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Relationship of Science Festival Programming and Policy Learning to Attitude Change in Rural Student Participants

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Abstract

The enduring disparities in educational resources between urban and rural communities have significantly hindered the development of scientific literacy and engagement among rural student populations. This research investigates the complex mechanisms through which targeted science festival programming, deliberately integrated with policy learning modules, facilitates profound attitude changes toward science and technology in rural students. By adopting a mixed-methods approach, this study evaluates the cognitive and affective transformations experienced by secondary school participants attending a specialized regional science festival designed to bridge the gap between abstract scientific concepts and local socio-economic realities. The programming emphasizes interactive exhibitions alongside structured deliberations on science policy, thereby exposing students not only to empirical phenomena but also to the governance, ethical considerations, and public administration of scientific endeavors. Data collected through extensive pre-intervention and post-intervention psychometric assessments, augmented by in-depth semi-structured interviews, reveal highly significant positive shifts in participants perceived self-efficacy, epistemic curiosity, and civic responsibility regarding scientific issues. The findings demonstrate that embedding policy learning within informal science education catalyzes a deeper contextual understanding, enabling rural youth to perceive science as a relevant, accessible, and malleable tool for regional development. This paper provides critical insights for educational policymakers, curriculum developers, and festival organizers seeking to democratize science engagement and foster a scientifically literate, policy-aware generation in historically marginalized geographical areas.

Keywords: Science Festivals; Policy Learning; Attitude Change; Rural Education; Science Festival Programming

1. Introduction

1.1 Background and Context of Rural Science Education

The provision of equitable and high-quality educational opportunities remains a fundamental challenge in educational policy and administration worldwide, with the urban-rural divide representing one of the most persistent structural inequities in contemporary education systems. Rural students frequently encounter systemic barriers that severely limit their access to advanced scientific infrastructure, specialized instructional personnel, and extracurricular enrichment programs. Consequently, these demographic cohorts often exhibit lower levels of engagement with science, technology, engineering, and mathematics disciplines compared to their urban counterparts. This engagement deficit is not merely a product of individual aptitude but rather a systemic outcome of localized resource scarcity, geographical isolation, and the absence of visible role models in scientific professions within their immediate communities. Furthermore, the traditional didactic approaches prevalent in many rural educational settings often fail to contextualize

scientific principles within the lived realities of the students, rendering the subject matter abstract, disconnected, and seemingly irrelevant to their daily lives or future career trajectories [1].

In recent years, informal science education initiatives, particularly regional science festivals, have emerged as prominent pedagogical interventions designed to circumvent the limitations of formal classroom environments. These transient, intensive, and highly interactive events serve as boundary-crossing platforms that bring together research institutions, industry professionals, educators, and the general public. By transforming public spaces into dynamic laboratories of exploration, science festivals aim to democratize access to scientific knowledge, spark intellectual curiosity, and foster a culture of lifelong learning. For rural populations, the arrival of a science festival often represents a rare and critical injection of scientific capital into the community, providing students with unprecedented opportunities to engage with cutting-edge technologies, participate in hands-on experiments, and interact directly with practicing scientists. However, while the capacity of these festivals to generate short-term enthusiasm is well documented, the underlying mechanisms that translate this ephemeral excitement into enduring cognitive and affective attitude change remain underexplored, particularly concerning how these interventions interact with the unique socio-cultural identities of rural youth [2].

1.2 The Integration of Policy Learning and Objectives of the Study

An emerging dimension in the discourse surrounding informal science education is the concept of policy learning, which transcends the mere acquisition of factual scientific knowledge to encompass a critical understanding of how scientific endeavors are governed, funded, regulated, and integrated into societal decision-making frameworks. In the context of rural communities, where issues such as agricultural innovation, environmental conservation, energy production, and resource management are often inextricably linked to regional economic survival, science is profoundly political. Therefore, empowering rural students requires an educational paradigm that not only demystifies scientific phenomena but also illuminates the policy mechanisms through which science impacts their immediate environment. When science festival programming incorporates elements of policy learning such as mock public hearings, debates on resource allocation, and interactive simulations of environmental regulation students are prompted to evaluate scientific advancements through a sociopolitical lens. This holistic approach posits that attitude change is optimized when students recognize their agency not solely as passive consumers of science, but as informed citizens capable of participating in the democratic governance of scientific application [3].

The primary objective of this comprehensive study is to systematically explain the process of attitude change among rural secondary school students who participate in a highly structured science festival that explicitly merges empirical scientific demonstrations with policy learning modules. Specifically, this research seeks to address the gap in the existing literature by isolating the distinct pedagogical components that drive shifts in students self-efficacy, their perception of scientific relevance, and their disposition toward civic engagement in science-related matters. By dissecting the interactive effects of experiential science learning and policy discourse, the study aims to construct a robust explanatory model that delineates how cognitive dissonance, active elaboration, and contextualized relevance converge to produce sustained attitudinal transformations. Ultimately, the insights generated from this investigation are intended to inform the strategic design of future educational outreach programs, ensuring that investments in informal science education yield maximal developmental dividends for marginalized rural populations, thereby contributing to the broader goal of systemic educational equity.

2. Literature Review and Theoretical Framework

2.1 The Efficacy of Informal Science Learning Environments

The theoretical conceptualization of learning has expanded significantly beyond the spatial and temporal confines of the traditional classroom, with increasing scholarly attention directed toward the pedagogical efficacy of informal science learning environments. Informal learning contexts, which encompass science centers, museums, community-based maker spaces, and itinerant science festivals, are characterized by their voluntary nature, learner-driven exploration, and emphasis on affective engagement over standardized

assessment. A substantial body of literature suggests that these environments are uniquely positioned to cultivate intrinsic motivation, as they allow participants to navigate educational content at their own pace, guided by personal interest and epistemic curiosity. Within the specific domain of science festivals, researchers have consistently observed that the immersive and multisensory nature of the programming disrupts preconceived notions of science as a solitary, rote, and unapproachable discipline. Instead, festivals reframe scientific inquiry as a collaborative, dynamic, and socially embedded enterprise. This reframing is particularly crucial for rural demographic segments, who may harbor implicit biases or anxieties regarding scientific subjects due to historically inadequate educational provision. The interactive exhibits typically featured at these events function as cognitive scaffolds, enabling participants to interact physically with complex phenomena, thereby reducing the cognitive load associated with abstract theoretical comprehension and facilitating the formation of foundational scientific schema [4].

Despite the recognized benefits of informal science environments, critical perspectives within the literature caution against overestimating their long-term impact in the absence of deliberate pedagogical structuring. Critics argue that while science festivals excel at generating transient positive affect often termed the wow factor they may fail to provoke the deep cognitive processing required for enduring attitude change if the content is completely divorced from the participants existing knowledge base or socio-cultural context. Consequently, contemporary research has increasingly focused on the concept of localized relevance, emphasizing that informal science initiatives must be intentionally tailored to reflect the ecological, economic, and cultural realities of the host community. When rural students encounter scientific exhibits that address local challenges such as agricultural water management, soil remediation, or regional biodiversity, the learning experience is immediately contextualized. This contextualization not only enhances cognitive retention but also directly targets the affective dimension of attitude, transforming the perception of science from a distant, elite pursuit into a highly applicable tool for community problem-solving and regional advancement [5].

2.2 Cognitive Frameworks of Attitude Change

To adequately analyze the transformations occurring within the context of science festival participation, it is imperative to ground the investigation within established psychological frameworks of attitude change. The Elaboration Likelihood Model serves as a primary theoretical anchor for this study. The model posits that attitude change can occur via two distinct pathways: the central route, which involves high cognitive effort, critical evaluation of arguments, and deep processing of information; and the peripheral route, which relies on superficial cues, emotional appeals, and heuristic processing. In the context of a science festival, the vibrant atmosphere, charismatic presenters, and visually striking demonstrations often activate the peripheral route, resulting in immediate but potentially fragile shifts in attitude. However, to achieve stable and enduring attitudinal transformations, educational programming must stimulate the central route of processing. This is accomplished by ensuring that the information presented is perceived as highly relevant to the participant, thereby motivating them to engage in active cognitive elaboration. When rural students are presented with scientific issues that directly impact their communities, their personal involvement increases, prompting them to critically evaluate the evidence and integrate the new information into their existing cognitive structures, leading to robust and lasting attitude change [6].

Complementing the cognitive processing models, the Theory of Planned Behavior provides vital insights into how altered attitudes translate into tangible intentions and subsequent actions. According to this framework, behavioral intentions are shaped by three core components: an individuals attitude toward the behavior, subjective norms, and perceived behavioral control. In the realm of science education, perceived behavioral control is closely aligned with the concept of scientific self-efficacy the belief in ones own capability to understand scientific concepts and participate in scientific discourse. Traditional rural educational experiences often inadvertently diminish scientific self-efficacy by presenting the subject as prohibitively difficult or disconnected from local utility. Science festivals, through their emphasis on experiential learning, low-stakes experimentation, and immediate positive feedback, serve as powerful interventions to rebuild this self-efficacy. By successfully completing hands-on tasks and engaging in peer discussions, students experience mastery and vicarious reinforcement, which significantly elevate their perceived behavioral control. Furthermore, the communal nature of the festival alters subjective norms,

creating a temporary social environment where enthusiasm for science is validated and encouraged by peers and community members, thereby fostering a highly conducive atmosphere for holistic attitude reconstruction [7].

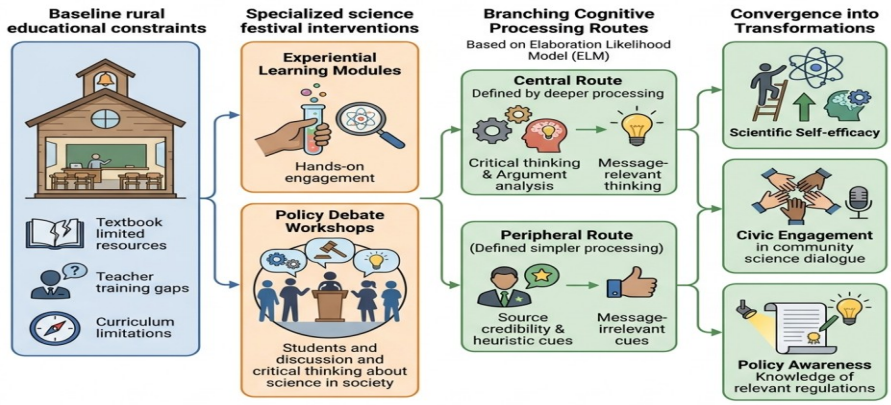

Figure 1: Comprehensive Theoretical Model of Attitude Change

2.3 Policy Learning as a Catalyst for Civic Scientific Literacy

The intersection of science education and public administration introduces the critical dimension of policy learning, an area that has historically been neglected in secondary educational curricula, particularly in rural regions. Policy learning in this context refers to the structured acquisition of knowledge regarding how scientific research is translated into societal regulation, how resources for scientific advancement are allocated, and how ethical considerations constrain or propel technological innovation. For rural populations, whose livelihoods are often directly regulated by agricultural, environmental, and infrastructural policies, an understanding of this translation process is paramount for meaningful civic participation. When youth are educated solely on the empirical facts of science without exposure to its policy implications, they are deprived of the intellectual tools necessary to navigate the complex socioscientific issues that will define their future. Integrating policy learning into informal science programming represents a paradigm shift from passive scientific literacy to active civic scientific literacy, empowering students to comprehend the systemic forces that shape scientific implementation in the real world.

The pedagogical mechanisms of policy learning within a festival setting typically involve immersive, participatory activities such as stakeholder role-playing, mock legislative sessions, and structured ethical debates. These activities require students to adopt diverse perspectives, negotiate conflicting interests, and synthesize scientific evidence with socio-economic variables to propose viable policy solutions. By participating in these complex cognitive exercises, students move beyond the mere memorization of facts to engage in higher-order analytical and evaluative thinking. This active engagement demystifies the policy-making process, revealing it not as an opaque, top-down imposition by distant authorities, but as a dynamic, accessible, and negotiable human enterprise. Consequently, policy learning acts as a potent catalyst for attitude change by enhancing the perceived relevance of science, fostering a sense of civic responsibility, and instilling the belief that local voices, armed with scientific understanding, can meaningfully influence the governance and trajectory of regional development initiatives [8].

3. Methodology and Research Design

3.1 Research Context and Participant Demographics

To empirically investigate the proposed theoretical models, this study employed a rigorously designed mixed-methods approach, situated within the context of a large-scale, mobile science festival deployed across several economically disadvantaged, predominantly agricultural rural districts. The selected region is historically characterized by significant deficits in secondary educational funding, high turnover rates among qualified science instructional staff, and lower-than-average regional matriculation rates into tertiary STEM programs. The science festival, which served as the primary intervention, was specifically engineered to address these local deficiencies by integrating state-of-the-art technological demonstrations with culturally resonant programming. Over a period of two weeks, the mobile festival established temporary educational hubs in central community locations, such as agricultural exhibition grounds and regional community centers, ensuring maximum accessibility for the dispersed student populations.

The participant cohort was selected utilizing a stratified random sampling technique across eight regional secondary schools to ensure a representative distribution of age, gender, and baseline academic performance. The final sample consisted of students aged fourteen to seventeen, a critical developmental window for the formation of long-term career aspirations and civic identities. Informed consent was meticulously obtained from both the participants and their legal guardians, in strict adherence to the ethical guidelines governing research involving minor subjects.

Table 1: Participant Demographic and Baseline Educational Characteristics

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Female	210	52.5
Gender	Male	190	47.5
Age Group	14-15 Years	185	46.2
Age Group	16-17 Years	215	53.8
Prior Extracurricular STEM	None	320	80.0
Prior Extracurricular STEM	1-2 Events	80	20.0

The demographic data highlights the pronounced lack of prior exposure to informal STEM enrichment activities, establishing a clear baseline that underscores the novelty and potential impact of the science festival intervention for this specific rural cohort [9].

3.2 Data Collection Instruments and Psychometric Assessment

The quantitative dimension of the mixed-methods design relied on the administration of a comprehensive, validated psychometric instrument developed specifically to measure multidimensional attitude change regarding science and science policy. The survey instrument was deployed in a pre-intervention and post-intervention format, with the post-intervention assessment occurring exactly four weeks following the conclusion of the festival to measure retained attitude shifts rather than immediate, transient emotional responses. The instrument utilized a structured Likert-type scale, encompassing multiple distinct sub-scales designed to isolate specific cognitive and affective constructs. These constructs included perceived scientific self-efficacy, valuation of scientific relevance to the rural economy, intrinsic interest in scientific inquiry, and civic confidence in participating in policy-related discourse. Rigorous statistical reliability tests were conducted on the instrument prior to deployment, ensuring high internal consistency and construct validity across all measured domains.

Complementing the quantitative surveys, the qualitative methodology involved a series of in-depth, semi-structured interviews conducted with a purposefully selected subsample of participants who exhibited the most significant variance in their pre- and post-intervention scores. These interviews were systematically designed to elicit narrative accounts of the students subjective experiences during the festival, providing critical insights into the specific pedagogical components that catalyzed their cognitive transformations. The interview protocols focused heavily on the students interactions with the policy learning modules, probing their understanding of stakeholder dynamics, their emotional responses to the mock debates, and their subsequent articulation of how science impacts their local community. All qualitative sessions were meticulously recorded, transcribed verbatim, and subjected to rigorous thematic analysis to identify recurring patterns of meaning, enabling the researchers to triangulate the qualitative narratives with the empirical survey data and thereby construct a highly nuanced and comprehensive understanding of the intervention's efficacy [10].

4. Program Implementation and Pedagogical Mechanisms

4.1 Integration of Scientific Exhibits and Policy Modules

The architectural design of the science festival programming was central to the success of the intervention, characterized by a deliberate departure from traditional, passive exhibition models. The festival was structurally divided into interlinked zones, each functioning as a cohesive pedagogical unit that seamlessly blended empirical scientific demonstration with explicit policy analysis. For example, rather than simply displaying a standalone exhibit on photovoltaic cell efficiency, the Renewable Energy Zone embedded the technological demonstration within a broader, localized socio-economic narrative. Students first engaged in hands-on activities to measure energy output under various simulated weather conditions, thereby acquiring foundational knowledge of the underlying physical principles. Immediately following this experiential phase, participants were transitioned into a structured policy module focused on the complexities of implementing solar infrastructure within their specific agricultural region. This module required students to analyze actual municipal zoning regulations, evaluate the economic trade-offs between utilizing land for energy production versus traditional crop cultivation, and debate the ethical implications of government subsidies for green technologies.

Similarly, the Water Quality and Agricultural Runoff Module was designed to address one of the most pressing ecological and economic challenges facing the rural demographic. Students utilized professional-grade chemical assay kits to test locally sourced water samples, identifying concentrations of specific agricultural pollutants. This empirical exercise was deeply integrated with a policy simulation where students assumed the roles of local farmers, environmental regulatory officials, and regional water authority representatives. Through facilitated town hall-style debates, the students were tasked with negotiating acceptable limits for chemical runoff, balancing the immediate economic necessity of maximizing crop yields against the long-term imperative of ecological preservation and public health. This highly contextualized programming structure ensured that scientific facts were never presented in a vacuum; instead, they were consistently framed as critical data points necessary for informed, responsible, and effective civic decision-making in a complex, multi-stakeholder environment.

4.2 Mechanisms of Engagement and Cognitive Elaboration

The mechanisms through which these integrated programming components induced attitude change were closely monitored and analyzed. A primary mechanism identified was the intentional induction of cognitive disequilibrium followed by guided resolution. During the policy debates, students were frequently exposed to compelling arguments from opposing stakeholder perspectives, challenging their preexisting simplistic notions of right and wrong in scientific implementation. This exposure generated cognitive dissonance, forcing the participants to critically re-evaluate their assumptions and engage deeply with the material to reconcile the conflicting information. The facilitation provided by the festival educators was crucial in this phase; rather than providing direct answers, the educators utilized Socratic questioning techniques to guide the students in evaluating the credibility of evidence, assessing the validity of different viewpoints, and synthesizing complex information to formulate their own reasoned conclusions. This rigorous intellectual exercise actively engaged the central route of the Elaboration Likelihood Model, ensuring that the resulting shifts in understanding were anchored in deep cognitive processing rather than superficial acceptance.

Furthermore, the deliberate emphasis on localized relevance served as a powerful mechanism for enhancing participant engagement and overcoming the traditional barriers of apathy or perceived inadequacy. By anchoring the scientific phenomena and policy discussions in the immediate, tangible realities of the students lived environment, the programming effectively neutralized the perception of science as an abstract, elitist pursuit. The students recognized that the issues being discussed pertained directly to the economic viability of their families farms, the health of their local ecosystems, and the future prosperity of their communities. This profound realization of personal and regional relevance dramatically amplified their intrinsic motivation to learn, fostered a heightened sense of ownership over the educational experience, and cultivated a robust sense of civic agency, ultimately driving the substantial attitudinal transformations observed throughout the course of the intervention [11].

5. Results and Discussion

5.1 Quantitative Findings on Attitudinal Transformation

The empirical data derived from the pre- and post-intervention psychometric assessments provide compelling evidence of the profound impact generated by the integrated science festival programming. Statistical analysis of the survey results indicates highly significant positive shifts across all targeted dimensions of student attitudes. A paired-samples analytical approach was utilized to compare the mean scores before the intervention with those collected four weeks post-intervention, ensuring that the measured changes reflected stable cognitive restructurings rather than immediate, transient enthusiasm. The analysis revealed that the most substantial and statistically significant increases occurred within the domains of perceived scientific self-efficacy and civic confidence in engaging with socioscientific issues. Students reported a markedly enhanced belief in their personal capability to comprehend complex scientific data and, critically, a newly formed conviction that they possess the necessary skills to participate meaningfully in local policy discussions concerning technological and environmental interventions.

Table 2: Pre- and Post-Inter

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