EXPLORING THAI SCIENTISTS' BEHAVIOR TO ENGAGE IN SCIENCE COMMUNICATION TRAINING

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ABSTRACT

Effective science communication plays a crucial role in bridging the gap between scientific communities and the public, fostering informed societal decision-making, and contributing to sustainable development across various sectors. This study offers a comprehensive analysis of the intentions and behaviors of Thai scientists towards science communication training within Thailand's distinctive cultural and educational landscape. Utilizing Partial Least Squares Structural Equation Modeling and the Integrated Behavior Model, our research examined a sample of 73 scientists from various fields including academia, healthcare, and government across areas in Thailand. The findings reveal that perceived control has a direct impact on Thai scientists' intentions to participate in science communication training and highlight the effect of such intentions on the actual behavior of engaging in these training programs. The study also highlights the role of resource allocation and past behavior in shaping actual engagement in science communication activities. Moreover, we discovered an inverse relationship between injunctive norms and intentions, suggesting that perceived peer pressure or expectations might not invariably foster an individual's intention to undergo science communication training. This finding invites further exploration into the cultural and institutional dynamics that might contribute to this outcome. Our research contributes to the global dialogue on science communication by providing unique insights into the factors that encourage scientists from engaging in communication training within a non-Western context. By underscoring the factors influencing Thai scientists' intentions and participation in science communication training, our goal is to offer insights to institutions and policymakers. This guidance is crucial for the strategic allocation of funding and time in the development of training programs tailored for scientists and science communicators, not only in Thailand but across ASEAN nations. Through this approach, we seek to enhance the effectiveness of science communication, fostering a well-informed public dialogue on scientific issues throughout the region.

Keywords: *Science Communication, Thai Scientists, PLS-SEM, Integrated Behavioral Model, Science Communication Training Program*

1. INTRODUCTION

In recent years, there has been an increasing acknowledgment of the necessity for scientists to adeptly disseminate their knowledge to the broader public. The imperative for effective science communication stems from various challenges that scientists encounter, including the intrinsic complexity of scientific information and a lack of training in simplifying these complexities for non-specialist audiences (Radford, 2011; Brownell et al., 2013). The global landscape of science communication research often reflects a Western-centric viewpoint (Guenther and Joubert, 2017). However, it may not universally apply, given the distinct cultural and institutional landscapes across different nations. Despite the global reach of science communication, it is profoundly influenced by local traditions and societal priorities, necessitating adaptations to suit diverse cultural contexts, particularly in developing nations (Schiele et al., 2012; Navarro and McKinnon, 2020). This perspective brings the focus of this research to the context of Thailand.

In Thailand, the approach to science communication is deeply influenced by Thai cultural norms, educational practices, and institutional frameworks. The impact of Buddhism and traditional Thai values significantly shapes the learning process, with local wisdom playing a pivotal role in science education (Yuenyong and Narjaikaew, 2009). Furthermore, the interaction between Science and Buddhism has a notable effect on Thai society, potentially challenging the communication and perception of science in the country (Chinnalong, 2015). These insights highlight the essential need for communication strategies that align with the preferences and values of the Thai population.

This study focuses on Thai scientists' engagement in science communication training, examining their attitudes and behaviors by employing the Integrated Behavior Model (IBM) and Partial Least Squares Structural Equation Modeling (PLS-SEM). It aims to uncover the unique factors affecting science communication in Thailand, providing critical insights for educators and policymakers. The objective is to improve scientific dialogue within Thailand and across ASEAN, supporting a more interconnected and informed scientific community.

2. METHODS

The Integrated Behavior Model (IBM) underpins this study, evolving from the Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB) (Fishbein and Ajzen, 2010). TRA focuses on how attitudes and subjective norms shape behavior, while TPB adds the concept of perceived behavioral control, involving the ease or difficulty of performing the behavior. These models primarily assert that behavior is driven by behavioral intentions influenced by attitudes, norms, and perceived control. However, they have limitations, notably in addressing past behaviors and the impacts of societal and ecological factors. IBM builds on these frameworks by incorporating additional factors like knowledge and skills, environmental constraints, behavior salience, and habits (Montano and Kasprzyk, 2015). Building on this theoretical foundation, the study proposes the following hypotheses, each reflecting a specific aspect of the IBM constructs and their influence on the science communication behavior of Thai scientists.

Hypothesis (H1): *Scientists with positive experiences in previous science communication activities are more likely to engage in future science communication.*

Hypothesis (H2): *Scientists who believe that engaging in science communication is instrumental in achieving their professional goals and generating positive public outcomes will show greater willingness to engage in science communication.*

Hypothesis (H3): *Scientists surrounded by colleagues who hold positive attitudes towards science communication are more likely to develop a willingness to engage in it themselves.*

Hypothesis (H4): *Scientists exposed to peers who frequently engage in science communication are more likely to show an increased willingness to participate in science communication activities.*

Hypothesis (H5): *Scientists who perceive a supportive environment that enables and encourages science communication are more likely to feel motivated to engage in science communication.*

Hypothesis (H6): *Scientists with positive self-perceptions regarding their abilities as effective science communicators are more likely to demonstrate a willingness to engage in science communication.*

Hypothesis (H7): *Scientists who have previously conducted science communication activities are more likely to continue participating in such activities, suggesting a pattern of behavioral continuity in science communication engagement.*

Hypothesis (H8): *Scientists who perceive that there is adequate allocation of resources towards science communication training and support within their institutions are more likely to be willing to engage in science communication efforts.*

Hypothesis (H9): *Scientists who demonstrate a strong intention to participate in science communication training are more likely to actively engage in such training programs.*

For a visual depiction of these hypothesized relationships, refer to Figure 1 below, which illustrates the interconnected paths and variables of the structural model.

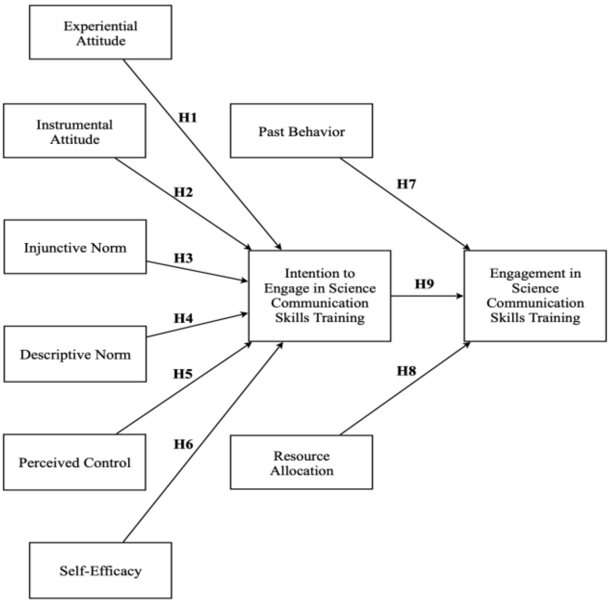

Figure 1. The Proposed Research Model

Sample and data collection

This study adopts a two-phase quantitative approach, beginning with a pilot phase that aims to validate the research tools, which are grounded in the TPB, IBM, and principles of science communication. This initial stage involved 23 science professionals from Bangkok and Chiangmai, Thailand, whose insights were crucial for refining the survey for wider use.

The second phase broadened the research to include a diverse group of Thai scientists from multiple disciplines and regions, including Bangkok, Hatyai, Chiangmai, Khonkaen, and Pathumthani. Utilizing an online survey distributed via Google Forms, the study collected responses through 33 questions rated on a 5-point Likert scale (from 1 - Strongly Disagree to 5 - Strongly Agree), running from

February 22 to March 17, 2024. Eventually, we received 73 complete and valid responses, with no missing values.

3. RESULTS AND DISCUSSION

Demographic profile of the respondents

The demographic profile of the 73 survey participants is detailed in Table 1. The data reveals a diverse range of experiences among the respondents in terms of their tenure in science-related fields: 32.9% have less than 5 years of experience, 35.6% have 6 to 10 years of experience, and 31.5% have dedicated more than 10 years to the field. Participants also represent a variety of sectors. Academia, including universities and colleges, accounts for 43.8% of the respondents. The government or public sector comprises 16.4%, the healthcare sector 34.2%, and research institutes 1.4%. A significant majority of the respondents, 80.8%, work in urban areas, while 19.2% are based in rural settings.

Table 1. Demographic profile of the respondents

Profile of respondents	Response	(%)
Length of career (DM1)	Less than 5 years	**32.9%**
	From 6 - 10 years	**35.6%**
	More than 10 years	**31.5%**
Sector (DM2)	Academia (University/College)	**43.8%**
	Government/Public Sector	**16.4%**
	Healthcare	**34.2%**
	Research Institute	**1.4%**
	Others	**4.1%**
Urban vs. Rural (DM3)	Urban	**80.8%**
	Rural	**19.2%**
Gender (DM4)	Male	**43.8%**
	Female	**54.8%**
	LGBTQ+	**1.4%**
Religion (DM5)	Buddhism	**84.9%**
	Islam	**2.7%**
	Christianity	**8.2%**
	Catholic	**1.4%**
	Others	**2.7%**

Measurement models assessment

In this study, PLS-SEM was employed to evaluate the measurement models. Key metrics such as Composite Reliability (CR), Cronbach’s Alpha, and Average Variance Extracted (AVE) were examined, with findings presented in Table 2. According to Hair et al. (2022), constructs exhibiting CR values above 0.70 are deemed reliably consistent. Here, all ten constructs have Cronbach’s alpha scores above 0.7, demonstrating solid reliability. Convergent validity was assessed through the AVE metric. Hair et al. (2022) propose that an AVE value of at least 0.5 signifies adequate convergent validity. This study's constructs have AVE values above 0.5 benchmark, confirming strong convergent validity.

Furthermore, discriminant validity, which assesses the distinctness of constructs, was evaluated using the HTMT (Heterotrait-Monotrait) ratio. The HTMT values listed in Table 3 all remain below the 0.90 threshold, indicating no issues with discriminant validity and ensuring the uniqueness of each construct within the study.

Table 2. Construct reliability and validity

	Cronbach's alpha	Composite reliability (CR)	Average variance extracted (AVE)
BE	0.828	0.845	0.587
BI	0.881	0.890	0.738
DN	0.798	0.822	0.707
EA	0.836	0.876	0.747
IA	0.834	0.841	0.750
IN	0.803	0.803	0.717
PB	0.873	0.880	0.799
PC	0.881	0.883	0.808
RA	0.865	0.865	0.789
SE	0.885	0.898	0.813

Table 3. Heterotrait-Monotrait

	BE	BI	DN	EA	IA	IN	PB	PC	RA	SE
BE										
BI	0.862									
DN	0.763	0.728								
EA	0.371	0.507	0.315							
IA	0.308	0.578	0.438	0.802						
IN	0.494	0.539	0.810	0.415	0.670					
PB	0.781	0.662	0.646	0.173	0.377	0.606				
PC	0.728	0.777	0.795	0.293	0.488	0.572	0.701			
RA	0.792	0.696	0.725	0.133	0.344	0.670	0.875	0.742		
SE	0.534	0.626	0.472	0.644	0.672	0.423	0.327	0.615	0.315	

Structural model assessment

Following the confirmation of the measurement model's reliability and validity, the structural model's assessment was conducted. This analysis employed a bootstrap resampling technique with 5,000 subsamples, using one-tailed tests at a significance level of 0.05. The results, detailed in Table 4, affirm the significance of the hypothesized causal links. Notably, a significant positive relationship was observed between Behavioral Intention (BI) and Actual Behavior (BE) ($\beta=0.459$, $p<0.001$), underscoring the direct impact of BI on BE. Additionally, the analysis reveals positive effects of Past Behavior (PB) and Resource Allocation (RA) on Actual Behavior (BE), with coefficients of $\beta=0.260$ ($p=0.001$) and $\beta=0.230$ ($p=0.008$), respectively.

Table 4. Significance Testing Results of the Structural Model Path Coefficients (Bootstrapping)

	Path Coefficients	p-values	95% Confidence Intervals (with Bias Correction)	Significance (p<0.05)?
BI -> BE	0.459	0.000	[0.297;0.593]	Yes
DN -> BI	0.286	0.034	[0.022;0.538]	Yes
EA -> BI	0.194	0.037	[0.011;0.365]	Yes
IA -> BI	0.073	0.259	[-0.124;0.243]	No
IN -> BI	-0.058	0.292	[-0.248;0.099]	No
PB -> BE	0.260	0.001	[0.122;0.403]	Yes
PC -> BI	0.381	0.007	[0.133;0.646]	Yes
RA -> BE	0.230	0.008	[0.062;0.378]	Yes
SE -> BI	0.099	0.202	[-0.1;0.286]	No

An in-depth examination, aligned with Hair et al. (2022)'s methodological guidelines, further explored the model's mediation effects. As indicated in Table 5, Behavioral Intention (BI) serves as a mediator in the relationship between Perceived Control (PC) and Actual Behavior (BE), with a beta coefficient of β=0.175 and a p-value of 0.011. This analysis highlights the pivotal role of BI in bridging PC and BE, substantiating its mediating influence within the structural framework.

Table 6 shows that the R^2 values for Behavioral Intention (BI) at 0.599 and Actual Behavior (BE) at 0.692 are considered moderate, according to Hair et al. (2011) and Henseler et al. (2009). This suggests the model effectively explains a considerable amount of variance in these constructs, demonstrating robust explanatory power. Table 7 shows all model indicators have $Q^2_{predict}$ values above zero, indicating the model's strong predictive capability beyond a basic benchmark.

Table 5. Mediation Analysis (Bootstrapping)

	Path Coefficients	**p-values**	**95% Confidence Intervals (with Bias Correction)**	**Significance (p<0.05)?**
DN -> BI -> BE	0.131	0.051	[0.016;0.28]	No
EA -> BI -> BE	0.089	0.053	[0.007;0.184]	No
IA -> BI -> BE	0.033	0.259	[-0.056;0.111]	No
IN -> BI -> BE	-0.026	0.297	[-0.121;0.044]	No
PC -> BI -> BE	0.175	0.011	[0.066;0.321]	Yes
SE -> BI -> BE	0.045	0.215	[-0.043;0.144]	No

Table 6. R Square Value

	R-square	**R-square adjusted**
BE	0.692	0.679
BI	0.599	0.563

Table 7. $PLS_{predict}$ Results Report

	$Q^2_{predict}$	**PLS-SEM_RMSE**	**PLS-SEM_MAE**	**LM_RMSE**	**LM_MAE**
BE1	0.421	1.041	0.818	1.269	0.952
BE2	0.302	1.255	1.055	1.520	1.255
BE3	0.567	0.757	0.582	0.988	0.754
BE4	0.193	1.089	0.876	1.369	1.095
BE5	0.176	1.218	1.007	1.527	1.242
BI1	0.262	1.024	0.830	1.206	0.908
BI2	0.525	0.768	0.600	0.931	0.750
BI3	0.354	0.810	0.638	0.983	0.752
BI4	0.288	0.873	0.699	1.070	0.853

Figure 2 presents the PLS results of the research model.

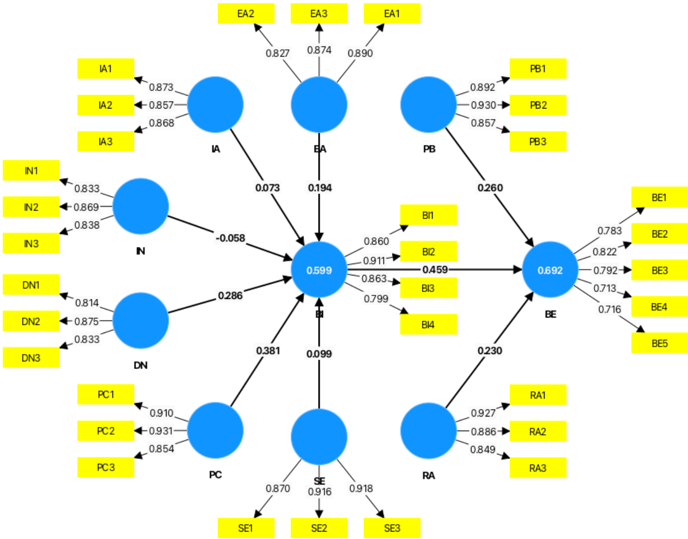

Figure 2. The structural model with path coefficients and R2 values

Discussion

The findings identified Descriptive Norm (DN), Experiential Attitude (EA), and Perceived Control (PC) significantly impact the Intention to Engage in Science Communication Training (BI), as evidenced by notable path coefficients: DN (0.286, p=0.034), EA (0.194, p=0.037), and PC (0.381, p=0.007). Furthermore, Behavioral Intention (BI) was found to have a strong direct positive effect on Actual Behavior (BE) with a coefficient of 0.459 (p<0.001). Mediation analysis indicated that BI serves as a mediator specifically between PC and BE (0.175, p=0.011), underscoring the critical influence of perceived control over one's actions. Additionally, past behavior was a predictor of future engagement (0.260, p=0.001), and resource allocation was directly linked to actual engagement (0.230, p=0.008). The study also uncovered an unexpected inverse relationship between Injunctive Norm (IN) and BI (-0.058, p=0.292), suggesting that perceived peer pressure or expectations might not invariably foster an individual's intention to undergo science communication training. This finding invites further exploration into the cultural and institutional dynamics that might contribute to this unexpected outcome. Despite confirming several hypotheses, the study found no significant impact from Instrumental Attitude (IA) and Self-Efficacy (SE) on BI, indicating a possible divergence from established theories.

4. CONCLUSION

This study emphasizes the significance of scientists' confidence in their resource navigation capabilities and the foundational role of past interactions and resources in fostering future training participation. While supporting various hypotheses, the study also unveils the nuanced impact of cultural and institutional factors through the lens of injunctive norms, suggesting fertile ground for further investigation.

This study on science communication training among Thai scientists, with a sample of 73 primarily from healthcare (34.2%) and academia (43.8%) in urban areas like Bangkok, Hatyai, Chiangmai, Khonkaen, and Pathumthani, provides valuable insights but has limited applicability across different geographic and sectoral contexts. The focus on specific urban centers and sectors suggests a broader, more diverse sample is needed for generalizable results across Thailand's scientific community. To address these limitations, future research should include a larger, more varied sample from both urban and rural areas beyond the initially studied cities, and from sectors outside healthcare and academia. Future studies should also involve investigating the role of institutional backing, assessing cultural and social norms' effects, utilizing digital channels for broader engagement, and undertaking comparative studies across cultures to deepen insights and improve training initiatives.

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