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Moderating Effect of Environmental Factors on the Relationship between Project Risk Management Practices and Implementation of Technology Integration in Public High Schools in Kenya

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ABSTRACT

This study focused on establishing the moderating effect of environmental factors on the relationship between Project Risk Management practices and the implementation of Technology Integration in high schools in Kenya. Data for the study were gathered from 189 out of the 373 public high schools located in Kiambu and Nairobi counties. A cross-

sectional descriptive design was employed, utilizing both quantitative and qualitative approaches for data collection, analysis, and reporting. Stratified sampling was used to select schools that actively employ Technology Integration in their educational practices. The study employed a combination of structured closed and open-ended questions in the questionnaires administered to the managers and teachers responsible for technology integration, as well as interviews conducted with the principals of the corresponding schools. Both descriptive and inferential statistics were performed. Correlation analysis was applied to assess the relationships between quantitative variables. The decision to accept or reject the null hypothesis for each pair of variables was determined based on the p-value, with p-values less than 0.05 indicating a significant relationship between the variables. Pearson Correlation and regression techniques were utilized for inferential analysis. The parameters of the regression model were used to ascertain the predictive role of the independent variables in the study. Risk management Practices has no significant effect on the Technology Integration in Public High Schools in Kenya (H_{03}: $\beta_3= 0$) when environmental factors are held constant was rejected (β_3=--0.0979, t= -2.42, p-value = 0.017). The null hypothesis: Environmental factors index has no significant moderation effect on relationship between Risk Management Practices and Technology integration in Public High Schools in Kenya (H_{06}: $\beta x_3 m= 0$) was not rejected ($\beta x_3 m$ = -0.155, t= -0.227, p-value = 0.820). Ultimately, this study will provide insights into the optimal environmental conditions that promote successful technology integration in public high schools in Kenya.

Key words: Project Risk Management practices Technology integration Environmental factors

BACKGROUND OF THE STUDY

A Risk Breakdown Structure (RBS) is a valuable tool for project teams, aiding them in categorizing and tackling potential risks within their projects. These risks are neatly divided into categories, comprising technical, external, organizational, and project management risks. Technical risks, which can be controlled by the project team, encompass elements like work delegation, vacation leave management, and budget allocation. On the other hand, external risks encompass factors beyond the project team's control, such as economic fluctuations, policy shifts, and natural disasters. When considering the integration of technology in projects, multiple studies have highlighted specific risks throughout the project life cycle, including inadequate technological infrastructure, time constraints for preparing teaching materials, resistance to change, a dearth of technical support, and a lack of training, as highlighted in research by Elemam (2016), Umar (2014), and Nikolopoulou (2015). These findings emphasize the critical need for proactive risk assessment and management in technology integration endeavors. The three identified barrier-factors or risks were lack of support, lack of confidence, and lack of equipment. Projects often lose sight of their original purpose due to unexpected events and changes in resources and organizational objectives, (Pinto 2016).

STATEMENT OF THE PROBLEM

In recent years, there has been a rapid increase in the integration of technology in public high schools in Kenya. However, this integration has been marked by challenges such as poor risk management practices that expose the schools to cyber-attacks, data loss, and other security risks. Studies have shown that environmental factors such as funding, policy support, and technical expertise influence the successful integration of technology in schools (Magara, 2018). Nevertheless, there is insufficient knowledge on the moderating effect of environmental factors on the relationship between risk management

practices and technology integration in public high schools in Kenya. According to the 2020 Kenya Economic Survey report, the government allocated Kshs. 1.2 billion for ICT integration in schools, an increase from Kshs. 1.0 billion in the previous year (Kenya National Bureau of Statistics, 2020). However, lack of funding, inadequate infrastructure, and poor policy support remain significant barriers to successful technology integration in public schools. Additionally, the 2018 Cyber Security Report by Serianu Limited revealed that the education sector in Kenya suffered 298 million cyber-attacks, with 75% of these attacks targeting public institutions (Serianu Limited, 2018). Despite these challenges, there is a lack of empirical evidence on how environmental factors impact the relationship between risk management practices and technology integration in public high schools in Kenya. Therefore, this study aims to investigate the moderating effect of environmental factors on the relationship between risk management practices and technology integration in public high schools in Kenya.

RESEARCH OBJECTIVE

To examine the moderating effect of environmental factors on the relationship between Project Risk Management Practices and Technology integration in Kenyan Public High School

HYPOTHESIS

$H0_1$ There is no significant moderating effect of environmental factors on the relationship between project risk management practices and implementation of technology integration in Public high schools in Kenya

THEORETICAL REVIEW

Situated Cognition Learning Theory

The Situated Cognition Learning Theory is often associated with the work of John Seely Brown, Allan Collins, and Paul Duguid who contributed significantly to its formation and it gained prominence in the late 1980s and 1990s through their research and publications. It does not have a single specific origin. The theory highlights the importance of social interaction and collaborative learning, which, when combined with tackling complex real-world challenges, leads to the development of strong problem-solving skills.

The Theory stresses that learning is deeply influenced by the environment and context in which it occurs. When high schools integrate technology, such as computers and the internet, into their classrooms, they provide students with reliable and meaningful learning experiences, mirroring real-world situations. This technology-driven learning promotes social interaction, collaboration, and engagement among students. To ensure successful implementation, it is vital to manage potential risks associated with technology, encompassing cybersecurity and data privacy, creating a safe and secure learning environment. By combining situated cognition principles with effective risk management, high schools can offer students immersive, authentic, and secure educational experiences that facilitate deep learning.

CONCEPTUAL FRAMEWORK

The conceptual framework in Figure 1 illustrates how Project Risk Management practices influence implementation of technology integration with environmental factors acting as a moderating influence.

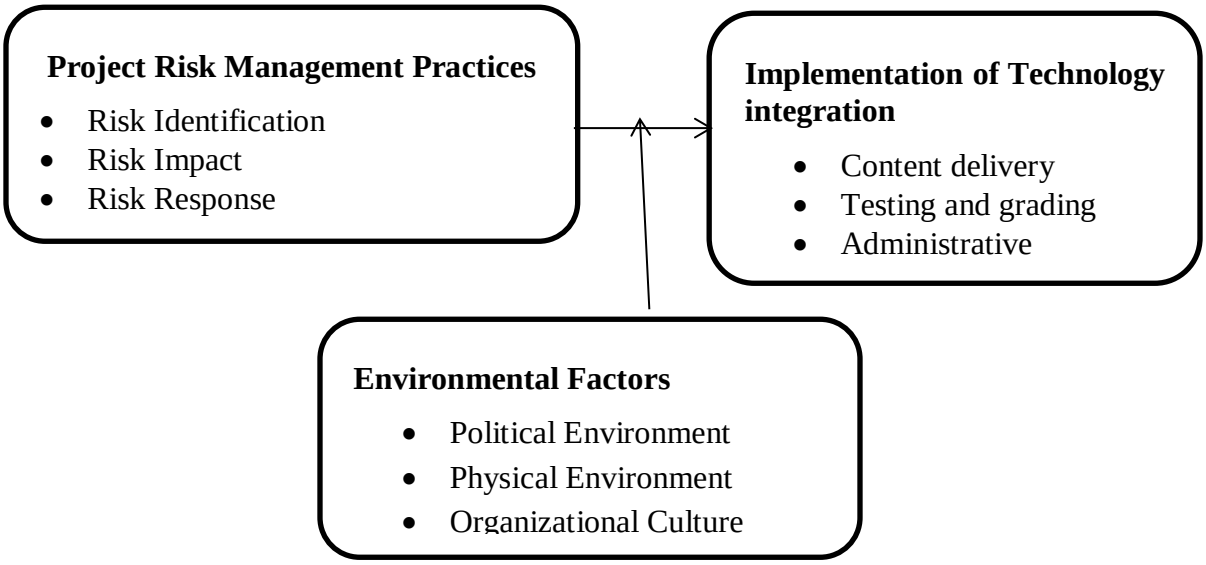

Figure 1: The Conceptual Framework

EMPIRICAL LITERATURE

Any projects' business case has a breakdown of a risk management plan specifying predicted risks, an analysis of each (quantitatively and qualitatively), risk response and control measures. According to Pinto (2016), Project risk management involves a variety of approaches designed to minimize or mitigate the consequences of project failure. Effective risk management strategies are critical in decreasing the likelihood of recurring risk factors or containing the impact of various project risks. (Pinto, 2016). The uncertain events that can have an impact on the success of a project include among others; schedule slippage and natural calamities. Criminality in some of the urban schools is one big issue that destabilizes education, (Mathipa, 2014). According to (Orodho, 2014), technology integration in education has been motivated by its proven progressive impact on the education delivery, quality and sustenance. However, some uncertainties border this venture and may impede the conveyance of anticipated results.

There is a myriad of risks linked to teacher technology projects in public high schools in Kenya that affect the fruition of its integration by teachers in their instructional approaches. According to (Wangila, 2015), this can emerge if the management of the schools is altered at the critical phase of the project execution. This is factual also if new school board members are appointed. Risks in ICTs have culminated into slow and scattered growth in their integration in Kenyan schools Juma, (2021). The study revealed that, although there have been efforts to incorporate ICT in Kenyan schools,

the challenges in integrating ICT have arisen due to slow and fragmented progress in implementation. A study by Mukwa (2018) found that despite efforts by the Kenyan government to promote the integration of ICT in education, many teachers lacked the necessary skills and support to effectively use technology in the classroom. In this study, questions of scrutiny were geared to unearthing whether there had been any risk plan and contingency measures set to achieve the objectives and yield the expected deliverable in the education sector.

RESEARCH METHODOLOGY

The study employed Cross sectional descriptive design using both quantitative and qualitative approaches for data collection, analysis and reporting**.** Stratified sampling was incorporated with a subgroup of 189 Secondary schools selected out of a population of 363 public high schools in Kiambu and Nairobi with homogenous characteristics based on inclusion and exclusion criteria in relation to implementation of technology integration

The sample size consisted of 189 derived where;

n = the required sample size

Z = Standard Z-score (standard value of 1.96 for 95% confidence interval)

p = the proportion of the population with the desired characteristic which is the application of ICT in teaching (taken to be 50%)

q = (1- p) = 0.5

e = margin of error (in this case taken to be 5%)

N=Finite population size.

With N = 373, the formula leads to;

$$n = \frac{Z^2pqN}{e^2(N-1)+Z^2pq} n = \frac{Z^2pqN}{e^2(N-1)+Z^2pq} = 189$$

Therefore, a total of 189 schools, comprising all categories of public high, that is National, Extra-County, and Sub counties were sampled for this study as shown in Table 1 below.

Table 1: Distribution of Sample size

COUNTY	NO. OF SCHOOLS	PROPORTION	NO. OF SCHOOLS SAMPLED
NAIROBI	95	25.47%	48
KIAMBU	278	74.53%	141
TOTAL	373	100.00%	189

Questionnaires with closed and open-ended questions were administered to dean of studies and deputies in charge of academics and Interviews conducted for the principal.

RESEARCH FINDINGS AND DISCUSSIONS

Only a small percentage of the respondents had specialized knowledge in project management. The findings indicate that a minority of survey participants possess project management skills as shown in Figure 1.

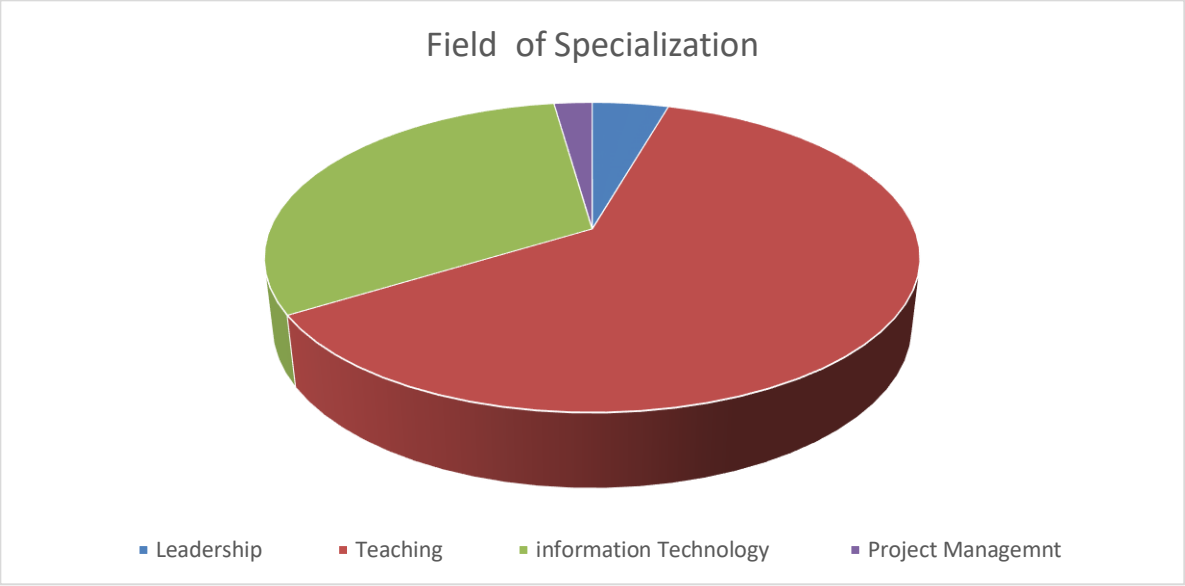

Figure 1: Field of Specialization

Descriptive Results for Project Risk Management Practices

The respondents who agreed to having received support from the Government constituted 65.91% of the total whilst 16. 48% (3.98%+12.50%) had a contrary view that drawback for integration could be as a result of lack of management support. Interview reports divulged that support from internal management was repressed by meagre funds from the Ministry of Education under the central Government and this posed a risk factor as dissemination of capitation for school's functionality was greatly affected.

Table 2: Project risk management practices

Item		SA	A	N	D	SD	Mean	Sd
i.	There is lack of support from the management	3.98%	12.50%	17.61%	34.09%	31.82%	2.03	0.735
ii.	There is lack of support from the teachers	5.11%	11.36%	16.48%	29.55%	37.50%	2.39	0.809
iii.	Teachers lack confidence to adopt ICT	2.84%	9.09%	9.09%	39.20%	39.77%	1.96	0.772
iv.	Government instability has negatively influenced project	11.93%	10.23%	15.34%	30.11%	32.39%	2.17	0.760
v.	Stakeholders are not aware of their expected roles	5.68%	5.11%	16.48%	31.82%	40.91%	2.23	0.754

KEY: SA= Strongly Agree; A=Agree; N= Neutral; D=Disagree; SD=Strongly Disagree; SD =Standard Deviation

Overall Cronbach Alpha value= 0.804 with 5 items

A citation by Atyang (2018), deduced that institutional strands that determine the successfulness of ICT integration in education were correlated with support given to tutors and pupils by the school administration and that enticement was paramount element in enabling stakeholders seize a transformation or not. Related perspective had been echoed by Ngavana (2018) who showcased that the school administration provided the school with ICT appliances; and had acquired some ICT implements hence accelerating technology integration. The percentage that owned up to the fact that there was teacher support was a minimal 16.47% of the total number of respondents (5.11%+ 11.36%) with mean= 2.30 and sd of 0.809. There was considerable variation in the responses and an abnormal 16.48% of the respondents took a stand of neutrality insinuating lack of support for teachers. An exploration by Pelila (2022) exposed that mentee tutors are more polished and ready for technology changes than long-serving and accomplished teachers as a result of technological resistance and comfort.

The risk associated with the fact that teachers were deficient of confidence was strongly annulled by 2.84% and 9.09% in disagreement with mean= 1.90 and sd of 0.772 depicting discrepancy in the responses secured. When interrogated, the principals highlighted instances when required support from the Government had been detrimental to technology integration success such as during elections, tribal clashes or internal conflicts where people are displaced. Ignorance of the stakeholders was manifested in assorted ways, as per principals' declarations during the interviews. A gigantic 40.91% agreed downrightly while 31.82% of the respondents acknowledged this thought; that stakeholders are ignorant. Concerned educational authorities should efficiently devise effective policies to consolidate ICT in teaching-learning applications that fulfill the economies' current requirements and academic affairs at all levels, (Akram, 2022).

Regression Results for the relationship between Risk Management Practices and Technology Integration

Three regression models were fitted hierarchically, that is; Model 1 with risk management practices as the predictor, Model 2 with risk management practices and environmental factors as the predictors and Model 3 with risk management practices, environmental factors and the interaction term as the predictors. The regression output is given in three parts; Model summary, Model comparisons and Model coefficients all presented in Table 3. Model 1 was significant (F (1,146) =13.66; p-value <.001) and therefore, Risk management practices was a valid predictor of Technology Integration. The coefficient of determination shows that 8.55 % of technology integration was explained by Risk management practices (R^2 =0.0855). The fitted model was;

Model 1: $Y= 4.463 – 0.136X_3$

Table 3: Model summary for the relationship between Risk Management Practices and Technology integration

Model summary						
Model	**R**	**R²**	**F**	**df1**	**df2**	**Sif fig**
1	0.292	0.0855	13.66	1	146	< .001
2	0.337	0.1138	9.31	2	145	< .001
3	0.338	0.1141	6.18	3	144	< .001
Model Comparisons						
Model	**Model**	**ΔR²**	**F**	**df1**	**df2**	**P**
1	2	0.0282	4.6196	1	145	0.033
Residue	3	3.18e-4	0.0517	1	144	0.820
Model Coefficients – y						
Predictor	**Estimate**	**SE**	**t**	**P**		
Model 1						
Technology Integration	4.463	0.0231	193.61	< .001		
Risk Management	-0.136	0.0368	-3.70	< .001		
Model 2						
Technology Integration	4.4547	0.0231	193.08	< .001		
Risk Management	-0.0979	0.0405	-2.42	0.017		
Environment Factors	-0.1051	0.0489	-2.15	0.033		
Model 3						
Technology Integration	4.4568	0.0249	178.918	< .001		
Risk Management	-0.0961	0.0415	-2.315	0.022		

Environment Factors	-0.1074	0.0501	-2.144	0.034
Risk Management & Environmental Factors	-0.0155	0.0683	-0.227	0.820

Independent variables

Where, Model 1: Risk Management Practices

Model 2: Risk Management Practices, Environmental factors

a) Relationship between Risk Management Practices on Technology Integration

The null hypothesis: Risk management Practices has no significant effect on the Technology Integration in Public High Schools in Kenya (H_{03}: β_3= 0) was rejected (β_3=-0.136, t= -3.70, p-value <0.001). This implies that one-unit increase in Risk Management Practices index leads to 0.136 decrease in Technology integration index.

Discussion of the findings on the Relationship between Risk Management Practices and Technology integration

Research studies suggest that effective risk management practices are critical to the success of technology integration initiatives in schools. In Kenya, the study by Otundo (2018), the study also found that risks associated to lack of a supportive ICT policy, inadequate funding for ICT, and limited access to ICT facilities outside of school were significant barriers to the integration of ICT in teaching and learning of chemistry in the schools in Kisumu County. Additionally, Puckett (2017) found that effective risk management practices, including the identification of project risks, the development of risk mitigation strategies, and the establishment of a risk management plan, were critical to the success of the iPad program. Effective risk management practices, including the identification of project risks, the development of risk mitigation strategies, and the establishment of a risk management plan, were important predictors of the success of the laptop program, Kim (2018 effective risk management practices were important predictors of successful technology integration initiatives O'Bannon (2015). Largely, it can be concluded that effective risk management practices are crucial to successful technology integration initiatives in schools. By identifying project risks, developing risk mitigation strategies, and establishing a risk management plan, schools can increase the possibility of fruitful implementation of technology integration.

Moderating effect of risk management practices, and technology integration

To investigate the moderating effect of environmental factors on the relationship between risk management practices and technology integration, environmental factors index variable was added to the Model 1 to give Model 2 which was also found to be statistically significant ((F (2,145) =9.31, p-value <0.001)). The R-squared significantly changed by 2.82% (Change in R-squared=0.0282, F (1,144) =9.31, p-value=0.033). The fitted model was;

Model 2: $Y= 4.4547 -0.0979X_3 -0.1051M$

The null hypothesis: Risk management Practices has no significant effect on the Technology Integration in Public High Schools in Kenya (H_{03}: β_3= 0) when environmental factors are held constant was rejected (β_3=--0.0979, t= -2.42, p-value = 0.017). This implies that one-unit increase in Risk Management Practices index leads to 0.0979 decrease in Technology integration index when environmental factors are controlled. The null hypothesis: Environmental factors has no significant effect on the Technology Integration in Public High Schools in Kenya (H_{05}: β_m= 0) when Risk Management

Practices are held constant was rejected (β_3=--0.1051, t= -2.15, p-value = 0.033). This implies that one-unit increase in Environmental factors index leads to 0.1051 decrease in Technology integration index when Risk Management Practices are controlled. The interaction term (risk management practices * environmental factors) was added to Model 2 to give Model 3 which was also found to be statistically significant. ((F (3,144) =6.18, p-value< 0. 001). The three predictors explained 11.41% (R2=0.1141) of the variation in Technology integration index.

The fitted model was;

Model 3: $Y= 4.4568 – 0.0961X_3 -0.107M-0.0155X_3*M$

The null hypothesis: Risk management Practices has no significant effect on the Technology Integration in Public High Schools in Kenya (H_{02}: $\beta_3= 0$) when environmental factors and interaction term are held constant was rejected. (β_3= -0.0961, t= -2.315, p-value=0.022). This implies that one-unit increase in Risk Management Practices index leads to 0.0961 decrease in Technology integration index when change in environmental factors and interaction term are controlled. The null hypothesis: Environmental factors has no significant effect on the Technology Integration in Public High Schools in Kenya (H_{05}: $\beta_m= 0$) when Risk Management Practices and interaction term are held constant was also rejected (β_m= -0.1074, t= -2.144, p-value=0.034). This implies that one-unit increase in Environmental factors index leads to 0.1074 decrease in Technology integration index when change in Risk Management Practices interaction term are controlled. Concerning the interaction term, the R^2 changed by a small margin of 0.0318% and the change was not statistically significant (Change in R-squared=0. 0.000318, F (1,144) =0.0517, p-value = 0.820). The null hypothesis: Environmental factors index has no significant moderation effect on relationship between Risk Management Practices and Technology integration in Public High Schools in Kenya (H_{06}: $\beta x_3 m= 0$) was not rejected ($\beta x_3 m$ = -0.155, t= -0.227, p-value = 0.820). The moderation effect could not be established and Figure 2.

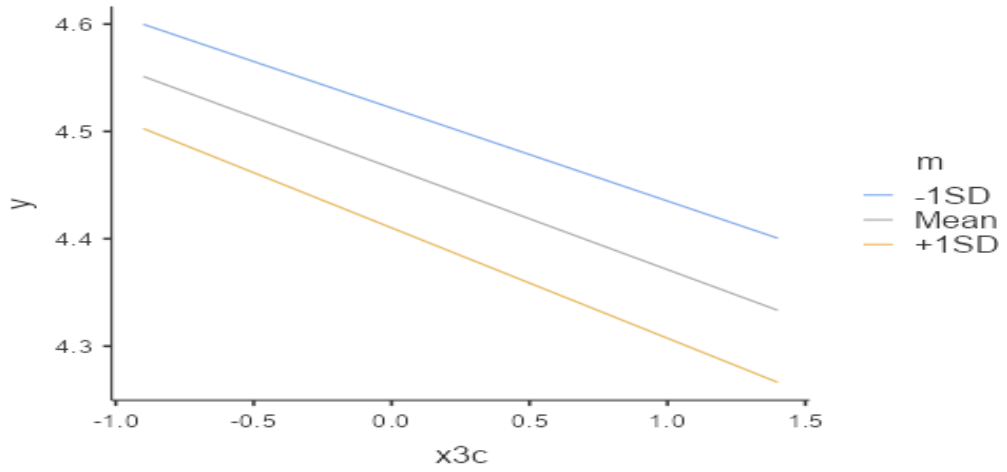

Figure 2 Moderating Effect of Risk Management Practices on Technology Integration

Where, x3c= Risk management practices
m= Moderation variable
y= technology integration
+1SD = High Moderation levels
-1SD =Low moderation levels

The graph shows two lines, one for a low level of environmental factors and one for a high level of environmental factors. The vertical axis represents technology integration, while the horizontal axis represents the level of risk management practices. The line for a low level of environmental factors has a steeper slope than the line for a high level of environmental factors. Based on the line graph, there is a negative association between Environmental Factors and Technology Integration, holding Risk Management Practices constant. As the level of Environmental Factors increases, the level of Technology Integration decreases. However, the graph also shows that the relationship is not consistent across different levels of Risk Management Practices. For example, when Risk Management Practices are at a low level, the negative relationship between Environmental Factors and Technology Integration appears to be relatively weak. As the level of Risk Management Practices increases, the negative relationship between Environmental Factors and Technology Integration becomes stronger.

Discussion of the findings of moderating effect of environmental factors on the Relationship between Risk Management Practices, and Technology Integration

Environmental factors index has no significant moderation effect on relationship between Risk Management Practices and Technology integration in Public High Schools in Kenya (H_{06}: $\beta x_3 m = 0$) was not rejected. These findings collaborate with Moghaddam, (2019) that deduced that organizational culture moderated the relationship between risk management practices and technology adoption in higher education institutions. Precisely, strong risk management culture was positively related with the acceptance of technology, while a weak risk management culture was negatively associated with technology implementation. Moreover, regulatory factors, such as government policies and standards, moderated the relationship between risk management practices and performance in higher education institutions. Compliance with regulatory requirements positively impacted the connection between risk management practices and performance (Al-Hawamdeh 2019). The study by Fosso (2017) established that environmental factors such as supervisory pressure, competitive intensity, and technological commotion moderate the relationship between risk management practices and technology integration in case companies. Increased risk awareness, effective risk communication, and robust risk control is positively correlated with successful technology integration through risk management practices, Shao (2018) This study's' findings similarly specified that environmental factors had a significant negative effect on Technology Integration in Public High Schools in Kenya, even when controlling for Risk Management Practices and the interaction term.

CONCLUSION

This study revealed that schools attempted to address security concerns by implementing increased security measures to safeguard their physical assets and facilities. Unfortunately, these efforts did not lead to the expected improvements in technology integration. The teachers opting to incorporate technology into their teaching faced challenges, as computer laboratories were often locked and inaccessible, obstructing their educational objectives. Additionally, when questioned about the presence of an initial risk plan, input strategies, tools, expected outcomes, and alternative risk mitigation approaches, respondents were unable to provide evidence indicating that essential project management preparations had been overlooked prior to implementation.

RECOMMENDATIONS

The study offers several key recommendations. First, it emphasizes the importance of educational institutions involving a project management professional to oversee the entire process, ensuring the effective use of relevant tools and expertise to achieve desired outcomes. Second, it suggests maintaining a balanced approach to risk management by assessing risks through workshops, investigating incidents, conducting audits, and continuously monitoring and analyzing potential impacts while implementing precautionary measures like security improvements. For enhanced security, it suggests implementing access control measures such as regulated entry points and biometric authentication systems like fingerprint or retina scans. Lastly, the study recommends the procurement of portable technological tools, including accessible smart projectors suitable for teacher use in the integration of technology.

AUTHOR'S CONTRIBUTIONS

Hilda W. Muturi wrote the journal article under the guidance of by Dr. Samson Nyang'au Paul and Dr. Yusuf Muchelule. The relevant institutions permission was sought, data collected, analyzed and then this article published.

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CONFLICT OF INTEREST

This research publication is free from any conflicts of interest. We meticulously adhered to ethical principles, upheld strict anti-plagiarism measures, and diligently ensured that informed consent was obtained.

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