Deficit Versus Dialogue Models of Science Communication: A Comparative Analysis of Effectiveness

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ABSTRACT

Communication in science is based much on two different models which is the deficit model and the dialogue model but there is a continuous argument on which of the two is better for this contemporary needs. So, what this study did was to compare the two models using a qualitative documentary design. The study gathered data from peer reviewed journal articles, books and conference papers that was published from 2018 onwards. The study was guided by three research questions: characteristics and assumptions that underlie each model, the similarities and differences between the two models and their effectiveness in promoting public understanding, trust and engagement. The literatures used were retrieved from databases that include Google Scholar, Scopus, l and Web of Science before it was subsequently analyzed using a thematic and comparative techniques. The findings of the study showed that deficit model sees the public as people that lacking knowledge and it relies on the one way expert-to-audience communication but the dialogue model sees the public as people who already have relevant knowledge and it promoted two-way exchange of communication between the expert and the audience but the similarity between the two models is that they aims to improve how science reaches the society but the rely on diverging assumptions, methods and measures of success. While the deficit model shows that it is effective for a fast communication of large information delivery, the dialogue model showed that it is effective in building trust and sustaining public participation genuinely. None of the models is more sufficient when used alone because their value depends on the communication objective and the audience involved. The study concluded that the combination of clear information delivery with structures opportunities for dialogue can lead to a more real path for effective science communication in Taraba State and Nigeria and the study recommended that science educators and communicators should adopt a hybrid of the strategies instead of treating the two models as exclusive.

Keywords: science communication, deficit model, dialogue model, public engagement, public trust, public understanding of science

INTRODUCTION

Scientific knowledge is so essential that it now influences decisions in health, agriculture, environmental management and public policy which means that ordinary citizens are concerned and involved in conversations that was once limited to laboratories and research institutions. The debate on climate change, vaccination, genetic engineering and artificial intelligence always requires that the public gives their input and this is why scholars now have interest to know how science is communicated to people outside the research community (Grant, 2023). In the twentieth century and most of the period, what was used to communicate science is what is now called the deficit model which is an approach that assumes that the reason why the public is skeptical towards science is because of their lack of knowledge and that the remedy is to supply more information through the one-way expert-to-audience channels such as lectures, broadcasts and through printed materials like newspaper (Reincke et al., 2020). What scientists believe in this model is that they have the knowledge while the public receives. Within this model, scientists hold the knowledge and the public receives it as lecture.

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With time researchers became curious and sought to know whether a one-way transfer of information alone could lead to change of attitudes or behaviour. But the studies that came been conducted began to show that people interpreted scientific claims through their cultural beliefs, prior experience and trust in institution rather than through facts alone (Metcalfe, 2019). This evidence that surfaced began to encourage a shift from the deficit model to a dialogue model which is a model that puts communication as a two-way process in which the scientists and the public exchange views, ask questions and learn from each other and it is achieved through public forums, science cafes and citizen science projects and many scholars now prefer the modem because of its glaring capacity to build trust between scientists and the public and to also sustain engagement between the two (Fahnrich et al., 2022). But even with this development, the deficit model of information communication has not disappeared as many institutions including the ones in Nigeria still rely on lectures and awareness campaigns as their default communication strategy which keeps the debate over which model serves science communication better very much alive (Onstad & van der Flier-Keller, 2025).

Statement of the Problem

The continuous public misunderstanding, skepticism and weak engagement of the public with scientific issues is still common despite many years of investment in science communication. And for a long period of time the deficit model was used because it was assumed that more information would produce more acceptance automatically but practical experience shows that this assumption does not always hold so the dialogue model was introduced in response to the shortfall and it was thought to have deeper engagement between the scientists and the public through interaction rather than instruction. The two models however still operate side by side in the practical sense but there is no consensus on which one of the models delivers better outcomes or under which circumstances each of the model is preferred. This comparison is important because previous studies have tended to examine the two models separately instead of placing them side by side with explicit attention to effectiveness. A focused comparison between the two models that is grounded on social constructivist theory, a theory that propose that understanding is developed through social interaction rather than passive reception of facts, and it provides a clear base for science educators for choosing communications strategies that suits specific audience and objectives.

So, science educators, communicators and policymakers are left without clear guidance on how to structure communication efforts because of this uncertainty and this is now a problem that this study want to address through a focused comparison based on literatures.

Purpose of the Study

The purpose of this study was to compare the Deficit and Dialogue Models of science communication and assess their relative effectiveness. The specific objectives were to:

1. Examine the key characteristics and communication underlying assumptions of the Deficit and Dialogue Models;

2. Analyze the similarities and differences between the two models; and

3. Evaluate the effectiveness of the two models in promoting public understanding, trust, and engagement in science.

Research Questions

1. What are the key characteristics and underlying assumptions of the Deficit and Dialogue Models of science communication?

2. What are the similarities and differences between the Deficit and Dialogue Models?

3. How effective are the Deficit and Dialogue Models in promoting public understanding, trust, and engagement in science?

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METHODOLOGY

The research design used in this study is the qualitative research design and this is a design which involves the systematic retrieval, review and interpretation of published materials that is already existing instead of collecting new data from human participants. This qualitative research design was suitable for the purpose of the study because it allowed for a comparison between the two models using the standpoints of the scholars without requiring a field work. The data came from secondary sources that include peer reviewed journal articles, scholarly books, and conference papers that conducted studies on science communication, public engagement and science literacy. Materials were specifically retrieved from academic databases that include Google Scholar, Scopus, Web of Science, Springer Link, Taylor and Francis Online, Sage Journals and Wiley Online Library. The researcher relied on secondary sources because it was more appropriate since the purpose of the study was to synthesizer existing knowledge instead of generating fresh empirical findings, therefore there was no human sample that was taken as the unit of analysis was the published literature and not individuals. Only sources that met the criteria: direct relevance to science communication, the deficit model, the dialogue model or public engagement; with preference for peer reviewed outputs; and a focus on materials published from 2018 onwards to keep the review current. So any that lacked academic credibility or that was not connected to the research questions were excluded. The process of data collection was reliance on keyword searches using terms like "science communication," "deficit model," "dialogue model," "public engagement" and "public understanding of science" all guided the retrieval across the databases listed earlier. Following this, the titles, abstracts and keywords were screened to only use the relevant ones before the full texts were obtained. After gathering these, the materials relevant to each research question was extracted and organized into groups of themes that correspond to the three objectives of the study. The data collected was analyzed using a thematic analysis by identifying recurring ideas and patterns across the literature while the comparative analysis was used to set the characteristics and assumptions and outcomes of the two models against each other and the findings from both techniques were synthesized as descriptions as it relates to the research questions and this allowed for conclusions to be drawn about the strengths and limitations of each model. There was also ethical consideration that the researcher considered like the consistent use of peer reviewed and other credible sources, using of a defined selection procedure and the cross checking of claims across the many publications instead of just relying on a single source.

RESULTS

Answering the research questions

RQI: What are the key characteristics and underlying assumptions of the Deficit and Dialogue Models of science communication?

Table 1: Comparison of the Deficit and Dialogue Models of Science Communication

DIMENSION	**DEFICIT MODEL**	**DIALOGUE MODEL**
	(Top-Down Information Flow)	**(Bidirectional Engagement)**
View of the Public	Public lacks scientific knowledge	Public possesses valuable knowledge and experiences
Communication Flow	One-way communication	Two-way communication
Role of Scientists	Providers of information	Participants and facilitators of discussion
Role of the Public	Passive recipients	Active participants
Main Goal	Increase scientific literacy	Promote engagement and mutual learning
Measure of Success	Knowledge acquisition	Understanding, trust, and participation
	Summary:	**Summary:**

	***Premise**: Assumes public skepticism toward science stems purely from a "knowledge deficit" or ignorance.*	***Premise**: Views the public as active, capable partners. It acknowledges that local, cultural, and experiential knowledge holds equal value to formal scientific data.*
		***Mechanism:** Two-way exchange, consultations, and interactive feedback loops.*
	***Mechanism**: Unidirectional, expert-to-layman dissemination of facts.*	***Effectiveness:** High. By inviting conversation, communicators can identify the root causes of public hesitancy. This builds long-term institutional trust and legitimacy and yields actionable values rather than forced consensus.*
	***Effectiveness**: Highly limited. Research demonstrates that simply providing more facts rarely changes public attitudes or behaviors, especially on polarizing issues. It frequently alienates audiences by appearing patronizing.*	

Characteristics and Assumptions of the Two Models

Table 1 sets out these contrasting assumptions across six dimensions (View of the public, communication flow, role of scientists, role of the public, main goal, and measure of success). It also outlines clearly the key characteristics and underlying assumptions of the Deficit and Dialogue Models of science communication. The deficit model assumes that the skepticism of the public towards science is because of their insufficient knowledge and that supplying accurate information through a one-way expert-to-audience channels will correct that gap (Grant, 2023). So, communication under this modem comes through lectures, documentaries and awareness campaigns with specific literacy treated as the chief measure of success (Metcalfe, 2019). The dialogue model on the other hand rejects the idea that the public is simply uninformed, instead it treats citizens as people who already have relevant knowledge and therefore communication in this model is framed as an exchange in which scientist and the public ask questions and learn from each other (the two-way approach) (Reincke et al., 2020). This model is passed through certain platforms like citizen science projects, public consultations and community forums and the success is measured by how much information was transmitted and more by the quality of understanding, trust and participation between the two that is achieved (Fahnrich et al., 2022).

RQ2: What are the similarities and differences between the Deficit and Dialogue Models?

Similarities and Differences

Table 1 also shows clearly the similarities and differences between the Deficit and Dialogue Models of science communication. Even though the two models' assumptions are in contrast yet they share three major aims: to improve the understanding of the public on science, to connect scientific knowledge with audiences outside the research community and to support informed decision making on matters like public health and environmental management. But they have differences and these differences go deeper than how surface description would suggest because the communication direction is reversed between the two models: the expert-to-public in deficit model and a reciprocal one in the dialogue model. The role of scientists also shifts from being a sole information provider to a facilitator of discussion and the role of the public also shifts from passive recipients to active contributors (Entradas et al., 2020). The methods of communication also differ in the two models accordingly: as lectures and media campaigns are typical examples of the deficit model while science cafes, workshops and

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stakeholder meetings are typical examples of the dialogue model practice. Again, the measure of success is divergent in the two models as deficit model favour knowledge gains and the dialogue model favour trust, participation and mutual understanding (Claessens, 2023).

RQ3: How effective are the Deficit and Dialogue Models in promoting public understanding, trust, and engagement in science?

Effectiveness in Promoting Understanding, Trust and Engagement

Table 1 also shows that in the Dialogue model of science communication the public possesses valuable knowledge and experiences, two-way communication, participants and facilitators of discussion, active participants, promote engagement and mutual learning, and, enhances public understanding, trust, and participation. Unlike the Deficit model, where the public lacks scientific knowledge, one-way communication, providers of information, passive recipients, increase scientific literacy, and knowledge acquisition. Though, both models can be inter-woven in communicating to the public during emergencies and crisis. And, in comparative effectiveness, the Dialogue model which is bidirectional engagement is highly effective.

Comparative analysis reveals the deficit model is largely ineffective for complex or controversial topics, as public decisions are driven by values and emotions rather than just a lack of facts. Its effectiveness is highly limited. Research demonstrates that simply providing more facts rarely changes public attitudes or behaviors, especially on polarizing issues. It frequently alienates audiences by appearing patronizing. While, the dialogue model proves superior by fostering mutual trust, integrating local knowledge, and addressing the specific sociopolitical context of audiences. This is because by inviting conversation, communicators can identify the root causes of public hesitancy. This builds long-term institutional trust and legitimacy and yields actionable values rather than forced consensus.

On the aspect of public understanding, the deficit model performs well when the task is straightforward information delivery to a large audience with limited prior knowledge and this pattern is supported by evidence that many science communicators still treat knowledge gain as their main objective (Besley et al., 2018) and that audiences continue to value clear and accurate explanations (Volk & Schafer, 2023). The same evidence shows that knowledge gain does not reliably translate into changed attitudes or behaviour since responses to scientific claims are influenced by values and prior trust as much as by facts (Reincke et al., 2020). The dialogue model exchange appears to close this gap more effectively since direct interaction allows people to question and relate new information to their own circumstances thereby producing deeper comprehension than one-way delivery alone (Entradas et al., 2020).

On the issue of trust, the literature shows that dialogue model solves this issue because simply distributing information does little to build confidence in scientific institutions if audiences already doubt the source but interaction that lets people question and challenge scientists tends to raise trust which is an outcome documented among participants who took part in direct engagement activities rather than receiving one-way briefings (Kennedy et al., 2021). Openness and responsiveness to public concern appear to matter as much as the accuracy of the information delivered (Houtman et al., 2021).

On the issue of engagement, the contrast is stark because the deficit model can stimulate initial interest through awareness campaigns but structured opportunities for participation remain limited within a one-directional format. So, the dialogue model by design builds participation into the communication process itself and initiatives led by citizens have been shown to increase the willingness of the public to take part in further activity related to science (Fahnrich et al., 2022) as well as interest in scientific problem-solving more generally (Fritz et al., 2024).

Consequently, the results suggest that the two models are not to be seen or treated as but tools suitable for different purposes because the deficit model retains clear value where speed and reach matter such as in public health advisories while the dialogue model has advantage where the goal is trust, sustained participation or handling of scientific issues with social or ethical dimensions.

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DISCUSSION

The findings that show that deficit model is still practiced in so many institutions and spaces despite many years of its criticism shows that there is still some relevance in it and is not outdated. Because institution that face time pressure like the ones issuing public health guidance still rely on this one-way dissemination because it is fast and reaches large numbers of people with little demand for logistics and this aligns with what

earlier studies observed that science communicators most times see knowledge increase as their basic objective even when they profess support for engagement in principle (Besley et al., 2018). Instead of seeing this persistence on deficit model as failure of the science to absorb newer thinking, it is important to understand that dialogue takes more time and resources that are not always available especially during emergencies or when addressing large number of audiences.

The finding that dialogue model builds trust more reliably that the deficit model aligns with the evidence that showed that participants in interactive activity showed a higher confidence in scientist than those that were engaged only on the one-way information (Kennedy et al., 2021). But one important thing to note is that trust does not depend much on the content of what is communicated but on whether people feel heard during the process. Where the deficit model does not give the public a channel to register doubt or ask questions the dialogue model builds from there and that is why responsiveness is seen to drive trust outcomes instead of just content accuracy (Houtman et al., 2021). But in contrast some scholars argue that too much emphasis on participation without regard to scientific accuracy or source credibility also has its own risk of misinformation especially where dialogue platforms are not moderated by an expertise. This caution however does not overturn the present finding but suggest that dialogue is not automatically protective against poor communication outcomes; but the quality of the exchange matters as much as its existence.

On the issue of engagement, the result showing the greater participation under dialogue format are in alignment with evidence that showed that there is stronger willingness among citizens to partake in further scientific activities if they are exposed to interactive programmes (Fahnrich et al., 2022; Fritz et al., 2024). A major reason here is that participation generated its own momentum because once people are invited to contribute instead of just listening, the experience of being asked is shown to increase appetite or stimulate interest for further involvement. And this pattern will be very hard to be observed in deficit model campaigns which by its definition just stops at the point of information delivery and gives no next step for public or audience to take.

The finding that public understanding improves under the two models though through different mechanisms complicates any attempt to simply rank the two approaches. Because clear and well- structured information delivery still matters and this point is supported by evidence that audiences across several European countries still value accuracy and accessibility in a high way even where dialogue opportunities existed (Volk & Schafer, 2023). So, this suggests that the contest between the two models is not actually about which one produces understanding, since both can produce understanding but the contest is about which one sustains that understanding alongside trust and participation over time. Dialogue in this case is better placed to do the latter and this aligns with the theoretical expectation from social constructivist thinking which assumes that understanding consolidates through social interaction rather than through one-off exposure to facts.

Another point is on the opportunity to register doubts and ask questions in Nigerian setting. Much of the empirical evidence reviewed originates from European and North American settings, where infrastructure for sustained public consultation, science cafes and citizen panels is well established to an extent. Nigerian and similarly resourced settings face practical constraints, including limited funding for engagement programmes and uneven access to digital platforms that often underpin the formats that is based on dialogue. The effectiveness patterns reported in the literature may therefore not transfer directly and caution is needed before assuming that strategies based on dialogue will perform identically in settings with different institutional capacity as in Nigeria.

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IMPLICATIONS FOR SCIENCE EDUCATION

For a classroom practice, the comparison suggests that science teachers should not rely solely on lecture style delivery when introducing topics that carry social or ethical weight, topics such as climate change or biotechnology. Building short discussion segments, question periods or small debates into lessons will reflect the dialogue model's emphasis on exchange and is likely to support deeper understanding than information transfer alone while the straightforward factual content such as basic definitions or procedures can still be delivered efficiently through direct instruction without any contradiction.

For teacher preparation, training programmes in science education would benefit from including explicit instruction on facilitating discussion and managing activities based on dialogue since many teachers are trained primarily to deliver content instead of just to moderate exchange. Because without this skill, attempts to introduce dialogue into the classroom risk becoming superficial gestures instead of the genuine engagement.

For curriculum development, the findings support including communication models such as the deficit and dialogue frameworks within science education syllabuses, so that trainee teachers understand not just scientific content but how that content is best conveyed to different audiences. Curriculum designers might also consider building structured opportunities for a student-led inquiry and discussion into existing schemes of work rather than treating dialogue as an optional add-on.

For educational policy, institutions responsible for public science communication including ministries of education and research bodies, should weigh the cost of programmes based on dialogue against their demonstrated advantages in trust and participation especially for contentious or socially sensitive scientific issues while reserving the faster deficit-style dissemination for situations genuinely requiring rapid reach.

On technology integration, digital platforms offer a practical route to dialogue-based engagement at a scale that physical forums cannot easily match, through tools such as online discussion boards, citizen science applications and social media question sessions with scientists, though such platforms also require moderation to guard against the misinformation risks noted earlier.

For future research, empirical studies involving Nigerian scientists, educators and members of the public would help establish whether the patterns reported in predominantly Western literature hold locally, especially given the resource and infrastructure constraints discussed above. Comparative work examining specific issues such as public health communication or climate education, would also sharpen understanding of when each model performs best.

CONCLUSION

The aim of this study was to compare the deficit model and dialogue model of science communication and the findings of the study showed that they have different assumptions about the public, they follow different communication processes, and they are measured by different measures. While the deficit model still remains a practical choice for rapid dissemination of large information, the dialogue model has more advantage in building public trust and sustaining of public participation but none of the model is sufficient as standalone across all circumstances but their values depend on the communication objectives, the audience involved, and the nature of the scientific issue at stake. The dialogue model has more broad advantage in addressing contemporary science challenges especially in places where public trust and long-term engagement matter but the deficit model is valuable wherever speed and reach is a priority.

While the deficit model may effectively create baseline awareness of general scientific concepts, it fails to resolve societal disputes. Modern science communication requires a hybrid approach. Experts must move from Deficit to Dialogue by investing in relationships, listening to community concerns, and aligning content with human values mostly in STEM education.

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RECOMMENDATIONS

Based on these findings, the following recommendations are made:

1. Science communicators should combine clear, accurate information delivery with structured opportunities for public questioning and feedback, rather than treating the two models as mutually exclusive.

2. Science teachers should incorporate discussion-based activities alongside direct instruction when teaching scientific topics with social or ethical dimensions.

3. Teacher training programmes should include explicit preparation in facilitating dialogue and managing classroom or public discussion, not only content delivery.

4. Research institutions and ministries of education should allocate resources for dialogue-based public engagement, particularly for contentious scientific issues, while retaining deficit-style dissemination for emergency or time-sensitive communication.

5. Researchers should conduct empirical studies within Nigerian and similarly resourced settings to test whether the effectiveness patterns identified in this review apply locally.

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