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Pedagogical Transformation Through STREAM: Evidence from a Primary School Case Study in Pakistan

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Abstract

This study examines the persistent limitations of conventional education practices in Pakistan, where rote memorization and subject fragmentation dominate instruction. It investigates the development and implementation of an integrated primary curriculum based on the STREAM (Science, Technology, Reading/Writing, Engineering, Arts, Mathematics) model at Umm Al Qura (UAQ) Schools, Katlang, Pakistan. The research explored how STREAM-inspired approaches can enhance 21st-century skills, foster thematic integration, and increase student engagement within culturally relevant frameworks. A qualitative case study design was employed, guided by constructivist, sociocultural, and integrated curriculum theories (Beane, 1997; Vygotsky, 1978; Dewey, 1938). Data were collected through focus group discussions with teachers, parents, and students, as well as document analysis of curriculum materials, lesson plans, teacher journals, and student work. Thematic analysis (Braun & Clarke, 2006) and Krippendorff's (2004) and content analysis were used to identify recurring patterns and cross-verified through triangulation. Findings indicate that STREAM-inspired practices promoted student participation, deeper cross-disciplinary connections, and socio-emotional growth. However, entrenched curricular rigidity, inadequate teacher preparation, and limited policy alignment remained obstacles to broader implementation. The study concludes that targeted professional development, performance-based assessment tools, and structured community engagement are critical for embedding STREAM as a sustainable reform. It recommends adapting low-cost, locally sourced STREAM resources, aligning assessment with inquiry-based learning outcomes, and fostering stronger school–community partnerships to ensure long-term impact in low-resource contexts.

Keywords: *STREAM education, curriculum integration, primary education, Pakistan, constructivist pedagogy, 21st-century skills*

Introduction

The 21st century education needs more than a cramming of isolated facts; it is becoming more and more a matter of learners being able to think critically, solving complex problems, and effectively working with others as well as directly applying knowledge into the real world. Education systems around the world have been realigning their curricula to these requirements by abandoning a subject-centric approach in favor of an integrated and inquiry-based approach. It is worth noting that many countries, including Finland, Singapore, or South Korea, have managed to incorporate interdisciplinary models, such as STEM, STEAM, or STREAM in their national education and developed the ability to be innovative and adaptive, which are the most sought-after skills in the current global knowledge economy (Leshner, 2018; Kruger et al., 2019).

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Pakistan has, however, not been able to make the same progress in education reforms. The point that makes the system very dependent on rote memorization and examination-based practices is that students are frequently rewarded to repeat information instead of implementing or synthesizing it (Amer et al., 2020). This is even complicated by structural issues: over-crowded classrooms and multi-grade instruction, inadequate number of trained teachers and insufficient instruction materials. Although there have been multiple reform initiatives, such as the newer Single National Curriculum (MoFEPT, 2022), the majority of the time, classrooms are still characterized by textbook-based and subject-centered teaching, with not much room left to prepare students to think at a higher level or be creative.

This dependence on superficial learning is not peculiar to Pakistan but is a problem inherent to most developing nations where the lack of resources, centralized curriculum and exam-based systems restrict the opportunity to innovate pedagogical practices (Lee, 2014). Curriculum integration in these situations is seen as a dangerous or unrealistic undertaking even when an increasing amount of research around the world indicates its possible benefits. As an example, the STREAM (Science, Technology, Reading/Writing, Engineering, Arts, Mathematics) has become an area of bright prospects to combine the disciplinary knowledge, to also incorporate the literacy and creativity, and thus to expand the range of STEM. It focuses on problem-solving, inquiry, and real-world application, which is characterized by project-based learning, which represents actually existing social and cultural situations (Lefever-Davis & Pearman, 2015; Dyer, 2018).

Strategic approaches based on STREAM have shown positive results in the world. According to studies, STREAM increases student motivation (Nilsook et al., 2022), creativity (Al Ajlouni and Al-Ani, 2023), and gives the teacher new bases to follow when building lessons. It is also demonstrated that the combination of literacy and arts education with science and mathematics education empowers students to express their knowledge of complex concepts, integrate their disciplines, and reflect critically (Zsoldos-Marchis, 2019). In addition, STREAM has been discussed as a culturally responsive pedagogy in a variety of settings, and, in such cases, it enables the incorporation of local values, moral reasoning and disciplinary knowledge (Khoiri et al., 2017).

Although these benefits exist, curriculum integration is not a well-studied and controversial research area. According to Grant and Paige (2007), studies on integrated curricula are still quite few and there are doubts regarding its sustainability in either it being effective in terms of equipping students to solve problems or in equipping them to meet the complex issues in the society. Similar arguments are made by Applebee, Adler and Flihan (2007) who claim that the evidence base is still not adequate, and require more research in various educational contexts. Even in those countries, where integration has been established officially, a number of barriers continue to exist, such as if teachers are ready to work with interdisciplinary subjects, the presence of subject silos, and the inability to link the assessment systems with the interdisciplinary learning outcomes (Dare et al., 2018; Margot & Kettler, 2019). Such issues become even more evident in the context of low-resource settings, as schools lack materials and professional development opportunities, and encounter institutional resistance in many cases that discourages experiments (Arnone & Hanuscin, 2018; Zsoldos-Marchis, 2019).

In Pakistan, such limitations are specifically clear. The teachers do not have time to develop professionally, and not many received interdisciplinary or inquiry-based teacher training (Shaheen et al., 2022). The role of parents in pedagogy is also a factor, since in most families, learning is associated with the amount of books being carried or the number of lines learned by heart and not with creativity or teamwork (Troudi & Alwan, 2010).

Furthermore, curriculum design tends to treat subjects, such as Islamiat and Urdu, as isolated units, even though these could be meaningfully connected to scientific, technological, or artistic inquiry. Such siloed instruction leaves students ill-prepared for the demands of higher education and the workforce, where integration and application of knowledge are critical.

Thus, while global evidence highlights STREAM's potential to transform learning, there remains a striking absence of empirical research exploring its feasibility in Pakistani schools, particularly those operating in low-resource contexts. Addressing this gap is significant for two reasons. First, it provides evidence on whether STREAM can serve as a locally adaptable and sustainable model for curriculum integration in Pakistan. Second, it helps to articulate the systemic barriers like policy, pedagogical, and cultural that must be addressed if integrated curricula are to move beyond pilot projects and into mainstream practice.

Guided by constructivist learning theory (Vygotsky, 1978), sociocultural perspectives on education (Dewey, 1938), and curriculum integration theory (Beane, 1997), this study investigates the development and implementation of a STREAM-based primary curriculum at Umm Al Qura (UAQ) Schools in Pakistan. It explores how teachers, students, and parents experienced this new model, and what opportunities and challenges emerged in the process. Specifically, it asks:

1. How can an integrated primary school curriculum be implemented using STREAM approaches in UAQ schools, and what problems are encountered in the process??
2. What pedagogical, institutional, and cultural challenges arise in the process?

By examining these questions through qualitative case study methods, the study contributes to the international literature on curriculum integration while providing localized evidence for policymakers, practitioners, and researchers interested in reforming education in Pakistan and similar contexts.

Methodology

A qualitative case study design was employed to capture the lived experiences of stakeholders and the curricular shifts enacted at Umm Al Qura Schools, Katlang. This approach was selected for its capacity to provide rich, contextualized insights into educational practices.

Data were collected from three focus group discussions, one each with teachers, parents, and students, as well as a purposive selection of school documents, including curriculum frameworks, lesson plans, teacher journals, student portfolios, and administrative guidelines. The FGDs lasted 45–60 minutes, were audio-recorded, and transcribed verbatim. Document collection aimed to capture both the intended and enacted curricula.

Thematic analysis (Braun & Clarke, 2006) was applied to FGD transcripts to identify recurring themes, while document analysis followed Krippendorff's (2004) content analysis framework, which included unitizing, coding into STREAM categories, identifying patterns, and interpreting their significance. Triangulation across datasets enhanced validity by cross-verifying emergent themes. Informed consent and student assent were obtained prior to data collection.

Findings and Discussion

The implementation of a STREAM-based curriculum revealed a complex but promising picture of pedagogical transformation. Data from focus group discussions (teachers, parents, students), interviews, and document analysis (lesson plans, teacher journals, and student portfolios) converged to highlight both the opportunities STREAM created for enhancing engagement and the obstacles that limited its full realization. This empirical evidence is combined with theoretical frameworks in the discussion below to illustrate the extent to which STREAM influenced learning and teaching practices in the UAQ school.

The improved student engagement was one of the most recurring themes of both teacher data and classroom observations. Teachers described students as "never bored" during STREAM activities, contrasting this with the passivity often observed in textbook-driven lessons. For instance, T2 emphasized:

> *Professional discussions help us update our practices, and students immediately respond when lessons are linked to real life.*

This was confirmed through document analysis of lesson plans in which various entries had

lesson objectives structured in terms of real world situations like applying local farming practices to present the scientific concepts of plant growth. These results are reminiscent of those of Bransford et al. (2000) who claim that multimodal and contextually based learning facilitates higher cognitive involvement.

Student voices reinforced this perception. In the FGD, S1 remarked:

> *We liked the projects because we worked together and could show our ideas.*

Similarly, S3 noted that STREAM projects allowed them to "explain science with stories and pictures," reflecting the integration of arts and literacy into scientific inquiry. Analysis of student portfolios further demonstrated this, where drawings, reflective writing, and group posters showcased connections between disciplines that are typically taught in isolation. Thematic coding of these artifacts revealed evidence of cross-disciplinary reasoning, such as linking Islamic values of conduct with environmental science or embedding mathematical calculations within engineering models.

At the same time, the findings revealed unevenness in curriculum integration. While science and technology projects were readily linked to Islamiat and literacy, subjects such as mathematics and engineering remained more siloed. T4 expressed this challenge:

> *We know how to combine science and Islamiat, but for engineering or maths we don't know how to integrate without losing focus.*

This tension highlights the broader issue of curriculum coherence, particularly in contexts where subjects are culturally or religiously sensitive. Beane's (1997) theory of curriculum integration emphasizes that meaningful integration requires thematic units that transcend subject boundaries; however, the case study shows that without explicit training and resources, teachers revert to familiar, compartmentalized methods.

The research also helped to shed light on the influence of teacher capacity in determining the success of STREAM. There was a lack of preparation as the teachers constantly reported enthusiasm. As T1 acknowledged:

> *We are the ones who possess the ideas but not the strategies. There should be training on how to design lessons that can fit in STREAM.*

In teacher journals there was more evidence of this struggle. Some of the entries were doubtful on assessment, with the following being some of the notes:

> *How do we test creativity? or "Hard to balance the tasks in STREAM with syllabus achievement"*

These are consistent with the findings of Shaheen et al. (2022), who recorded the same impediments to interdisciplinary instruction in Pakistan, which highlights the idea that capacity-building should be based on systemic change.

Other complexity came in the parental perceptions. Even though some parents liked that their children were more engaged, others compared the lowered focus on textbooks to a fallen academic level. For example, P1 stated:

> *Children used to carry a lot of books before and now few notebooks. It feels less serious.*

These perceptions exemplify the reason why curriculum change can cause emotional and cultural anxieties as argued by Troudi and Alwan (2010) when the change is perceived to be against the norms of what real learning should be. As evidenced by the case, reforms may fail because they will not be understood or embraced by the community unless they are systematically engaged with and sensitized.

The other theme that came out was the use of cheap and local resources to enable STREAM projects. The teachers were recorded replacing lab materials with household items, like plastic bottles to use in the experiments or clay to use in engineering models. Although this resourcefulness was admirable and enabled STREAM activities to be conducted even though materials were limited, the weakness of this innovation was also put into focus. As

T3 reflected:

> *STREAM can be accomplished with the local materials, though it requires more time to prepare and in some cases, it does not work as it was planned.*

Sustainability of STREAM can therefore not simply be on the creativity of the teachers, but also on institutional support in provision of resources and time to plan the lesson.

Theoretically, the findings demonstrate how STREAM may be used to operationalize the constructivist and sociocultural learning. The concept of the Zone of Proximal Development introduced by Vygotsky (1978) was visible in the interactions between students, as they scaffolded each other in the process of learning in a group project. Students shared roles, started discussing tasks, and gave feedback, which were observed in several observations in the classroom. This collaborative behavior supports Dewey's (1938) argument that education should be rooted in experiential and social learning. At the same time, the challenges of uneven integration and limited training reveal the gap between the theoretical promise of integrated curricula and the realities of classroom practice.

Taken together, the findings suggest three key insights. First, STREAM has significant potential to transform learning environments in Pakistan by enhancing engagement, fostering cross-disciplinary reasoning, and supporting socio-emotional growth. Second, the sustainability of STREAM is contingent on targeted teacher professional development and parental awareness programs, without which integration risks being superficial. Third, systemic and cultural factors, curriculum rigidity, exam-oriented assessment, and parental expectations remain formidable barriers to mainstream adoption.

These insights reinforce international scholarship that highlights both the advantages and challenges of curriculum integration (Grant & Paige, 2007; Applebee et al., 2007). However, this study contributes original empirical evidence from Pakistan, a context largely absent in the STREAM literature. By documenting both successes and struggles, it offers a nuanced understanding of how integrated approaches may be adapted to resource-constrained settings, and what systemic shifts are necessary for them to thrive.

Conclusion and Recommendations

This study has demonstrated the feasibility and pedagogical promise of integrating a STREAM-based curriculum within the primary school context of Pakistan. The findings show that interdisciplinary approaches not only enhanced student engagement and collaboration but also nurtured socio-emotional growth and critical thinking, while encouraging teachers to shift from traditional textbook-driven methods toward more learner-centered practices. At the same time, structural challenges including limited resources, gaps in teacher preparation, and parental concerns, continue to constrain the broader implementation of STREAM.

In order to establish future reform, a number of priorities have to be met. Professional growth that is sustained and practice based is critical in equipping teachers with skills that can be used in designing and delivering integrated lessons. The barriers may be minimized by supporting resource adaptation such as creating low-cost teaching aids specific to STREAM that can be used to facilitate consistency in instructions. Another point is equally vital: assessment practices should be reformed to shift out of rote memorization into performance-based and formative assessment, which can measure the creativity, collaborative skills and problem-solving abilities that are sought by STREAM. It is also essential to enhance parent/school relationships in order to eliminate the myth of rigor and establish a mutual stake in innovation. Lastly, the incorporation of STREAM into national curricula and policy will help to make integration not look like an added feature but a core component into making learners competent in the 21st century.

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