International Journal of Social Science and Economic Research

ISSN: 2455-8834

Volume:10, Issue:02 "February 2025"

Effect of Teacher Professional Development and the Implementation of Integrated Science in Competency Based Curriculum: A Case Study of Junior Schools in Westlands Sub-County, Nairobi City County

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DOI: 10.46609/IJSSER.2025.v10i02.022 URL: https://doi.org/10.46609/IJSSER.2025.v10i02.022

Received: 14 Nov. 2024 / Accepted: 10 Jan. 2025 / Published: 10 March 2025

ABSTRACT

The purpose of the study was to examine the effect of teacher professional development on implementation of integrated science in competency-based curriculum in junior schools in Westlands Sub-County. The study was guided by the social development theory. A descriptive research design was used. The target population were teachers, principals and heads of departments in the 30 junior schools in Westlands Sub County. A census was conducted for the integrated science teachers while 30% of heads of departments and principals were purposively selected. Data were collected through mixed methods. A structured questionnaire was distributed to the teachers in the selected schools. Interviews were conducted with heads of departments and principals. A pilot study was conducted to assess the validity and reliability of the data collection tools. Quantitative data was analyzed using the Statistical Package for Social Sciences version 29, employing correlation and regression analysis techniques. Qualitative data was analysed thematically. Results showed that teacher professional development positively correlated with implementation of integrated science in the CBC in JSS(r=0.923, p=0.000). This study concludes that, despite teachers' strong understanding of integrated science, they face challenges due to a lack of resources, such as teaching materials and laboratory equipment. There was an increase in teacher workload, yet few received sufficient job training or continuous education opportunities in integrated science. The study suggests that JSS should encourage greater involvement in research activities and professional organizations to promote continuous professional growth.

Key words: Competency Based Curriculum, implementation of integrated science , Junior Schools teacher professional development

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1.0 INTRODUCTION

Background of Study

The Competency Based Curriculum (CBC) reflects a paradigm shift in teaching methodologies, shifting away from conventional approaches that are teacher-centered to learner-centered approaches. According to Delbert and Jacobs (2021), the primary focus of the CBC is on developing learners' competencies rather than merely imparting content knowledge. In this context, competencies are considered more crucial than the accumulation of information. The evaluation process within CBC is formative and summative. This means that the emphasis is placed on continuous feedback and improvement, fostering the development of learners' skills and abilities throughout the learning journey. The ultimate goal is to prepare students holistically for future challenges. Fitria et al, (2022) define CBC as a curriculum that outlines specific learning outcomes and competencies to be achieved by the learners.

Competency is the proven capacity to use one's knowledge, skills, and abilities in a way that advances their profession. In response to the rapidly changing global landscape, educational reforms have become necessary. CBC emerges as a promising approach to address the evolving needs of learners (Uzule, 2020). This curriculum prioritizes competencies over content, recognizing the importance of practical skills and abilities. It also emphasizes formative evaluation, providing continuous feedback to enhance the learning process. The implementation of the CBC is designed to empower students by equipping them with the vital skills and knowledge required to thrive in a rapidly evolving world. Unlike traditional education systems that often focus on rote memorization and standardized testing, the CBC places a strong emphasis on practical skills, critical thinking, problem-solving, and adaptability. In CBC, students are encouraged to actively engage with the learning process, fostering a deeper understanding of subjects and the ability to apply their knowledge in real-life situations. This learner-centric approach not only prepares students for academic success but also equips them with the skills necessary to navigate complex challenges in their personal and professional lives.

CBC curriculum prepares learners to adapt and thrive in diverse and unpredictable environments. The aim is to equip students with the tools they need for personal and professional growth, ensuring they are well-prepared for the challenges and opportunities that lie ahead (Morrish & Neesam, 2021). In Australia, competence is the explicit description of knowledge, skills, and their practical application to meet the expected performance standards within a professional environment. These essential competencies encompass digital learning, effective communication, and critical thinking (Beneitone & Yarosh, 2022).

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The preparedness, professionalism and access to resources among teachers relates with students' achievements (Wambua & Samuel, 2019). This link between instructors' competencies and students' success surpasses the effect of various other factors, including financial investments such as salaries. The correlation between teachers' capabilities and students' accomplishments carries greater significance than other variables, underscoring the imperative nature of investing in the professional development and support of educators.

2.0 Statement of the Problem

The implementation of CBC has generated significant interest among scholars in Kenya due to its novel approach to education. When properly implemented, CBC aims to produce well-rounded learners, with teachers playing a pivotal role in ensuring active and participative learning to make the curriculum successful. Despite its potential benefits, the implementation of integrated science in CBC in junior schools has faced challenges and criticism since its introduction. This is because integrated has three learning subjects in one learning area and the teacher is trained in teaching two subjects. Many education stakeholders have expressed concerns about the lack of teaching experience, poor leadership practices, inadequate training, and insufficient resources. Instructional leadership and teacher knowledge are lacking in integrated science as a learning area for effective implementation of the curriculum. The 8.4.4 system of education teaches two science subjects to graduate teachers, while the CBC curriculum requires that these teachers have knowledge and teach three science subjects. The challenge is that the curriculum is being implemented despite the recommendations from the task force on the retooling process. Thus, there is a gap in knowledge of the third science subject. Additionally, junior schools may not have adequate teachers, resources, and personnel to offer integrated science (Okoth, 2018). This study sought to …

Purpose of the Study

The purpose of the study was to examine the effect of teacher professional development on implementation of integrated science in CBC in junior schools in Westlands Sub-County.

Research hypothesis

H_{01} : There is no significant relationship between teacher professional development and implementation of Integrated Science in CBC in junior schools in Westlands Sub-County

3.0 LITERATURE REVIEW

Relationship between Teacher Professional Development Opportunities and Implementation of Integrated Science in CBC Junior Schools

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Teachers can better understand the interdisciplinary connections within science, investigate cutting-edge teaching techniques, and create curriculum materials that are in line with integrated science objectives by taking part in workshops, seminars, collaborative planning sessions, and other professional development activities (Agyei, 2021). Dolfing et al. (2021) examined strategies supporting teachers' professional development in the context of simultaneous pedagogical and content changes in curriculum innovations in America. They took an existing framework designed for professional development and adapted it to evaluate how teachers perceived it in the context of teaching science curricula that emphasize real-world applications. This modified framework served as the basis for creating activities aimed at improving teachers' competence in three specific areas related to teaching these science units: creating a relevant classroom environment, adopting new teaching roles, and delivering new subject matter. Six secondary school teachers participated in a professional development program that followed this framework, and a qualitative inner-case analysis was used to gain insight into how they made sense of the program. The results indicated that teachers effectively integrated all three aspects into their teaching, although the process of incorporating new subject matter differed from the pathways followed for the other aspects. The study explores the relationship between these findings and the adapted framework, with the goal of deriving strategies for designing professional development initiatives that assist teachers in implementing curriculum innovations. The study was limited in sample, as only 6 teachers were involved in the study.

Agyei (2021) conducted a study aimed at assessing the influence of an ICT-instructional professional development initiative on the quality and extent to which teachers were able to translate the ideas and concepts acquired during capacity building into their classroom instructional practices. The study used semi-structured survey instruments and diaries as tools to capture the various activities and events that unfolded during the implementation of the program. Findings revealed satisfaction among teachers regarding both the content of the program and the processes involved. There were inadequate conditions that hindered the effective transfer of program ideas into the school-level implementation phase. The study highlighted the need for sustainable effects on teaching and learning. ICT-instructional professional development is conceptually different from teacher professional development, which has a wider scope.

Based on the professional competencies they believed were necessary for their jobs and their self-perceived competence levels, Njenga (2022) evaluated the learning needs of vocational teachers in Kenya. Six hundred and seventy questionnaires were distributed to 6 institutions. The teachers acknowledged a great desire for continual professional development (CPD) while feeling quite competent. instructors who had received Initial Teacher Education (ITE) showed the greatest need for CPD, demonstrating ITE's effectiveness in making instructors aware of its significance. New teachers, however, exhibited lower perceptions of competence, highlighting

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the need for mentorship. The study also revealed that TVET teachers in Kenya tended to equate content mastery with effective teaching skills, underscoring the importance of reviewing the TVET teacher curriculum to enhance subject-specific teaching skills recognition and development. The study focused on TVETs, while the current study focuses on JSS.

4.0 Theoretical Framework

Social Development Theory

The Social ….theory, attributed to Lev Vygotsky (1896-1934), posits that each task in a child's cultural development manifests itself twice: first, at the societal level, and subsequently, at the personal level. Key principles of the theory involve the notions of the More Knowledgeable Other and the Zone of Proximal Development and scaffolding (MockingJay, 2022). The More Knowledgeable Other refers to an individual possessing greater expertise than the learner in a particular task, such as a teacher, an older adult, or a peer. It is noteworthy that the More Knowledgeable Other need not necessarily be a person; it could also be an entity or resource with additional information on the subject compared to the learner. Effective school policies regarding ICT use, proficient head teachers, teachers, and learners act as the More Knowledgeable Others, playing a crucial role in shaping the implementation of digital literacy. The Zone of Proximal Development delineates the cognitive space where the More Knowledgeable Other offers suitable assistance or instructive lessons, facilitating a child's development of skills that they can subsequently apply independently, thereby enhancing advanced mental capabilities. Collaborative learning, particularly within the zone of proximal development, is instrumental in cultivating the skills of pupils (Healy, 2015).

In such educational environments, students are viewed as unique individuals, and the primary emphasis is on promotion of personal meaning rather than solely relying on teacher-imparted knowledge and instructor-directed activities. Through this theory, the implementation of integrated science in CBC diverges from the traditional teacher-centered approach, placing a significant emphasis on empowering students to actively engage in the learning process. The integration of science into the CBC for junior schools necessitates school administrators to allocate adequate resources, that would enhance active learner engagement. Drawing from the social development theory, teacher professional development and teacher knowledge are critical in integrated science integration. Learners are empowered to build on educational foundations based on guidance from teachers, enabling them to develop their own reality and knowledge. This theory emphasizes collaboration, interaction, scaffolding and practical experiences in the learning process.

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5.0 RESEARCH METHODOLOGY

Research Design

This study used a correlational research design. A correlational research design examines connections between variables without the researcher having control over any of them. A correlation indicates how strong and/or in which direction variables are related. A correlation can have either a positive or negative direction. This design entails observing and examining the study variables as they naturally exist, without any intentional manipulation or alteration. The design was important to the study as it helped to assess the relationship between leadership practices and implementation of integrated science in CBC in junior schools in Westlands Sub County Nairobi county.

Study Location

The study was conducted in junior schools in Westlands subcounty. It is one of the seventeen sub counties in Nairobi county. The sub county has 5 wards. Westlands Sub County was selected as it has a good distribution of public and private JSS and being an urban centre, it becomes a mirror for the other urban centres in the country.

Study population

This study's target population were teachers, principals and heads of departments (HODs) in the 30 JSS schools in Westlands Sub-County Nairobi City County. Table 3.1 shows the distribution of the study population.

Table 1: Target Population

Category	Population
Teachers	94
Head of departments	30
Principals	30
Total	**154**

Source: Ministry of Education, 2023

Sampling procedure

Sample size

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The study selected all teachers in the 30 JSS schools in the sub county as the population is small and easily accessible. Mugenda and Mugenda (2003), a sample size of 10%-30% is adequate for analysis. Consequently, this study selected 10 HODs and 10 principals. Table 2 illustrates the sample size: -

Table 2: Sample Size

Category	Population	Sample
Teachers	94	94
Head of departments	30	10
Principals	30	10
Total	**154**	**114**

Sampling Techniques

The study employed a census for all the 30 schools in the sub-county, as the population was small and easily accessible. Five Heads of Departments (HODs) from public schools and five HODs from private schools were also purposively sampled. 5 principals from a public school and 5 principals from private schools were purposively selected for the study.

Data Collection Techniques

The data collection procedure commenced with the recruitment and training of one research assistant, who was trained on the research objectives. The distribution of questionnaires was conducted in person to ensure an even distribution of respondents, with all schools being visited. The study's objectives were clearly communicated to the participants, and those who agreed to participate were provided with the questionnaires and given ample time to complete them. In cases where participants encountered difficulties in filling out the questionnaires, both the researcher and the research assistant were available to assist. Subsequently, the questionnaires were collected, and their accuracy examined.

The researcher then held interviews with the sampled principals and HoDs. This commenced with booking appointments with the principals one week in advance. The study's objectives were explained to these respondents, and each interview session was timed to take approximately 30 minutes to obtain in-depth information. The interviews were recorded for examination and respondents were informed of the recording, most respondents were not comfortable being recorded but were ready to give the responses.

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Data Collections Tools

Data was collected through mixed methods using questionnaires and interviews. The study provided a structured questionnaire to the teachers of integrated science in all the schools, with detailed instructions on how to complete the questionnaires to ensure accuracy and consistency in the responses. The researcher reassured respondents that their participation in the study entailed no risk. Additionally, the study conducted interviews with Heads of Departments (HoDs) and sampled Junior school principals to gather additional information.

Data Analysis Techniques

The accuracy and consistency of the questionnaires were carefully assessed. Quantitative data was analyzed using the Statistical Package for Social Sciences, employing correlation and regression analysis techniques. Descriptive analysis was conducted to examine the data. Each independent variable was compared to the dependent variable using inferential statistics. The Pearson correlation coefficient was used to assess the relationship between the variables. Regression analysis was also carried out to examine the cumulative effect of the factors. The study variables were tested at a significance level of 5%. The research adopted the multiple regression model for analysis: -

$$Y=\beta_0+\beta_1 X_{1+}\ \varepsilon$$

Where: -

Y implementation of Integrated Science in CBC, β_0 is a constant, β_1 is the Beta coefficient, X_1 is teacher professional development and ε is the error term

Qualitative data was categorized into themes to facilitate analysis. Graphs, tables, and narrations were used to present findings.

6.0 RESULTS AND DISCUSSIONS

Response rate

6.1 Demographic Information and Response Rate

The study issued 90 questionnaires to the teachers of integrated science in all the schools, out of which 87 were completed and returned; this was a response rate of 97%. Additionally, the researcher successfully interviewed the 8 out of 10 principals, hence 80% responses rate. Likewise, 8 HODs out of 10 were successfully interviewed. Mugenda and Mugenda (2003) recommend a response rate of 50% or higher for data analysis, with a 60% and 70% rate being considered very good and excellent. Consequently, the study's response rate of 97% is excellent.

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Demographic information

Out of 87 respondents, 50 (57%) were male and 37(43%) were female. This showed that 50(57%) had the highest frequency distribution as illustrated in the table above. Fourteen respondents (16%) were between the age of 18-25 years, 50(57%) were 26-35 years, 20 (23%) were 36-45 years and 3(3%) were 46-55 years of age. This showed that 50(57%) had the highest frequency. Nineteen respondents (22%) had diploma education, 53(61%) had bachelors' education and 15(17%) had masters' education. Twenty-three (26%) had 1-5 years of experience, 35 (40%) had 6-10 years, 26 (30%) had 11-15 years and 3 (3%) had 16-20 years of experience. This showed that 35 (40%) had the highest frequency.

6.2 Descriptive Analysis

6.2.1 Teacher professional development on Implementation of Integrated Science in CBC in junior schools

Results show that 23% strongly agreed that the number of duties for teachers of integrated science in the school had increased, 25 % agreed, 2% were not sure, 33% disagreed and 16% strongly disagreed (Mean=3.06; SD=1.473). Additionally, 5% strongly agreed that teachers in the school received job training on integrated science, 18 % agreed, 18% were not sure, 41 % disagreed and 17% strongly disagreed (Mean=2.52; SD=1.119). Two percent strongly agreed that there was continuous education for teachers of integrated science in the school, 21% agreed, 14 % were not sure, 36 % disagreed and 28% strongly disagreed (Mean=2.34; SD=1.160). Additionally, 25% agreed that teachers in the school were involved in research work for development, 16% were not sure, 36% disagreed and 23 % strongly disagreed (Mean=2.44; SD=1.107). Two percent strongly agreed that teachers in the school were offered job assignments to sharpen their integrated science skills, 21% agreed, 16% were not sure, 46 % disagreed and 15% strongly disagreed (Mean=2.49; SD=1.055). Moreover, 2% strongly agreed that teachers in the school were members of professional organizations for sciences, 14 % agreed, 23 % were not sure, 38% disagreed and 23 % strongly disagreed (Mean=2.34; SD=1.055). The study participants' responses are summarized and presented in Table 3: -

Table 3: Teacher professional development on the Implementation of Integrated Science in CBC in junior schools

Statements	N	Mean	Std. Dev	SA	A	N	D	SD
The number of duties for teachers of integrated science in the school have increased.	87	3.06	1.473	23	25	2	33	16
Teachers in the school receive on the job training on integrated science.	87	2.52	1.119	5	18	18	41	17

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There is continuous education for teachers of integrated science in the school.	87	2.34	1.160	2	21	14	36	28
Teachers in the school are involved in research work for development.	87	2.44	1.107	0	25	16	36	23
Techers in the school are offered job assignments to sharpen their integrated science skills.	87	2.49	1.055	2	21	16	46	15
Teachers in the school are members of professional organisations for sciences.	87	2.34	1.055	2	14	23	38	23

Source: Research Data

The study sought to know the opportunities for teacher professional development in the implementation of Integrated Science. HOD2 noted, "The school offers regular workshops and seminars specifically tailored to Integrated Science pedagogy, where teachers can learn about the latest teaching methodologies, assessment strategies and curriculum alignment techniques. The school facilitates teachers to participate in external professional development opportunities, such as conferences, workshops and online courses, to further enhance their knowledge and skills in Integrated Science instruction."

The study inquired from principals' the teacher professional development opportunities provided to facilitate the implementation of Integrated Science. Principal 1 indicated, "At our school, we provide targeted workshops and training sessions to enhance teachers' knowledge and skills in integrated science. The school facilitates teachers with teaching materials to support teachers in integrated science. The school aims to empower teachers with tools and knowledge needed to effectively implement Integrated Science curriculum."

6.2.2 Implementation of Integrated Science in the CBC

Out of 87 responses, 14% strongly agreed that the syllabus for integrated sciences was covered in time in the school, 32 % agreed, 53% disagreed and 1% strongly disagreed (Mean=3.05; SD=1.210). Additionally, 9% strongly agreed that there was improved pedagogical approach in integrated science courses in the school, 21% agreed, 16% were not sure, 34% disagreed and 20% strongly disagreed (Mean=2.66; SD=1.265). Five percent strongly agreed that students in the school achieved set outcomes in integrated science, 25% agreed, 11% were not sure, 31% disagreed and 28% strongly disagreed (Mean=2.48; SD=1.265). Additionally, 7% strongly agreed that teaching and learning activities in the school runs effectively in the laboratory, 20% agreed, 14% were not sure, 45% disagreed and 14% strongly disagreed (Mean=2.62; SD=1.164). Eleven percent strongly agreed that teaching and learning activities in the school were efficient, 16% agreed, 15% were not sure, 30% disagreed and 28% strongly disagreed (Mean=2.54; SD=1.354). Moreover, 8% strongly agreed that there was improvement for integrated science

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performance among students in the school, 30% agreed, 3% were not sure, 45% disagreed and 14% strongly disagreed (Mean=2.74; SD=1.253).

Table 4 Implementation of Integrated Science in the CBC

Statements	N	Mean	Std. Deviation	SA	A	N	D	SD
The syllabus for integrated sciences is covered in time in the school.	87	3.05	1.210	14	32	0	53	1
There is improved pedagogical approach in integrated science courses in the school	87	2.66	1.265	9	21	16	34	20
Students in the school achieve set outcomes in integrated science.	87	2.48	1.265	5	25	11	31	28
Teaching and learning activities in the school run effectively in the laboratory.	87	2.62	1.164	7	20	14	45	14
Teaching and learning activities in the school are efficient.	87	2.54	1.354	11	16	15	30	28
There is improvement for integrated science performance among students in the school.	87	2.74	1.253	8	30	3	45	14

Source: Research Data

The study sought from the HODs their department's status on the implementation of Integrated Science. HOD4 noted, "The department has not made significant progress in implementing Integrated Science in its curriculum. Teachers have barely undergone any training to understand the principles and methodologies of Integrated Science instruction. The program is continually refined and improved to meet student needs and prepare them for success in the ever-changing world. Limited resources are a huge barrier to full implementation of integrated science in CBC"

The study sought from the principals their schools' status on the implementation of Integrated Science. Principal 7 noted, "The school has not made significant progress in implementing Integrated Science in curriculum due to a lack of teaching staff and resources. There are inadequate financial resources and equipped laboratories to support implementation of integrated Science. Innovative instructional approaches like inquiry-based learning and project-based assessments have not been implemented. The school is however committed to ensure success of the program."

The study sought to comprehend challenges in the implementation of Integrated Science in JSS in their schools. Principal 1 indicated, "The implementation of Integrated Science in our school faces challenges such as coordinating the integration of scientific disciplines into a cohesive curriculum, maintaining teacher alignment, and maintaining a broad range of knowledge and skills. Assessment and evaluation also present challenges, as traditional methods may not capture

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students' understanding. Addressing these requires collaboration, professional development, and adaptation of instructional strategies to meet student needs effectively."

The researcher inquired from principals on what could be done to address challenges in the implementation of Integrated Science in JSS in their schools. Principal 3 noted, "It is important to provide continuous professional development opportunities, enhance teacher collaboration and allocate adequate resources for implementation of integrated science in the CBC. This would enhance student engagement and achievement in CBC."

6.3 Inferential Analysis

6.3.1 Correlation Analysis

Pearson correlation analysis was carried out and results illustrated in Table 5

Table 5: Correlation Analysis

		Implementation
Implementation	Pearson Correlation	1
	Sig. (2-tailed)	
	N	87
Teacher professional development	Pearson Correlation	.923**
	Sig. (2-tailed)	0.000
	N	87

**. Correlation is significant at the 0.05 level (2-tailed).

Source: Research Data

The research findings highlight correlations between variables. The significance of these correlations is determined by p-values. Results showed that teacher professional development positively correlated with implementation of integrated science in the CBC in JSS($r=0.923$; $p=0.000$).

6.3.3 Hypothesis Testing

The hypothesis of the study was; H01 : There is no significant relationship between teacher professional development and implementation of Integrated Science in junior schools in Westlands Sub-County. Results indicate $t=22.107$; $p=0.000$ shows that teacher professional development is a significant determinant of implementation of Integrated Science in junior

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schools in Westlands Sub-County. The null hypothesis that there is no significant relationship between teacher professional development and implementation of Integrated Science in junior schools in Westlands Sub-County is rejected. Results of this study's first hypothesis is indicated in Table 6.

Table 6 : Hypothesis H_{01} Testing

Model	Unstandardized Coefficients	Std. Error	Standardized Coefficients	t	Sig.
(Constant)	-0.009	0.131		-0.069	0.945
Professional development	1.062	0.048	0.923	22.107	0.000

a. Dependent Variable: Implementation of Integrated Science in CBC in junior schools

Source: Research Data

6.3.4 Linear regression model

A regression analysis was done to examine how the independent variables effect the dependent variable. An overview of the linear regression model is shown in Table 7

Table 7: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.782[a]	0.712	0.684	0.04892

a. Predictors: (Constant), teacher professional development

b. Dependent Variable: implementation of integrated science in CBC

Source: Research Data

Results reveal that the coefficient of determination, r squared is 0.712 that is, 71.2%. This means that implementation of integrated science in the CBC in junior schools would vary by 71.2% due to changes in teacher professional development, at 95% confidence level. Only 28.8% of the variations in implementation of integrated science in the CBC in junior schools can be ascribed to other factors. The correlation coefficient, denoted , R, is a measure for assessing the relationship between variables. Findings revealed a significant and positive correlation between the variables, evident by a correlation coefficient of 0.782.

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Table 8: ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	109.219	3	36.406	77.903	.000[b]
Residual	7.904	83	0.095		
Total	117.123	86			

a. Dependent Variable: implementation

b. Predictors: (Constant) professional development

Source: Research Data

ANOVA results showed a level of significance at p=0.000, highlighting the significant link between the dependent and independent variables. This finding reveals that there exists a significant relationship between variables. Moreover, the calculated F-value was observed to be greater than the critical F-value (77.903> 2.719). The model employed in the study is thus reliable and consequently, the results are considered adequate to formulate conclusive findings and offer credible recommendations.

Table 9: Coefficients

	Unstandardized Coefficients	Std. Error	Standardized Coefficients	t	Sig.
(Constant)	0.982	0.093		1.882	0.063
professional development	0.464	0.072	0.403	6.417	0.000

a. Dependent Variable: implementation of integrated science in JSS CBC.

Source: Research Data

Table 4.15 shows the model equation to be:

$Y = 0.982 + 0.464\ X_1 + \varepsilon$

Findings reveal that teacher professional development positively and significantly affects implementation of integrated science in the CBC in junior schools ($\beta = 0.464$, $p = 0.000$). A unit increase in teacher knowledge leads to 0.464 unit increase in implementation of integrated science in the CBC in junior schools.

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7.0 Discussion of Study Findings

Teacher professional development opportunities positively and significantly relates with implementation of integrated science in the CBC in JSS. Participative Leadership Theory promotes collaboration, shared decision-making, and empowerment in educational settings. It involves teachers in curriculum development, instructional strategies, and professional development initiatives, enhancing their ownership and commitment to Integrated Science implementation (Lam et al., 2015). This encourages sharing expertise, ideas, and innovative teaching approaches, fostering a culture of continuous improvement in JSS.

This study's findings agree with those of Dolfing et al. (2021) adapted a professional development framework for teachers to teach science curricula with real-world applications. Six secondary school teachers participated in a program aimed at improving competence in creating a relevant classroom environment, adopting new teaching roles, and delivering new subject matter. Results showed that teacher professional develop relates with CBC implementation. In the same vein, Looi et al. (2018) developed a teacher professional development model for a Singapore science curriculum and noted that structured professional development improved classroom questioning, student-centered activities, and conceptual understanding of science. Likewise, Agyei (2021) assessed the effect of an ICT-instructional professional development initiative on teachers' ability to translate capacity building ideas into classroom practices. Results showed dissatisfaction with program content and processes and inadequate conditions hindered effective curriculum implementation. Additionally, Njenga (2022) examined vocational teachers and found that they desire continuous professional development. Initial Teacher Education teachers showed the most need for CPD, while new teachers needed mentorship. The study highlighted the need for subject-specific teaching skills development.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions of the Study

The study concludes that many teachers noted an increase in their workload, yet few receive sufficient job training or continuous education opportunities in integrated science. Additionally, there is limited involvement in research activities and professional organizations among teachers. While schools offer workshops and seminars on integrated science pedagogy, the training provided is limited in scope. However, schools facilitate access to science teaching materials and enhance collaborative learning among teachers. Principals note a strong commitment to comprehensive teacher professional development, allocate funds and promote peer-to-peer. Principals emphasize the importance of access to resources and a culture of inquiry in

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empowering teachers to effectively implement the integrated science curriculum and inspire students.

8.2 Recommendations of the Study

The management of JSS should leverage technological advancements and provide internet access, which plays a crucial role in keeping teachers updated on teaching methodologies and advancements in integrated science education. Online resources, webinars and professional development platforms should be availed to teachers to enhance their implementation of CBC.

Principals of JSS should prioritize comprehensive teacher professional development initiatives, allocate funds and promote peer-to-peer learning opportunities. Principals play a pivotal role in providing guidance and support to teachers, fostering collaboration and sustaining teacher knowledge. The principals should empower teachers to effectively implement the integrated science curriculum.

The Teachers Service Commission should employ and post more teachers with competence in each of the science subjects. This would ensure teacher workload management and promote teaching and learning in integrated science. In the same vein, the management of JSS should implement strategies to manage workload pressures, streamline administrative processes and offer incentives for participation in professional development activities. Continuous education opportunities ensure that teachers remain updated on best practices and innovations in integrated science education.

The CUE and universities should collaborate on a curriculum for integrated science teachers in physics, chemistry and biology, that incorporate interdisciplinary approaches, pedagogical techniques and practical experiences for effective instruction in the CBC.

Teacher training workshops should expand the scope and depth of professional development opportunities to cover a broader range of topics, including assessment strategies, interdisciplinary teaching approaches, and technology integration. This ensures that teachers receive comprehensive training that addresses their diverse needs and challenges.

The management of JSS should enhance collaborative learning communities among teachers to facilitate knowledge sharing, peer support and collaborative problem solving. Structured meetings, online forums and professional learning communities can provide avenues for teachers to collaborate, share resources and exchange ideas for improving integrated science instruction.

The boards of management of JSS should provide leadership training, mentorship and resources to equip HODs and principals with the necessary skills and knowledge to support

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implementation of integrated science in CBC. Collaboration between school leadership, HODs and principals is critical for enhancing change and improvement in integrated science.

The leadership of JSS should prioritize evaluation and continuous improvement strategies to assess the effectiveness of integrated science instruction and professional development initiatives. Regular feedback mechanisms, data analysis and stakeholder consultations can inform decision-making processes and drive ongoing improvements in teaching practices, resource allocation and support structures.

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