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Influence of the Availability of Instructional Resources on the Implementation of the Integrated Science Curriculum in Public Junior Secondary Schools in Western Region, Kenya

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Abstract- The Competency-Based transition has placed a practical, resource-intensive science curriculum in schools whose material base is often thin. This paper examines the influence of the availability of instructional resources on the implementation of the Integrated Science curriculum in public junior secondary schools in the Western Region of Kenya. Anchored on the social constructivist theory of Lev Vygotsky, the study adopted a descriptive survey design within a mixed methods approach. From a universe of 113,237, a sample of 1,087 respondents was drawn using stratified, simple random, systematic and purposive techniques, and 844 (77.6%) responded. Data were collected through questionnaires for students, teachers, heads of department and head teachers, and through interviews with one Regional and four County Quality Assurance and Standards Officers, and were analysed using descriptive statistics and the Chi-square goodness-of-fit test at the 0.05 level of significance. Of the four preparedness dimensions examined, the availability of instructional resources returned the lowest mean ($M = 1.57, SD = 0.77$), falling in the low band. Every one of the seven resources tested departed significantly from an even spread of responses, and the responses clustered on scarcity: the resources most central to inquiry-based science returned the largest values, namely charts and models ($\chi^2 = 343.703$), internet for research ($\chi^2 = 267.139$) and information and communication technology tools ($\chi^2 = 248.163$), with 196 (93.8%), 181 (86.6%) and 177 (84.7%) of teachers respectively reporting them absent. The null hypothesis was rejected, and the availability of instructional resources was found to have a statistically significant influence on implementation. The qualitative evidence attributed the shortfall to a chronic shortage of science resources and to the late delivery of the materials that were supplied. The paper concludes that resource scarcity was the most binding constraint on implementation, forcing theoretical delivery, and recommends the prioritised, timely supply of the practical and digital resources the curriculum assumes.

Keywords: Availability Of Instructional Resources; Curriculum Implementation; Integrated Science; Teacher Preparedness

I. INTRODUCTION

Kenya's Competency-Based Curriculum introduced Integrated Science at the junior secondary level as a subject to be taught through inquiry, practical work and the application of knowledge to real problems, and the curriculum treats instructional resources, both human and non-human, as integral to its delivery [1]. Integrated Science is taught across the three grades of Junior Secondary School, namely Grades 7, 8 and 9, and Grade 9 is the terminal grade of that cycle, at which the learning of the subject across the whole of Junior Secondary School is brought to account and placement into the senior secondary Science, Technology, Engineering and Mathematics pathways is determined [1]. Any constraint on delivery anywhere in the cycle therefore accumulates to that exit point and carries consequences well beyond the junior years. Instructional resources are not peripheral to such a curriculum but constitutive of it, since the materials a school holds mediate the relationship between the intended and the enacted curriculum and set the limits within which any teacher must work [2].

The concern is that ambitious curricula are repeatedly introduced without the resources their delivery requires, so that schools are asked to enact a curriculum they are not equipped to deliver, with the burden falling hardest on poorly resourced public schools [3]. Within Kenya, resource shortfalls have accompanied the Competency-Based reform from the outset, and inadequate resources have been found to compound the training gap and to leave teachers without the means to enact the curriculum even where they understand it [4]. This paper reports the second objective of a larger study on teacher preparedness, namely to examine the influence of the availability of instructional resources on the implementation of the Integrated Science curriculum in public junior secondary schools in the Western Region of Kenya. The corresponding null hypothesis held that the availability of instructional resources has no statistically significant influence on the implementation of the Integrated Science curriculum.

II. STATEMENT OF THE PROBLEM

The successful realisation of Competency-Based Education rests on teachers' preparedness, of which the material base of the classroom is a central component [5], and the government has invested heavily since the reform began in teacher retooling and in the supply of instructional materials [6, 7]. Despite this investment, the availability of resources has emerged as a recurrent constraint. The allocation of resources has been shown to influence the implementation of the Competency-Based reform, so that schools with fewer resources implement it less fully [8]. Within the study area, the information and communication technology resources the curriculum assumes were found to be largely absent from schools in Bungoma [9], and only about a fifth of public secondary schools in the county had the resources needed to implement a comparable technology-rich curriculum [10]. Similar shortfalls have been documented across the region, where the resources a competency-based reform assumes have often been unavailable [11].

These conditions carry serious consequences for Integrated Science, a subject whose inquiry and practical work depend on laboratories, apparatus, consumables and digital tools that other subjects can do without. Where these resources are absent, the curriculum cannot be enacted as designed, however willing or able the teacher, and delivery retreats into the theoretical instruction the reform was meant to replace. Because Grade 9 is the terminal grade of Junior Secondary School and its results govern placement into the senior secondary STEM pathways, a curriculum delivered without its material base across the cycle risks misplacing learners at that exit point on the basis of competencies they were never given the means to develop [1]. The cost of inaction therefore falls on the learner, on the validity of competency-based assessment and on the state's investment in the reform. Yet the adequacy of instructional resources specifically for the Integrated Science curriculum in Junior Secondary School in the Western Region has not been established, which is the gap this study addresses.

III. THEORETICAL FRAMEWORK

The study is anchored on the social constructivist theory of Lev Vygotsky, which holds that higher mental functions originate in social processes and that knowledge is co-constructed through shared activity, dialogue and cultural guidance before being internalised by the learner [12]. Central to the theory is the mediation of thought through cultural, physical and symbolic tools, so that instructional resources, from laboratory apparatus to digital simulations, are not peripheral aids but the very artifacts through which learners manipulate, negotiate and conceptualise scientific ideas [12]. Learning advances within the zone of proximal development, where a more knowledgeable other scaffolds the learner through tasks that lie just beyond independent mastery [13], and the resources deployed in the classroom are the means by which that scaffolding is enacted.

For a learner-centred, inquiry-based subject such as Integrated Science in Junior Secondary School, this places the availability of resources at the centre of implementation. If learning is inherently mediated by tools, the structural availability of diverse, high-quality and contextually relevant instructional resources becomes a prerequisite for cognitive development, since without these mediating tools the abstract concepts of Integrated Science remain divorced from the learner's experiential reality [14].

Ensuring the availability of such materials aligns with the constructivist mandate to provide authentic, context-rich environments that stimulate conceptual change [14], and the continued relevance of this framework to classroom practice is well established [15]. The theory therefore predicts that the availability of instructional resources will bear directly on the implementation of the curriculum, which the present study tests.

IV. LITERATURE REVIEW

Instructional resources are widely treated in the literature as constitutive of a curriculum rather than incidental to it. Choppin, McDuffie, Drake and Davis [2] showed that the materials available to teachers strongly mediate the relationship between the intended and the enacted curriculum, so that the resources a school holds set the limits of what can be taught. Studies of effective implementation reach the same conclusion: in Dubai, the availability of adequate resources was among the conditions that distinguished effective from ineffective implementation, and resource constraints undermined even well-planned curricula [16]. Science teaching is especially resource-dependent, because the inquiry and practical work at the heart of a science curriculum require laboratories, apparatus and consumables that other subjects can do without.

African studies document a persistent shortfall in these resources. In Nigeria, an assessment of laboratory resources for basic science in junior secondary schools found them inadequate, which limited the practical activities essential to the subject [17]; a study of instructional resources for biology in Kwara State found that schools lacked the equipment teaching required [18]; and the resources available for basic science more broadly fell short of what the curriculum demanded [19]. Inadequate instructional materials were listed among the principal problems facing science teachers [20], and resource constraints in South African schools narrowed what science teachers could attempt [21]. Reviewing the sub-Saharan experience, Verspoor [3] found that ambitious curricula were repeatedly introduced without the resources their delivery required, with the burden falling hardest on poorly resourced public schools.

The East African evidence echoes these findings. In Uganda, inadequate instructional resources were among the factors constraining the implementation of the competency-based curriculum [22]; in Rwanda, shortages of materials and laboratory facilities limited what science teachers could do [23]; and in Tanzania the resources needed for the reform were often unavailable [11]. A regional review concluded that the gap between the resources a reform assumed and those schools actually held was a recurring feature of competency-based implementation in East Africa [24]. Within Kenya, the allocation of resources significantly influenced implementation, so that schools with fewer resources implemented the curriculum less fully [8], and inadequate resources compounded the training shortfall, leaving teachers without the means to enact the curriculum even where they understood it [4]. Within the study area, the information and communication technology resources the curriculum assumes were largely absent from Bungoma schools [9], and only about a fifth of public secondary schools in the county had the resources to implement a comparable technology-rich curriculum [10]. National policy recognises the need for a standardised model to ensure consistency in the resourcing of science and STEM education across schools [25]. What remains unestablished is the adequacy of these resources specifically for the Integrated Science curriculum in public junior secondary schools in the Western Region, which the present study sets out to determine.

V. RESEARCH METHODOLOGY

The study adopted a descriptive survey design within a mixed methods approach, which suits the establishing of the level of a condition such as the availability of resources across a large, dispersed population [26]. It was conducted in the Western Region of Kenya and targeted the stakeholders in the delivery of the Integrated Science curriculum in public junior secondary schools, namely learners, teachers of Integrated Science, heads of the science department and head teachers, together with the Regional and County Quality Assurance and

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Standards Officers. The learner respondents were drawn from across the three grades of Junior Secondary School, so that the study captured the delivery of Integrated Science over the whole cycle and not at its terminal grade alone. The universe consisted of 113,237 respondents.

A sample of 1,087 respondents was drawn using stratified, simple random, systematic and purposive sampling: 271 head teachers, 271 teachers of Integrated Science and heads of department, 540 students, one Regional and four County Quality Assurance and Standards Officers. The student sample was justified using Cochran's formula for an unrestricted population, which returned a baseline of about 385 after finite population correction [27], a threshold consistent with the tables of Krejcie and Morgan [28]; the sample of 540 exceeded this baseline and reduced the effective margin of error to about 4.21%. Data were collected through open- and close-ended questionnaires, on which teachers and heads of department rated each resource as available and adequate, inadequate, or not available, together with interview schedules for the Quality Assurance and Standards Officers, an observation checklist and document analysis. Validity was established through expert review, and reliability was confirmed at the pilot stage through the split-half technique, with the Spearman-Brown coefficient exceeding 0.80. Quantitative data were analysed in the Statistical Package for the Social Sciences using descriptive statistics and the Chi-square goodness-of-fit test at the 0.05 level of significance [29], while qualitative data were analysed thematically and synthesised with the quantitative findings. Ethical clearance and a research permit were obtained, participation was voluntary, and the confidentiality of respondents was maintained throughout.

VI. FINDINGS

The study achieved an overall response rate of 844 (77.6%), comprising 220 (81.2%) head teachers, 209 (77.1%) heads of department and teachers, 410 (75.9%) students, and a full return from the Regional and County Quality Assurance and Standards Officers, a rate that exceeded the thresholds commonly recommended for survey generalisation [30]. The learner respondents spanned the three grades of Junior Secondary School, comprising 264 (64.4%) in Grade 9, 91 (22.2%) in Grade 8 and 55 (13.4%) in Grade 7, with the concentration in the terminal grade reflecting the point at which the cumulative delivery of Integrated Science across the cycle is brought to account. On the descriptive measure of preparedness, in which item responses were pooled onto a common three-point scale, the availability of instructional resources returned the lowest mean of the four preparedness dimensions at 1.57 (SD = 0.77), falling within the low band, which signalled at the outset that scarcity, rather than any other dimension, was the sharpest constraint on preparedness.

The availability of seven instructional resources, as rated by the teachers and heads of department, was then tested using the Chi-square goodness-of-fit test at the 0.05 level of significance, with the critical value set at 5.991 for two degrees of freedom. The results are presented in Table 1.

Table 1 Chi-Square Goodness-of-Fit Results for Availability of Instructional Resources

Resource	N	Chi-square	df	p-value	Decision
Textbooks	209	27.455	2	<.001	Significant
Teachers' guide	209	39.799	2	<.001	Significant
Laboratory equipment	209	27.828	2	<.001	Significant
Chemicals and reagents	219	95.041	2	<.001	Significant
ICT tools	209	248.163	2	<.001	Significant
Internet for research	209	267.139	2	<.001	Significant
Charts, models and aids	209	343.703	2	<.001	Significant

Note. Responses by teachers and heads of department on a three-point scale (available and adequate, inadequate, not available). Critical value 5.991 at df = 2; a result is significant where the computed value exceeds it at $p < 0.05$.
Source: Field data (2026).

Table 1 shows that every resource returned a chi-square value above the critical value of 5.991, all significant at p below 0.05, so the responses on availability were strongly patterned rather than evenly spread, and the pattern was one of scarcity. The largest values fell on the resources most central to inquiry-based science, namely charts and models ($\chi^2 = 343.703$), internet for research ($\chi^2 = 267.139$) and information and communication technology tools ($\chi^2 = 248.163$), where the responses clustered overwhelmingly on not available, with 196 (93.8%), 181 (86.6%) and 177 (84.7%) of the teachers respectively reporting these absent. Even the resources that fared better, such as textbooks ($\chi^2 = 27.455$) and laboratory equipment ($\chi^2 = 27.828$), were rated inadequate more often than adequate. The learners and head teachers reported the same shortage, since among learners the absence of information and communication technology in teaching produced the strongest result of all ($\chi^2 = 455.244$), and among head teachers internet and such technology returned 376.645 and 360.118. Since every item departed significantly from an even spread, the null hypothesis was rejected, and the availability of instructional resources was found to have a statistically significant influence on the implementation of the Integrated Science curriculum in Junior Secondary School. The implication is that teachers were being asked to deliver a practical, technology-rich curriculum in classrooms stripped of the very tools it assumes, so that the scarcity of resources was not a marginal difficulty but the central obstacle to implementation, a reading consistent with the argument that the absence of laboratory facilities turns science from a process of discovery into rote memorisation [31] and with the finding that the pace of the Junior Secondary School rollout outstripped the supply of science equipment and digital tools [32].

The qualitative evidence, drawn from the interviews with the Quality Assurance and Standards Officers and from the open-ended responses, explained this pattern through two themes. First, there was a chronic shortage of science resources: most schools lacked functional laboratories, chemicals, reagents and apparatus were absent or far below the quantities needed for class-sized practical work, and information and communication technology tools and internet access were almost wholly missing outside a small number of well-resourced schools, so that the digital dimension of the curriculum existed mainly on paper. Second, even the basic materials that were supplied, such as textbooks and teaching guides, often arrived after the term had begun, which forced teachers to start topics without the resources meant to support them. A school cannot deliver an investigative curriculum from empty cupboards, and resources that arrive late cannot support lessons that have already been taught. The availability gap was therefore both deep and badly timed, and it pushed teachers toward theoretical delivery not by choice but by necessity. This reading aligns with the evidence that materials set the limits of what can be enacted [2] and that ambitious curricula are repeatedly introduced without their material base [3]; the Ministry did dispatch digital content and teaching guides from 2020 [33], which suggests that the problem lay less in whether resources were sent than in whether they reached classrooms in usable quantities and in good time.

VII. CONCLUSIONS

The study concludes that the availability of instructional resources has a statistically significant influence on the implementation of the Integrated Science curriculum, and that among the four dimensions of teacher preparedness examined it was the most binding constraint. Instructional resources were generally scarce, and the shortage was most severe for the resources central to inquiry-based science, namely information and communication technology tools, internet access, charts and models, and laboratory chemicals and equipment; even textbooks and teaching guides, the most available resources, were more often rated inadequate than adequate. The qualitative evidence traced the

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shortfall to a chronic shortage of science resources and to the late delivery of the materials that were supplied. Because the resources on which the curriculum depends were absent, teachers could not deliver it as intended regardless of their training or their willingness, so the curriculum was implemented in form more than in substance. Preparedness fails first where the material base is missing, and no amount of training or goodwill can compensate for that absence.

VIII. RECOMMENDATIONS

Arising from the findings, the study makes the following recommendations. First, the Ministry of Education and the Kenya Institute of Curriculum Development should prioritise the supply of the practical and digital resources on which the Integrated Science curriculum depends, in particular laboratory equipment and chemicals, information and communication technology tools and internet access, with particular regard to the poorly resourced public schools where the shortfall is sharpest. Second, the supply chain should be managed so that basic materials such as textbooks and teaching guides reach schools before the start of each term, since resources that arrive late cannot support lessons that have already been taught. Third, because supplying resources does not by itself change practice, provision should be paired with the training and follow-up support that enable teachers to put the resources to use, so that closing the availability gap translates into the practical, inquiry-based delivery the curriculum was designed to achieve.

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