16	16	16	Census	
Total	**366,242**	**929**	**556**		**100%**

Source: *Field Data (2023)*

This study collected data using, questionnaire for principals and teachers, focus group discussion guide for students and interview guide for MOE directors, as well as document analysis guide. The researcher utilized mixed methods analysis by applying quantitative techniques to the quantitative data and qualitative techniques to the qualitative data. The qualitative data collected from interviews, FGDs and open-ended questions in questionnaires underwent a systematic analysis Creswell's six-step process (Creswell & Creswell, 2018). The quantitative data underwent simulation and was subsequently analyzed using Statistical Package for Social Sciences (SPSS Version 24). The collected data first was analyzed using descriptive statistics and also inferential analysis. The regression model was as follows.

$Y= \beta_{0+} \beta_{1,}X_1$…… ……Model I

Where

Y= Dependent variable (Development and Adoption of Green Technologies)

β_0 = Regression constant or Y intercept

$\beta_{1,2,3}$ = Coefficients of independent variable (principal' communication) to be estimated

$X_{1,}$= Independent variable (principal' communication)

ε = Stochastic error

1.9 Results and Findings

The study sought the influence of principal's communication skills in adopting green technologies by Kiambu County's public secondary schools. The study sought the opinion of different school stakeholders, which included school teachers, students, principals and MOE directors on the influence of principal's communication skills in adopting green technologies.

Influence of Principal's Communication Skills in Adopting and Developing Green Technologies in Secondary Schools

The study requested the school principals to specify their level of agreement with a number of statements regarding the influence of their communication skills on adoption of green technologies in public secondary schools. School principals were surveyed for their opinions using a 5 Likert scale as indicated in the questionnaire.

Table 2 ***School Principal Opinion the Influence of Principal's Communication on Development and Adoption of Green Technologies in Schools***

n=119

	VLE		LE		ME		GE		VGE		Mean	Std. Dev
	F	%	F	%	F	%	F	%	F	%		
I communicate the importance of green technologies to your staff	5	4.2	23	19.3	41	34.5	26	21.8	24	20.2	3.3445	1.13075
I provide clear and detailed information about the benefits of green technologies	5	4.2	32	26.9	42	35.3	23	19.3	17	14.3	3.1261	1.09355
I encourage open communication about green initiatives within the school	6	5.0	23	19.3	37	31.1	42	35.3	11	9.2	3.2437	1.03307
I address issues related to the adoption of green technologies	6	5.0	30	25.2	55	46.2	22	18.5	6	5.0	2.9328	.91810
I use various communication channels such as social media, school magazine etc. to promote green initiatives	43	36.1	30	25.2	28	23.5	12	10.1	6	5.0	2.2269	1.18920
I provide updates on green technology adoption progress in the school	26	21.8	40	33.6	36	30.3	12	10.1	5	4.2	2.4118	1.06891
I seek feedback from the school community on green initiatives	5	4.2	32	26.9	55	46.2	22	18.5	5	4.2	2.9160	.88853
I address resistance or concerns regarding the adoption of green technologies	30	25.2	32	26.9	36	30.3	14	11.8	7	5.9	2.4622	1.16292
I communicate the link between green technologies and academic success to the school community	7	5.9	39	32.8	45	37.8	14	11.8	14	11.8	2.9076	1.07350

Source: *Field Data (2024)*

Key: F=Frequency, VLE=Very Less Extent, LE=Less Extent, ME=Moderate Extent, GE=Great Extent, VGE=Very Great Extent

Table 2 shows that the highest percentage of principals, 46.2%, reported addressing issues related to green technology adoption to a moderate extent, while 36.1% indicated that they use various communication channels like social media and school magazines to promote green initiatives to no extent. Additionally, 37.8% of the respondents moderately communicated the link between green technologies and academic success, and 34.5% communicated the importance of green technologies to their staff to a moderate extent. The study results further shows the standard deviations, ranging from approximately 0.89 to 1.19, suggest a moderate variability in the school principals' responses, indicating differences in the level of agreement regarding the influence of their communication on the adoption of green technologies. Other percentages and details are available in the table provided.

Table 2 also shows that the school principals to a moderate extent agreed with the statements that they communicate the importance of green technologies to their staff; they encouraged open communication about green initiatives within the school; they provided clear and detailed information about the benefits of green technologies; they addressed issues related to the adoption of green technologies; they sought feedback from the school community on green initiatives. The school principals to a less extent agreed

with the statements that they address resistance or concerns regarding the adoption of green technologies; they provide updates on green technology adoption progress in the school, they use various communication channels such as social media, school magazine etc. to promote green initiatives.

These findings indicate that school principals in Kiambu County's public secondary schools exhibited moderate levels of communication skills regarding green technologies. The moderate engagement in key communication areas implies a lukewarm approach to green technologies, which may hinder the full-scale development and adoption of such initiatives within the schools. While the lower level of engagement suggests that principals may not be fully leveraging all available communication strategies to foster a more inclusive and comprehensive adoption of green technologies. The less frequent use of various communication channels and insufficient efforts to update and involve the school community may contribute to the observed low level of green technology adoption in Kiambu County's secondary schools. This lack of robust communication and engagement can be a significant barrier, indicating a need for improved strategies to enhance the development of green technologies in these educational institutions.

The study's findings showed that school principals in Kiambu County exhibit moderate levels of communication regarding green technologies in line with Hoffstaedter (2020), who emphasized the crucial role of leadership communication in implementing sustainability initiatives but noted that many leaders fall short in effectively disseminating information. Additionally, this study’s results reflect the barriers identified by Darko et al. (2017), who highlighted that insufficient communication and lack of knowledge significantly impede the adoption of green technologies, suggesting that more comprehensive and targeted communication strategies are necessary for successful implementation. Thus, effective communication was seen as crucial for fostering a positive attitude and encouraging the incorporation of echo-friendly technologies in schools. The study concurs with Desfandi and Maryani (2016) who also revealed that school principals' leadership, including their commitment to environmental issues and ability to effectively communicate the eco school program's goals, it’s important in the program's success by motivating and modeling eco-friendly attitudes and behaviors for all school members.

Teachers' Responses on various Aspect of Principal's Communication Skills

The study sought to establish teachers' responses on various aspect of principal's communication skills. The study findings are presented in table 3.

Table 3 *Teachers' Responses on various Aspect of Principal's Communication Skills*

n=162

Teachers' Responses on various Aspect of Principal's Communication Skills	**Frequency**	**Percent**
Principal's Discuss Sustainability Practices and Green Technologies During Staff Meetings or Other School Sessions		
Very frequently	9	5.55%
Frequently	19	11.72%
Occasionally	84	51.85%
Rarely	44	27.16%
Never	6	3.70%
Total	**162**	**100%**
Teachers' Perception on Effectiveness of Principals in Communicating the Benefits of Green Technologies to The Staff		
Very effectively	10	6.17%
Effectively	27	16.67%
Moderately effectively	80	49.38%
Not very effectively	39	24.07%
Not effectively at all	6	3.70%
Total	**162**	**100%**
Teachers Opinion on Whether Principal Seeking Feedback from Teachers Regarding the Implementation of Green Technologies		
Very often	2	1.23%
Often	35	21.60%
Occasionally	92	56.79%
Rarely	33	20.37%
Never	0	0.00%
Total	**162**	**100%**
Teachers Opinion on the Principal's Responsiveness to Issues on Implementation of Green Technologies		
Very responsive	2	1.23%
Responsive	44	27.16%
Moderately responsive	92	56.79%
Slightly responsive	24	14.81%
Not responsive at all	0	0.00%
Total	**162**	**100%**

Source: *Field Data (2024)*

The teachers rated their school principals on how often they discussed sustainability practices and green technologies during staff meetings or other school sessions. Teachers gave their opinion based on a 5-point liker scale: very frequently, frequently, occasionally, rarely and never. Table 3 reveal varying frequencies at which principals discuss sustainability practices and green technologies during school sessions. A minority of teachers reported that their principals discussed these topics very frequently (5.55%) or frequently (11.72%). A larger proportion indicated that these discussions occurred occasionally (51.85%), while a substantial number reported rare discussions (27.16%) or no discussions at all (3.70%). These findings suggest a varied engagement by principals in promoting sustainability initiatives within their schools. This distribution implies a potential gap in consistent communication on sustainability issues, which could impact the awareness and integration of green technologies within school practices.

Principals who frequently discussed these topics might contributed positively to fostering environmental awareness and sustainability initiatives among their teaching staff, potentially leading to greater adoption of green technologies by Kiambu County's public secondary schools. The study results align with Beena, Rao and Meegada (2024) views who also established that effective leadership communication is crucial in promoting organizational goals, including sustainability initiatives. The variability in principals' engagement with sustainability discussions, as observed in the study, suggests that inconsistent communication may hinder the integration of green technologies in schools, underscoring the need for more regular and focused discussions on these topics.

In order to establish teachers' perception on how effectively they think their school principal is at communicate the benefits of green technologies to the staff, the teachers gave their opinion based on a 5-point liker scale: very frequently, frequently, occasionally, rarely and never. According to Table 3 majority of teachers 49.38% viewed their principals on how they communicate green technology benefits as moderately effectively. A significant proportion (24.07%) felt that communication was not very effective, while 3.70% believed it to be ineffective. Conversely, smaller percentages rated communication as effective (16.67%) or very effective (6.17%). These findings suggest a mixed reception among teachers, indicating a potential need for clearer and more persuasive communication strategies from principals to enhance awareness and acceptance of green technologies within the school community. Addressing these communication gaps could potentially foster greater engagement and support for sustainable initiatives among staff.

The effectiveness of principals in communicating the benefits of green technologies aligns with existing research on leadership communication. Syafwan and Fathia (2023) indicate that clear, persuasive communication from leaders significantly impacts the adoption of new initiatives. Leadership communication quality directly correlates with employee engagement and acceptance of change. The mixed reception among teachers in this study mirrors these findings, emphasizing the importance of enhancing principals' communication strategies to foster better understanding and support for green technologies.

The study sought opinion of teachers on how often their principal seek feedback from teachers regarding how green technologies are being put into use. Teachers offered their opinion based on a 5-point liker scale: very often, often, occasionally, rarely and never. Table 3 shows that a majority of teachers 56.79% indicated that this occurs occasionally. This suggests a moderate level of engagement between principals

and teachers regarding green technology initiatives. Furthermore, 21.60% reported that such feedback is sought often, indicating a significant but not predominant frequency. Conversely, a minority of teachers 1.23% noted that principals seek feedback very often, with even fewer 20.37% reporting rare occurrences or never 0% experiencing such feedback. These findings imply a varied landscape in principals-teachers interactions concerning green technology implementation, suggesting potential areas for enhancing communication and collaboration to foster adoption of green technologies by Kiambu County's public secondary schools. Kurian, Carvalho, Carvalho & Carvalho (2024) were of the view that effective leadership communication, particularly leaders seeking feedback from staff, enhances engagement, organizational transformation and development.

The study also assessed teachers' perceptions on their principal's responsiveness to issues such as questions and concerns regarding the implementation of green technologies. Teachers gave their opinion based on a 5-point liker scale: very responsive, responsive, moderately responsive, slightly responsive and not responsive at all. Table 3 shows that majority of teachers 56.79% perceive their principals as moderately responsive. A significant portion, 27.16%, rated their principals as responsive, while a smaller proportion found them very responsive (1.23%) or slightly responsive (14.81%). Notably, no respondents reported their principals as not responsive at all. These findings suggest a generally positive outlook on principal responsiveness, indicating a willingness among principals to engage with teachers' concerns regarding green technology implementation. However, the moderate ratings imply potential areas for improvement in fostering more proactive communication and support for green technologies in public secondary schools in Kiambu County, Kenya. The study results align with existing literature on leadership communication, which emphasizes its pivotal role in organizational change and innovation. According to Musaigwa (2023), effective communication by leaders fosters a shared understanding and commitment among stakeholders, enhancing the adoption of new initiatives. Specifically, leaders who clearly articulate their vision and actively engage in dialogue create a conducive environment for implementing change. This is consistent with the findings that schools where principals who effectively communicate green initiatives through various channels enhance higher engagement and adoption of these technologies in schools.

MOE Directors' Responses on various Aspect of Principal's Communication Skills

The MOE directors' interviews sought to establish how effective communication skills of school principals contribute to the successful adoption of green initiatives in public secondary schools. The interviews with the Ministry of Education directors in Kiambu County highlighted several key themes regarding how the effective communication skills of school principals contribute to the successful development of green technologies in public secondary schools. One prominent theme was the ability of principals to articulate the benefits of green technologies persuasively. According to the directors principals who were skilled communicators conveyed the advantages of sustainable practices in a compelling manner, which fostered enthusiasm and participation among stakeholders. This persuasive communication helped in building a supportive environment where everyone is motivated to engage in and support green initiatives. For example, a principal's transparent dialogue about recycling programs can rally school community support, thereby enhancing school cleanliness and environmental consciousness. Such communication bridges gaps between different stakeholders, enabling collaborative efforts towards achieving sustainability goals.

Another key theme was the role of communication in building trust and championing efforts towards a

common goal. The directors noted that in order to adopt green technologies, stakeholders needed to understand their importance which is crucial for overcoming initial resistance and scepticism. They also noted that principals who use platforms like school assemblies and staff meetings to educate and update school stakeholders on sustainable practices build trust and encourage participation in environmental initiatives. Clear communication from principals helped align the efforts of students, teachers, and other school stakeholders towards the school's sustainability vision. This alignment is essential, as the directors put it, for creating a cohesive school community that actively supports the implementation of green technologies. Furthermore, they reported that principals who transparently share the vision and progress of sustainable projects foster a collaborative environment where ideas about green technologies are openly discussed. This openness builds enthusiasm and sustained support for green technology initiatives, ensuring their long-term success. Some of the directors views were as follows:-

One of the director (Code D/03/2024), said the following:

> *Effective communication bridges knowledge gaps and mobilizes support. Majority of school principals are able to communicate clearly and consistently about green technologies and thus fostering understanding and buy-in from teachers, students, and other school community members. This transparency builds a collaborative environment where innovative solutions like recycling technologies, solar and rainwater harvesting systems etc. can thrive. Although financial constraints are a significant barrier, effective communication ensures that the school community remains committed and ready to act when resources become available (D/03/2024 Personal Communication 13th June 2024).*

The MOE directors were also requested to explain how well they think the principals were in communicating about green technologies in public secondary schools in Kiambu County. Directors had a mixed views about how well do they think the principals are in communicating about green technologies in public secondary schools in Kiambu County. Some of the directors' views were captured by one of them (Code D/01/2024) who said the following:

> *While the level of adoption of green technologies is currently low in Kiambu County, this is often due to financial constraints rather than poor communication from principals. Majority of school principals are good communicators. Their communication plays a critical role in the successful adoption of green technologies. Majority of schools principals communicate clearly and consistently about the benefits and importance of green technologies and thus fostering a culture of sustainability within the school community. This communication helps to build a shared vision among teachers, students, and parents, which is essential for the successful implementation of green technologies (D/01/2024 Personal Communication 25th June 2024).*

While another director (Code D/09/2024) had a different and said the following:

> *Many principals lack the ability to communicate the long-term vision and benefits of green technologies effectively. They focus on short-term implementation without highlighting the long-term positive impacts on the environment, school finances, and students' education. Without this long-term perspective, it is challenging to maintain sustained effort and commitment from the school community. Principals' communication should paint a clear picture of the future benefits, but this is often missing, leading to a lack of sustained interest and effort in green initiatives (D/09/2024 Personal Communication 18th June 2024).*

Students Responses on various Aspect of Principal's Communication Skills

The students FGDs revealed similar results like of those of majority of teachers and MOE directors. The content analysis of the student responses reveals a mixed perception of the effectiveness of communication between the school principal and students regarding green technology initiatives. Some students felt well-informed and appreciated the regular updates and engagement through assemblies and dedicated meetings. They highlighted the principal's enthusiasm and the inclusion of student-led eco clubs and environmental committees. However, other students express a need for more detailed and frequent communication, suggesting structured approaches like monthly updates, social media, and interactive sessions. The responses indicated that while some students felt adequately informed and involved, others desired more consistent follow-up and direct involvement in the progress and impact of the green technologies.

As one student (Code S/0004/FGD4/2024) put it:

> *I think our principal communication is pretty effective. We have a green week every year where the principal and teachers focus on green technologies and sustainability. There are activities, and presentations related to this topic. It's a fun and informative way to keep us updated and engaged (S/0004/FGD9/2024 Personal Communication 4th July 2024).*

While another student (Code S/0011/FGD5/2024) had a different opinion

> *In my opinion, the communication could be better. The principal does mention green initiatives during assemblies, but it's often brief and not very detailed. I would like to see more in-depth discussions and perhaps student involvement in planning and implementing these technologies. That way, we can all feel more connected to the green technologies in the school (S/0011/FGD5/2024 Personal Communication 21st June 2024).*

This was also supported by student (Code S/0008/FGD9/2024) who said: -

> *Honestly, I don't feel very informed about the green technologies our school is implementing. The principal mentioned something about plan of installing solar panels in school during an assembly last year, but there hasn't been much communication since. I think having a more structured approach, like monthly updates, would make a big difference (S/0008/FGD9/2024 Personal Communication 9th July 2024).*

The findings of this study align with the literature emphasizing the critical role of leadership communication in the adoption of green technologies. Like Darko et al. (2017), who highlighted the importance of communication in overcoming barriers to green technology adoption, this study found that effective communication by school principals significantly influences the implementation of green initiatives. Both studies underscore that clear, detailed information and open communication can reduce resistance to change and foster a more supportive environment for green practices. Similarly, Khan et al. (2023) identified the positive impact of green leadership on sustainability practices in the manufacturing sector, emphasizing that effective communication strategies are essential for leaders to articulate the benefits of green technologies and engage stakeholders.

Contrastingly, Hoffstaedter (2020) emphasized internal and external communication in a municipal context, finding it crucial for sustainable development. While the current study focused on educational institutions, the underlying principle remains consistent: effective leadership communication is pivotal in driving sustainability efforts. The study by Rajakaruna and Hettiarachchi (2017) also supports the importance of interpersonal communication and information sharing, suggesting that such practices can build trust and facilitate the transition towards sustainable practices. However, unlike the purposive sampling method used by Rajakaruna and Hettiarachchi, this study employed a more robust sampling

technique, ensuring greater generalizability of the findings. Overall, the study's results reinforce existing literature, highlighting that leadership communication is vital across different sectors for promoting green technologies.

The Status of Development and Adoption of Green Technologies in Schools

The researcher further asked the principals to indicate the extent to which they agreed with the various statements regarding the status of adoption of green technologies their schools. Their responses as summarized below were based on a 5-point Likert scale of: Strongly Disagree, Disagree, Undecided, Agree, and Strongly agree as was indicated in the questionnaire.

Table 4 *School Principal Rating on The Status Of Development and Adoption Of Green Technologies In Schools* n=119

	SD		*D*		*U*		*A*		*SA*		*Mean*	*Std. Dev*
	F	%	F	%	F	%	F	%	F	%		
My school has adopted and developed energy-efficient systems	29	24.4	20	16.8	41	41	25	21.0	4	3.4	2.6218	1.16438
My school has adopted and developed renewable energy sources	41	34.5	26	21.8	30	30	19	16.0	3	2.5	2.3025	1.17570
My school has adopted and developed sustainable building practices	31	26.1	27	22.7	49	49	8	6.7	4	3.4	2.3866	1.05050
My school has adopted and developed eco-friendly sanitation	4	3.4	23	19.3	33	33	31	26.1	28	23.5	3.5706	1.14850
My school has adopted and developed recycling technologies	26	21.8	40	33.6	34	34	17	14.3	2	1.7	2.4034	1.03596
My school has adopted and developed rainwater harvesting systems	0	0.0	2	1.7	12	12	54	45.4	51	42.9	4.2941	.71726
My school has adopted and developed paperless systems & technologies	55	46.2	30	25.2	32	32	2	1.7	0	0.0	1.8403	.88282

Source: ***Field Data (2024)***

Key: F= Frequency, SD= Strongly Disagree, D= Disagree, U= Undecided, A= Agree, SA= Strongly Agree

Table 4 shows that the most notable percentages for each statement show varying degrees of adoption: 41% of principals were undecided about energy-efficient systems, 34.5% strongly disagreed with the adoption of renewable energy sources, 49% were undecided on sustainable building practices, 26.1% agreed on eco-friendly sanitation, 33.6% disagreed on recycling technologies, 45.4% agreed on rainwater harvesting systems, and 46.2% strongly disagreed on adopting paperless systems and technologies. The standard deviations indicate variability in responses, with the highest variability seen in items like the adoption of renewable energy sources (SD = 1.17), and the lowest in the adoption of rainwater harvesting systems (SD = 0.71), suggesting differing levels of consensus among principals on these practices. Other percentages and responses can be seen in the table for a comprehensive understanding. The study results infer that there was a low level of adoption of green technologies in schools, with significant variations in the levels of agreement and adoption of different practices.

Table 4 also shows that the school principals agreed with the statements that their schools had adopted and developed rainwater harvesting systems and eco-friendly sanitation. Each had a mean score of 4.29

and 3.57 respectively. The school principals were neutral or undecided on whether their school had adopted and developed energy-efficient systems which had a mean score of 2.62. The school principals disagreed with the following statements; their school has adopted and developed recycling technologies; their schools have adopted and developed sustainable building practices; their school has adopted and developed renewable energy sources and their school has adopted and developed paperless systems and technologies. Each statement had a mean score of 2.40, 2.38, 2.3025 and 1.84 respectively.

The findings reveal a mixed level of development and adoption of green technologies in public secondary schools in Kiambu County, Kenya. School principals indicated strong adoption of rainwater harvesting systems and eco-friendly sanitation. However, the adoption of energy-efficient systems, recycling technologies, sustainable building practices, renewable energy sources, and paperless systems was notably low. These findings suggests that while there is some progress in specific areas of green technology, the overall level of adoption remains limited. The study results contrast, Heracleous et al. (2022) and Barwińska-Małajowicz et al. (2023) who showed more comprehensive and high adoption of green technologies in educational buildings in developed countries. This suggests that while some schools in Kenya are advancing in certain areas, there is a notable gap in the holistic adoption of green technologies compared to international examples. The study infers that significant efforts are needed to enhance the implementation of a broader range of green technologies, indicating a gap in comprehensive sustainability practices within these schools.

Hypothesis Testing

Regression analysis was used to establish if there was a statistically significant influence of principal's communication on the development and adoption of green technologies in public secondary schools in Kiambu County, Kenya. The results are as presented in Tables 5, 6, and 7. To identify the statistical influence of principal's communication on the development and adoption of green technologies in public secondary schools in Kiambu County, Kenya, multiple regression using the following model was adopted:

$$Y = \beta_2 + \beta_1 X_1 + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{Model I}$$

Table 5 *Model Summary for Principal's Communication*

n=119

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.606[a]	.368	.362	4.67492

a. Predictors: (Constant), X2PrincipalsCommunication

Source: *Field Data (2024)*

Table 5 shows the results of model summary of the influence of principal's communication on the adoption of green technologies by Kiambu County's public secondary schools. The R^2 value of 0.368 suggests that around 36.8% of the variation in the adoption of green technologies in schools is attributable to the principal's communication variable. Thus, there is a moderately strong influence of principal's communication on the adoption of green technologies by Kiambu County's public secondary schools.

Table 6 *ANOVA for Principal's Communication*

n=119

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1486.846	1	1486.846	68.033	.000[b]
	Residual	2557.019	117	21.855		
	Total	4043.866	118			

a. Dependent Variable: YAdoptionandDevelopmentofGreenTechnologies
b. Predictors: (Constant), X2PrincipalsCommunication

Source: ***Field Data (2024)***

Table 5 presents the significance of the model as determined through an ANOVA test. The ANOVA results indicate that the regression model is statistically significant, this is so as it had a high F-statistic (F = 68.033) and the low p-value (0.000<0.05). This implies that principal's communication has a positive and significant influence on the adoption of green technologies by Kiambu County's public secondary schools.

Table 7 ***Coefficients for Principal's Communication***

n=119

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	7.971	1.441		5.531	.000
	X2PrincipalsCommunication	.444	.054	.606	8.248	.000

a. Dependent Variable: Y adoption and Development of Green Technologies

Source: ***Field Data (2024)***

Table 6 shows the coefficients for principal's communication and the development and adoption of green technologies by Kiambu County's public secondary schools. The new model now becomes

$$Y = 7.971 + 0.444X_2 + \varepsilon \quad \text{.....Model II}$$

The results show that β=0.444, and p=0.000<0.05. This infers that there is a positive and statistically significant influence of principal's communication on the adoption of green technologies by Kiambu County's public secondary schools. The study results imply that principal's communication influence the adoption of green technologies by Kiambu County's public secondary schools by a factor of 0.444 holding all other factors constant. Therefore, as principal's communication skills increases the development and adoption of green technologies in public secondary schools in Kiambu County, Kenya is expected to rise.

The study results further shows that principal's communication (β_2=0.444, p=0.000<0.05) had a positive and significant influence on the development and adoption of green technologies by Kiambu County's public secondary schools. Thus, the study rejects the null hypothesis there is no significant influence of principal's communication skills on development and adoption of green technologies in public secondary schools in Kiambu County, Kenya.

1.10 Conclusion and Recommendations

The study further concludes that principal's communication has a positive and significant influence on the the development and adoption of green technologies in public secondary schools in Kiambu County, Kenya. The study recommends that the ministry of education should invest in regular communication training programs for principals, focusing on effective ways to convey the importance and benefits of green technologies. School principals should also establish regular updates on the progress of green technology adoption and create feedback mechanisms that involve the entire school community. School principals should immediately develop detailed communication plans for their schools that outline how to disseminate information about green technologies. This could include using various channels such as social media, newsletters, and school magazines to reach a broader audience and keep the community informed about ongoing green initiatives. School principals should as soon as possible establish mechanisms to monitor and evaluate the effectiveness of their communication strategies on green technologies. School principals should regularly assess how well information about green technologies is being received and understood, making adjustments as necessary to improve clarity and engagement. This continuous assessment will ensure that communication efforts are effective and impactful. School principals should start immediately utilizing a variety of communication channels, including social media, school magazines, and community forums, to disseminate information about green initiatives in their school.

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