A Comparative Study Practical Versus Reflective Models in Training Scientists to Communicate with The Public

Gladys Uzezi Jack and Adiga Inogwuanya Elizabeth

Department of Science Education, Faculty of Education, Taraba State University, Jalingo, Taraba State, Nigeria

DOI: https://doi.org/10.47772/IJRISS.2026.100700404

Received: 15 July 2026; Accepted: 20 July 2026; Published: 01 August 2026

ABSTRACT

Science communication training for scientists broadly follows two competing pedagogical traditions: a Practical Model emphasising public speaking, writing, and media skills, and a Reflective Model emphasising theory, ethics, and critical awareness of the science-society relationship. Despite the global expansion of such training, comparative empirical evidence on the relative value of the two approaches remains scarce, particularly within the Nigerian tertiary context. This study used an explanatory sequential mixed-methods design to compare the two models among 112 postgraduate scientists and early-career researchers (56 per group), using the Science Communication Self-Efficacy Scale and the Science Communication Training Effectiveness Scale, followed by semi-structured interviews and focus groups ($n = 30$). Independent-samples t-tests showed that the Practical Model produced significantly higher communication confidence and public engagement frequency, while the Reflective Model produced significantly higher dialogue orientation and audience-centred behaviour (all $p < .001$, $d > 1.0$). Hierarchical multiple regression showed that Practical Skill and Reflective Orientation jointly explained 48% of variance in overall communication competence, with their interaction term explaining a further 11% ($p < .001$), confirming that blended competencies yield the greatest overall gain. The study concludes that neither model alone is sufficient and recommends an integrated, sequenced curriculum for training scientists to communicate credibly and inclusively with the public.

Keywords: science communication, practical model, reflective model, scientist training, public engagement, blended curriculum.

INTRODUCTION

Science communication has become a defining competency for twenty-first-century researchers, as public trust in science increasingly competes with misinformation, polarisation, and anti-scientific rhetoric. The field has moved historically from a deficit model, in which scientists transmitted knowledge to a passive public, toward dialogue-oriented and participatory approaches that treat the public as active partners in meaning-making (Brossard & Lewenstein, 2010; Simis et al., 2016). This shift has direct implications for how scientists themselves are trained: contemporary training programmes tend to emphasise either a Practical Model, built around measurable delivery skills such as public speaking, plain-language writing, and media engagement, or a Reflective Model, built around theoretical grounding, ethical awareness, and reflexivity about the scientist's position relative to the audiences addressed (Trench & Miller, 2023; Schön, 1983).

Purpose of the Study. The purpose of this study was to compare the Practical and Reflective models of science communication training and to determine their differential and joint effects on scientists' communication confidence, public engagement behaviour, dialogue orientation, and overall communication competence, with a view to proposing an evidence-based, integrated training framework.

Statement of the Problem. Although science communication training is now widely offered by universities and professional bodies, institutions continue to design curricula with little comparative empirical guidance on

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

whether practical, reflective, or blended approaches best prepare scientists for effective and ethical public engagement. A curriculum analysis by Canfield et al. (2023) found that 40.7% of published science communication curricula reflected deficit-model features and only 19.8% reflected a fully inclusive, reflexive approach, indicating that most training remains skewed toward one tradition rather than deliberately integrating both. This imbalance leaves curriculum designers, funders, and postgraduate training coordinators - including those responsible for science education programmes in Nigerian universities - without a clear evidence base for structuring training that builds both competence and contextual sensitivity.

Research Questions

The study was guided by the following research questions:

(i) What are the defining characteristics of the Practical and Reflective models of science communication training?

(ii) (ii) How do scientists trained under each model compare in communication confidence and self-efficacy?

(iii) (iii) What differences exist in public engagement behaviour across trainees of each model? (iv) What advantages and limitations do trainers and trainees associate with each model?

(iv) (v) How can elements of both models be integrated into a more effective training framework?

Research Hypotheses

Correspondingly, three hypotheses were tested:

H1: Scientists trained under the Practical Model will show significantly higher communication confidence and frequency of public engagement than those trained under the Reflective Model.

H2: Scientists trained under the Reflective Model will demonstrate significantly more dialogue-oriented and audience-centred communication behaviours than those trained under the Practical Model.

H3: A blended training approach combining Practical and Reflective elements will yield superior outcomes in overall communication competence compared with either model alone.

LITERATURE REVIEW

The Practical Model aligns with Bandura's (1986) Social Cognitive Theory, in which mastery experiences, modelling, and corrective feedback build communication self-efficacy; practitioner-oriented reviews confirm that skills workshops reliably raise immediate confidence and the frequency of public engagement (The Open Notebook, 2026). The Reflective Model, grounded in Schön's (1983) theory of reflective practice, instead cultivates critical awareness of audience context, positionality, and the ethics of the science-society relationship, and is associated with more dialogical, audience-centred engagement rather than rapid gains in output (van Mil et al., 2020).

More recent scholarship suggests the two traditions are increasingly treated as complementary rather than competing. Fähnrich et al. (2021) proposed a competence model that folds affective, cognitive, and reflexive learning objectives into a single framework, while Lewenstein and Baram-Tsabari (2022) argue that later-career interventions in particular should deliberately add reflection and identity work onto basic practical training rather than treating skills instruction as sufficient on its own. Consistent with this, Pilt and Himma-Kadakas (2023) found that effective evaluation of science communication training should be anchored in specific, named learning goals rather than generic satisfaction measures, and Vasquez-Guevara et al. (2025) reported that an action-learning workshop combining self-reflexivity modules with practical speech- and social-media-writing

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

modules produced gains in both audience-centred initiative-building and technical content-creation skill among an interdisciplinary research team, reinforcing the case for deliberately blended designs.

Set against this trend, Canfield et al. (2023) and Trench and Miller (2023) together document that most existing curricula still lean toward one tradition, underscoring the practical relevance of empirically testing an integrated framework of the kind proposed in this study.

METHODOLOGY

An explanatory sequential mixed-methods design was adopted (Creswell & Clark, 2017). In the quantitative phase, 112 usable responses (93.3% response rate) were obtained from postgraduate scientists and early-career researchers across the life, physical, and social sciences, comprising 56 participants who had completed predominantly Practical training and 56 who had completed predominantly Reflective training.

Communication confidence, public engagement frequency, dialogue orientation, and audience-centred behaviour were measured using the Science Communication Self-Efficacy Scale and the Science Communication Training Effectiveness Scale (Rodgers et al., 2020). In the qualitative phase, semi-structured interviews ($n = 20$) and trainer focus groups ($n = 10$) were conducted and analysed thematically (Braun & Clarke, 2006) to contextualise the quantitative patterns. Independent-samples t-tests were used to test H1 and H2, and a two-block hierarchical multiple regression - with the Practical × Reflective interaction entered in the second block - was used to test H3.

RESULTS

Table 1 presents the independent-samples t-test results comparing the Practical and Reflective training groups on the four continuous outcome variables.

Table 1: Comparison of Practical and Reflective Training Groups on Communication Outcomes (N = 112)

Variable	PracticalModel M (SD)	ReflectiveModel M (SD)	t(110)	p	Cohen's d
Communication Confidence	4.21 (0.45)	3.68 (0.52)	5.76	< .001	1.09
Public Engagement Frequency	4.05 (0.61)	3.44 (0.58)	5.42	< .001	1.02
Dialogue Orientation	3.52 (0.50)	4.18 (0.44)	-7.41	< .001	1.40
Audience-Centred Behaviour	3.61 (0.55)	4.26 (0.49)	-6.60	< .001	1.25

Note. M = mean; SD = standard deviation; n = 56 per group.

As shown in Table 1, the Practical Model cohort reported significantly higher communication confidence, $t(110) = 5.76$, $p < .001$, $d = 1.09$, and public engagement frequency, $t(110) = 5.42$, $p < .001$, $d = 1.02$, than the Reflective Model cohort, supporting H1.

Conversely, the Reflective Model cohort scored significantly higher on dialogue orientation, $t(110) = -7.41$, $p < .001$, $d = 1.40$, and audience-centred behaviour, $t(110) = -6.60$, $p < .001$, $d = 1.25$, supporting H2. All four effect sizes exceeded Cohen's (1988) conventional threshold for a large effect.

Table 2: Hierarchical Multiple Regression Predicting Overall Communication Competence (N = 112)

Predictor	β	R^2	ΔR^2	F	p
Block 1: Practical Skill	0.42				< .001
Block 1: Reflective Orientation	0.39	.48		F(2,109) = 50.30	< .001
Block 2: Practical × Reflective (interaction)	0.31		.11	F-change(1,108) = 15.52	< .001

Note. Block 1 $R^2 = .48$, $F(2, 109) = 50.30$, $p < .001$; Block 2 $\Delta R^2 = .11$, F-change(1, 108) = 15.52, $p < .001$.

Table 2 shows that Practical Skill ($\beta = 0.42$, $p < .001$) and Reflective Orientation ($\beta = 0.39$, $p < .001$) were each significant independent predictors of overall communication competence, jointly explaining 48% of the variance. Entering the Practical × Reflective interaction term in Block 2 produced a further significant increase in explained variance ($\Delta R^2 = .11$, $p < .001$), with a positive interaction coefficient ($\beta = 0.31$, $p < .001$), indicating that competence is highest when high practical delivery skill co-occurs with high reflective capacity. H3 was therefore supported.

Thematic analysis of the interviews and focus groups reinforced these quantitative patterns. Practical-model trainees described that repeated rehearsal reduced performance anxiety but sometimes left them without strategies for handling values-driven audience resistance. Reflective-model trainees described strong stakeholder awareness but reported initial hesitation and "analysis paralysis" in live public settings. Both groups endorsed a blended curricular format.

DISCUSSION

These findings resolve, in the specific comparative form tested here, an ongoing tension in the science communication training literature between skills-based and reflexivity-based pedagogy. The pattern - Practical training driving confidence and behavioural frequency, Reflective training driving dialogue depth, and their interaction predicting the highest overall competence - is consistent with the joint operation of Social Cognitive Theory (Bandura, 1986) and Reflective Practice Theory (Schön, 1983), and echoes Fähnrich et al.'s (2021) call for a competence model that integrates affective, cognitive, and reflexive learning objectives rather than treating them as separate tracks. The result is also consistent with Vasquez-Guevara et al. (2025), who found that combining self-reflexivity modules with practical speech- and content-creation modules in a single short-course workshop produced audience-centred, ethically grounded public engagement outcomes among an interdisciplinary research team, and with Lewenstein and Baram-Tsabari (2022), who argue that reflective and identity-based learning objectives should be deliberately layered onto practical instruction rather than assumed to develop on their own.

A degree of contradiction is nevertheless worth noting. Swords et al. (2023) reported that science communication training raises both self-reported confidence and the frequency with which scientists subsequently engage non-expert audiences - a finding that appears to support the Practical Model result obtained here. However, the same study also cautions, drawing on earlier video-based pre- and post-training assessments, that gains in self-reported confidence do not automatically translate into externally rated communication competence, since some trainees who felt more confident performed no better - and occasionally worse - on structured audience-facing tasks after training. This qualifies the present study's H1 finding: elevated self-efficacy and engagement frequency among the Practical Model cohort should not, by itself, be read as evidence of superior communicative quality, which is precisely the gap the Reflective Model's dialogue-orientation and audience-centred behaviour scores were designed to capture. Pilt and Himma-Kadakas (2023) similarly caution that training evaluation anchored only in generic satisfaction or confidence measures can overstate a programme's real impact unless it is tied to specific, named communication competencies, reinforcing the case for the dual-outcome, mixed-methods design used in this study.

Within the Nigerian tertiary context, in which postgraduate science education programmes such as those at Taraba State University increasingly expect scientists-in-training to disseminate research to school communities, policymakers, and the wider public, these findings suggest that curricula built solely around public-speaking or examination-style communication drills - without accompanying reflection on audience diversity, positionality, and ethical framing - are likely to under-prepare graduates for genuinely dialogical public engagement, even as they build short-term confidence.

CONCLUSION

This study confirms that the Practical and Reflective models of science communication training produce distinct but complementary competencies: the Practical Model efficiently builds self-efficacy and increases the frequency of public-facing engagement, while the Reflective Model is indispensable for cultivating dialogical, ethically grounded, and audience-centred communication. Neither model alone produces a complete profile of communication competence; the interaction between practical skill and reflective orientation accounted for the largest share of variance in overall competence. An integrated, sequenced training model that deliberately pairs operational skill-building with structured reflexivity is therefore the more defensible basis for preparing scientists - including postgraduate science education students - to communicate credibly and inclusively with the public.

RECOMMENDATIONS

1. Curricular Integration: Faculties of Education and Science Education departments, including at Taraba State University, should design science communication modules that deliberately pair practical skill labs (public speaking, plain-language writing, media and social-media practice) with reflective seminars on science-society relations, ethics, and audience equity.
2. Sequenced Pedagogy: Training should establish foundational practical self-efficacy first, followed immediately by supervised public engagement activities paired with structured reflective journaling, consistent with the action-learning approach demonstrated by Vasquez-Guevara et al. (2025).
3. Competency-Anchored Evaluation: Programme evaluators should assess named communication competencies rather than confidence or satisfaction alone, in line with Pilt and Himma-Kadakas (2023), to avoid mistaking self-efficacy gains for improved communicative quality.
4. Institutional Policy and Funding: University research offices and postgraduate boards should recognise science communication training as a core researcher competency and support longitudinal, rather than single-workshop, evaluation of training outcomes.

REFERENCES

1. Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Prentice-Hall.
2. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77-101.
3. Brossard, D., & Lewenstein, B. V. (2010). A critical appraisal of models of public understanding of science. In L. Kahlor & P. Stout (Eds.), Communicating science: New agendas in communication. Routledge.
4. Canfield, K. N., Dawson, E., Patterson, T., Salmon, R. A., & Su, L. J. (2023). Analysis of inclusivity of published science communication curricula for scientists and STEM students. CBE-Life Sciences Education, 22(1), ar4.
5. Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Erlbaum Associates.
6. Creswell, J. W., & Clark, V. L. P. (2017). Designing and conducting mixed methods research (3rd ed.). SAGE Publications.

7. Fähnrich, B., Wilkinson, C., Weitkamp, E., Heintz, L., Ridgway, A., & Milani, E. (2021). RETHINKING science communication education and training: Towards a competence model for science communication. Frontiers in Communication, 6, Article 795198.
8. Lewenstein, B. V., & Baram-Tsabari, A. (2022). Life-stage segmentation of science communication training needs. Journal of Science Communication, 21(4), A01.
9. Pilt, E., & Himma-Kadakas, M. (2023). Training researchers and planning science communication and dissemination activities: Testing the QUEST model in practice and theory. JCOM, 22(06), A04.
10. Rodgers, S., Wang, Z., & Schultz, J. C. (2020). A scale to measure science communication training effectiveness. Science Communication, 42(1), 90-111.
11. Schön, D. A. (1983). The reflective practitioner: How professionals think in action. Basic Books.
12. Simis, M. J., Madden, H., Cacciatore, M. A., & Yeo, S. K. (2016). The lure of rationality: Why does the deficit model persist in science communication? Public Understanding of Science, 25(4), 400-414.
13. Swords, C. M., Porter, J. S., Hawkins, A. J., Li, E., Rowland-Goldsmith, M., Koci, M. D., Tansey, J. T., & Woitowich, N. C. (2023). Science communication training imparts confidence and influences public engagement activity. Journal of Microbiology & Biology Education, 24(2), e00037-23.
14. The Open Notebook. (2026). Hands-on science communication training for scientists [Practitioner resource and course summaries]. https://www.theopennotebook.com
15. Trench, B., & Miller, S. (2023). Models of teaching science communication to scientists: A global perspective. Sustainability, 15(4), Article 3120.
16. van Mil, M. H. W., Bosman, A. M. T., & Franssen, T. (2020). From deficit to dialogue in science communication. EMBO Reports, 21(1), e49122.
17. Vasquez-Guevara, D. H., Lazzarini Moscoso, D. A., Bermeo, S. J., Seade, C., & Ochoa-Aviles, A. (2025). Action learning workshops for scientists: Science communication for public engagement skills for the VLIR-Teams Active Parks research group. JCOM, 24(05), N01. https://doi.org/10.22323/144720250729092032