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Educator–Learner Homophily Effect on Participants' Adoption of Agribusiness Recordkeeping Practices

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Abstract: Homophily is the tendency of individuals to be attracted to and associate with people who share similar sociodemographic, behavioral, and intrapersonal characteristics. Homophily plays a significant role when introducing innovations to create behavioral change. Understanding the educator–learner homophily effect is important to introduce and diffuse innovations efficiently and effectively. A quasi-experimental design was used to test the effect of educator–learner homophily on technology adoption in agriculture. Researchers showed one of four instructional videos about agribusiness recordkeeping practices to 238 Guatemalan female farmers. After the video instruction, the participants were given agribusiness logbooks to track farm sales and expenses. Initially, literate participants were more than four times as likely to adopt agribusiness recordkeeping practices than illiterate participants. Logistic regression determined the effects of the trainer's gender and nationality on the participants' likelihoods of adopting agribusiness recordkeeping practices at 6- and 21-weeks post-training. The 21-week logistic regression model was statistically significant; participants who received training from a female instructor were 0.441 times less likely to adopt and maintain agribusiness recordkeeping practices over the long-term. Nationality was not associated with the likelihood of adopting recordkeeping as an agribusiness practice. Program administrators should consider trainers' perceived credibility and participants' cultural norms when planning agribusiness management training programs with topics having limited immediate benefit.

Keywords: agribusiness management; sustainable entrepreneurship; inclusive entrepreneurship; innovation of farm entrepreneurs; innovation in agricultural systems; technology adoption in agriculture; farm management competencies

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1. Introduction

Homophily is the tendency for people to be drawn to and socialize with others who share similar sociodemographic, behavioral, and intrapersonal characteristics [1]. People may be homophilous in various dimensions, including gender, ethnicity, age, native language, religion, social class, and education level.

Previous research has shown that homophily can mediate the flow of information and influence behavior within a social system [2–4]. When an individual receiving a message perceives homophily with the message's sender, the receiver is more likely to regard the messenger as credible, attributing greater subject matter expertise and trustworthiness to the messenger [5–9]. Believing the messenger to be credible correlates with enhanced knowledge transfer and increased behavior change [8,10,11].

Regarding knowledge transfer and behavior change, researchers often study homophily as a phenomenon occurring among peers within a network [2,4]. The effect of change agents' homophilous versus heterophilous impacts has been examined in diverse formal and nonformal educational contexts. Ref. [12] found that trauma-informed classroom training was more effective when homophilic peer instructors disseminated

knowledge versus their heterophilic counterparts. Ref. [13] reported that Florida Extension program stakeholders were more satisfied with educational programming when the Extension agents were homophilic to their customers. Homophilic actors' knowledge transfer and adoption were improved when homophilic change agents, representing 11 East African locations, distributed the educational information [14]. The effectiveness of social networks at informing and motivating farmer adoption of agricultural technology was predicted by their homophily [15]. The lack of homophily reported by [16] was the attribute that hindered stakeholders' uptake and use of social media instructor-distributed educational content. Few studies have systematically examined how homophily influences learning, knowledge retention, and behavior change in the context of agribusiness or farm management training among small-scale farmers.

Regarding behavior change, the homophily effect is most often explored in the context of marketing and sales. Specifically, studies found that homophily influences how persuasive a fellow consumer's recommendation is in influencing one's intention or decision to purchase a product or service [17–19]. The research suggests that educator–learner homophily effect may mediate the adoption of information (i.e., new ideas or practices). However, given the dearth of limitations in such studies, additional research is needed to better understand the role of educator–learner homophily in small-scale farmers' adoption of farm management practices.

Training and extension education programs are ubiquitous in international agricultural development, including those designed for small-scale agribusinesses, farmers, and/or small business owners in rural areas. Those audiences' needs are not unlike participants' training needs in other sectors; hence, the focus of this study transcends disciplines across the human resource development spectrum. The implications for training or extension education programs are vast, particularly in settings where shared homophilic characteristics between educators and learners are limited or nonexistent.

International volunteerism in agricultural development organizations is one such setting. International volunteers often differ from beneficiary populations regarding ethnicity, race, religion, social class, education, and occupation [20]. If educator–learner homophily influences knowledge retention and behavior change, there may be relevant considerations for designing international training and development agricultural programs that include foreign volunteers. Measuring the effect of educator–learner homophily on learner behavioral outcomes could help international agricultural development program administrators improve the design and delivery of their services. Furthermore, such research provides insights to postsecondary education personnel, extension agents, and capacity-building actors worldwide to improve their programs' effectiveness in training future development workers.

Sustainable development goals (SDGs) are widely accepted foundations for research, teaching, extension, and outreach efforts of industry, academia, not-for-profit organizations, and governmental agencies. Training and extension education programs in international agricultural development, especially those with site-specific interactions between host-country nationals and international subject matter specialists, include many SDGs, as evidenced in this research. For example, SDG #1's focus on poverty reduction includes increasing access to sustainable livelihoods and entrepreneurial opportunities. Zero hunger (SGD #2) outlines the necessities of education initiatives, use of economic incentives, and new technology development, which positively impacts adequate, nutritious, and stable food supplies of underrepresented audiences' access to their respective food supplies, and income and employment opportunities resulting from new market channels. SDG #3's attention to good health and well-being encompasses advancing economic accessibility and growth via sustainable transportation that integrates urban and rural economic linkages resulting from new networks and marketing channels. Quality education (SDG #4) includes the critical nature of improving actors' education and training in context-specific paradigms, such as innovations to mitigate climate change. SDG #8 (decent work and economic growth) calls for a green economy to improve sustainable economic development

and offer stakeholder assistance in attaining employment to generate personal income. Innovation and a resilient infrastructure are the highlights of SDG #9. Finally, SDG #12 calls for responsible consumption and production patterns, which may be achieved through technological and innovative development practices that propel us toward sustainable livelihoods in current and future generations.

A controlled study was designed to answer three questions: (a) Does educator–learner gender homophily impact participants' adoption of agribusiness recordkeeping practices? (b) Does educator–learner nationality homophily impact participants' adoption of agribusiness recordkeeping practices? (c) Do interaction effects exist between educator–learner gender and nationality homophily and participants' adoption of agribusiness recordkeeping practices?

1.1. Literature Review

Limited research exists about the homophily effect on learner perception of educator credibility and learner attitude, knowledge retention, and behavior change. There is a gap in the understanding of how educator– or trainer–learner characteristics affect credibility and attitude in learners' knowledge retention and behavior change after participating in an international agricultural training and development program.

To partially address the gap, research [21] was conducted to explore the role of homophily in knowledge transfer and behavior change in the context of an agricultural extension education program that sends international (U.S.) volunteers to train farmers in Guatemala and the Dominican Republic. Using focus groups and interviews, the participants reflected on their experiences of learning from U.S. volunteers, including how the volunteer's sociodemographic, intrapersonal, and behavioral characteristics affected their ability to learn and/or adopt recommended practices (agribusiness recordkeeping). The participants asserted that the foreign volunteers' similarities and differences had no bearing on the perceived credibility of the information shared during the training program. Instead, they consistently described international volunteers as more credible and reliable than their local extension agents (in Guatemala or the Dominican Republic). In this context, local extension agents shared higher levels of cultural, background, and geographic origin homophily with program participants than did the international volunteers, suggesting that the perception of homophily did not correlate with improved knowledge retention and behavior change.

However, given that homophily's effect on perception and behavior is often implicit or subconscious [4], a qualitative exploration of these factors and relationships is incomplete because it reveals only the conscious attitudes and preferences that participants were willing to share. In addition, typical local extension programs are structured differently from most international agricultural development programs. The training information received from international volunteers may be of higher quality or more relevant to the participants' technical training needs and circumstances. Therefore, a clear need exists for quantitative study of the quality of training information while controlling the trainers' sociodemographic, behavioral, and intrapersonal characteristics.

1.2. Conceptual Framework

The study's framework is grounded in Rogers' diffusion of innovation (DOI) theory [8]. DOI theory is one of the oldest and most well-known social science theories. DOI describes how, over time, new or improved ideas and/or products (i.e., innovations) gain attention and momentum and are tested, resulting in decisions to adopt/reject the innovation, and how those processes are diffused through specific populations or social systems (Figure 1).

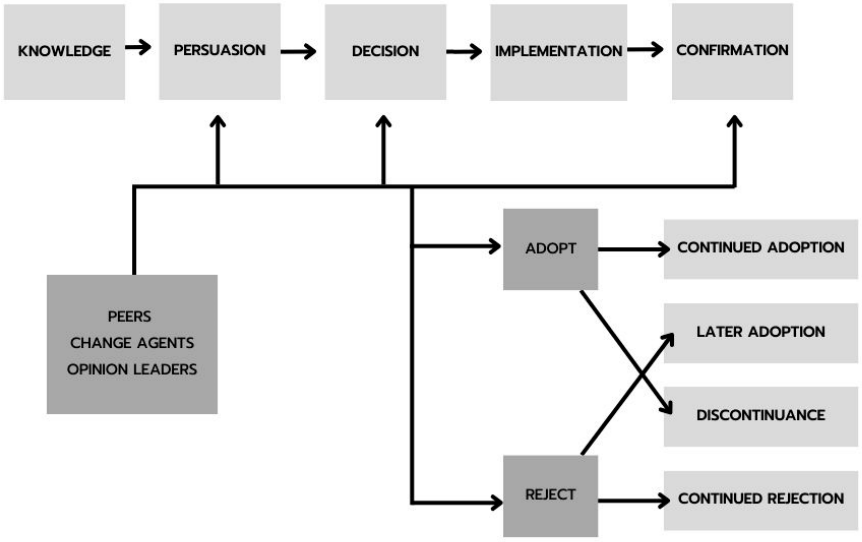

Figure 1. Rogers' DOI theory and process.

According to Rogers, change agents, near peers, and opinion leaders strongly influence whether an innovation is adopted or rejected [8]. Rogers theorized that homophily influenced the adoption and diffusion of innovations. He posited that when the change agent and receiver of information are homophilous, the change agent will more effectively convey information and promote behavior change [8].

Moscarelli's [21] model (Figure 2) builds on Rogers' DOI theory. The model indicates that educator–learner homophily affects learners' perceptions of the trainer's credibility [5–7]. That perceived credibility then affects the learners' attitudes, knowledge retention, and behavior change [8,10,11]. The Moscarelli model describes the learner's attitude, knowledge retention, and behavior change as a function of educator–learner homophily in training and development settings; however, we recognize that trainees' behavior change depends on innovation characteristics, as well.

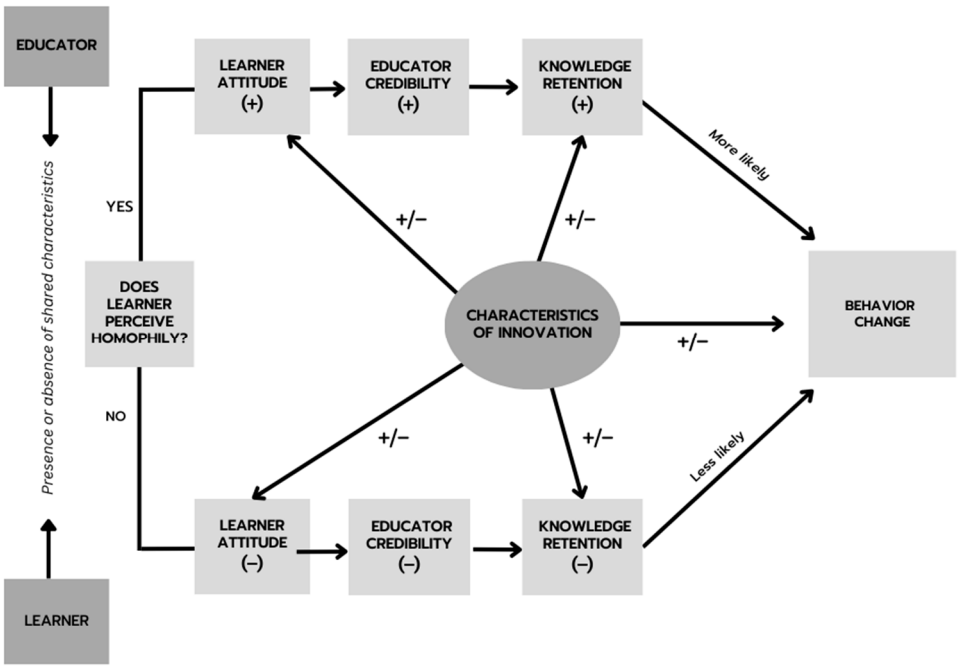

Figure 2. Moscarelli model.

1.3. Summary

In summary, homophilic similarities in actor networks are essential to achieving sustainable development goals [22]. Homophily's phenomena describes similarities between nodes and graph neural networks in deep learning models [23,24]. In the social sciences, Rogers [8] identified homophily as the similar physical characteristics between the social system and organizational change agents. Individuals choose their social system's phenotypic cues, resulting in homophily [25,26]. Given the vast resources spent on education and capacity-building programs worldwide [27,28], it is critical to study the influences that educator–learner homophily has on learning outcomes and behavior change.

2. Materials and Methods

The researchers used a quasi-experimental design to test the effect of educator–learner gender and nationality homophily on the participants' adoption of agribusiness recordkeeping practices. Texas A&M University's IRB Administration approved this study (IRB2019-0447M).

The population of interest was an estimated 5000 female small-scale farmers in Chiantla, Huehuetenango, Guatemala [29]. For this study, the researchers defined small-scale farmer as someone who undertakes agricultural activities (i.e., crop production, livestock production, etc.) for household income, manages less than two hectares of land, relies primarily on family labor, and has an annual household income of less than USD 3000.

Simple random sampling was not possible due to logistical and financial limitations. The researchers used a purposive sample from three communities in Chiantla, Huehuetenango, Guatemala; the participants were part of an international development nonprofit agency's U.S.-funded dairy goat project. The participants were small-scale farmers that managed dairy goats and seasonal crops, including maize, beans, and potatoes. The researchers coordinated with the international development organization's Guatemalan extension agents to schedule nine training sessions in the three communities during August 2022. The extension agents invited 350 participants to attend one of nine group training sessions, of which 238 female small-scale farmers attended (229 and 220 participants remained in the study after 6 and 21 weeks, respectively). The small-scale farmers were bilingual in Spanish and Mam (Mayan language). Additional demographic information follows in Table 1.

Table 1. Sample demographics.

Demographics	6 Weeks (n = 229)	21 Weeks (n = 220)
Literacy rate	65.5% (150)	66.3% (146)
Age 19 and below	7.8% (18)	8.2% (18)
Age 20 to 29	62.4% (143)	62.7% (138)
Age 30 to 39	21.4% (49)	10.9% (24)
Age 40 to 49	7.9% (18)	7.7% (17)
Age 50 to 59	<1% (1)	<1% (1)

During each meeting, two Guatemalan extension agents and two U.S. researchers administered surveys to capture the participants' gender, age, literacy, and community demographics. After the survey, the researchers administered the treatment, one of four instructional videos about agribusiness recordkeeping practices. Agribusiness recordkeeping practices was the training topic selected, as it is widely recognized as a beneficial practice for farmers regardless of the type of crop and livestock they grow, and no participants in the study reported having familiarity with the concept or ever using recordkeeping.

Each instructional video used the same Spanish language script and PowerPoint presentation. The differences among the four videos were based on trainers' gender and nationality: Guatemalan male and female, and U.S. male and female. Each trainer stated that they were 35 years old in the video. It should be noted that the length of videos varied slightly due to the speed at which trainers spoke: the Guatemalan male video was

14:15 min, the Guatemalan female video was 14:06 min, the U.S. male video was 15:45 min, and the U.S. female video was 18:41 min.

After the video, each participant received an agribusiness logbook. The logbook and recordkeeping examples in the instructional videos were in the same format to maintain consistency in technical information. The researchers informed the participants that they should use the agribusiness logbooks to track all future farm-related costs and revenues.

The researchers coordinated with the international development organization's Guatemalan extension agents to schedule check-ins with the participants from October 2022 (six weeks post-training) to January 2023 (21 weeks post-training). These timeframes were selected due to logistical challenges. The extension agents asked the participants to bring their agribusiness logbooks to the check-ins. During each check-in, one Guatemalan extension agent and one U.S. researcher reviewed the agribusiness logbook to determine if the participant had adopted or rejected this agribusiness practice.

At the six-week check-in, the researchers classified unused logbooks as a rejected agribusiness practice. A logbook containing any recorded cost and/or revenue entry was classified as an adopted practice. At the 21-week check-in, the researchers classified agribusiness logbooks as rejected practices if it was unused or only had entries between training and the six-week check-in but nothing after six weeks, despite the participants' verbal reports of costs and revenues. The agribusiness logbooks were classified as an adopted practice if cost and revenue entries were made between the 6- and 21-week check-ins. Likewise, the researchers classified a logbook as an adopted agribusiness practice if it had entries between training and the six-week check-in but none after when the participant verbally reported having no additional costs or revenues.

All the data were entered into two Microsoft Excel spreadsheets by two data coders. The researchers compared the two spreadsheets using the spreadsheet compare function. The researchers double-checked the source materials and corrected all the cells that did not match. The spreadsheet was then converted into SPSS.

The data were analyzed using descriptive statistics, checking for outliers, normality, correlations, and skewness, among other basic descriptive statistics [30]. After thoroughly examining the descriptive statistics, chi-square tests of independence and binary logistic regression analyses (Equation (1)) were conducted to locate statistically significant predictor variables and the percentage of variability explained in each model [31]. The predictor variables were trainer gender, trainer nationality, participant age, participant literacy, and participant community. The response variables were participant's behavior change, as measured by agribusiness logbook rejection (0) or adoption (1) at the 6- and 21-week post-training check-ins.

$$\ln[p/(1-p)] = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 \quad (1)$$

where:

a = Constant
b_1X_1 = $\text{Participant}_{\text{Literacy}}$
b_2X_2 = $\text{Participant}_{\text{Age}}$
b_3X_3 = $\text{Participant}_{\text{Community}}$
b_4X_4 = $\text{Trainer}_{\text{Gender}}$
b_5X_5 = $\text{Trainer}_{\text{Nationality}}$

3. Results

3.1. Descriptive Statistics and Chi-Square Tests of Independence

Table 2 provides a descriptive summary of the participants' adoption of agribusiness recordkeeping practices by time. A chi-square test of independence was performed to examine the relationship between the trainer and adoption of agribusiness recordkeeping practices at 6- and 21-weeks post-training. At six weeks, the relationship between initial adoption and the trainer was statistically significant (χ^2 (4, N = 229) = 11.47, p = 0.022).

A medium effect size (Cramer's V/phi = 0.224) was noted. The effect size quantifies the strength or magnitude of an observed significant effect. The effect size ranges from 0 (no association) to 1 (perfect association); hence, a larger effect size indicates larger practical significance. Likewise, at 21 weeks post-training, the relationship between long-term adoption and the trainer was statistically significant (χ^2 (4, N = 220) = 18.94, $p < 0.001$). A large effect size was noted (Cramer's V/phi = 0.293).

Table 2. Adoption rates of agribusiness recordkeeping practices.

Treatment	6-Week Adopt %, (*n*)	6-Week Reject %, (*n*)	21-Week Adopt %, (*n*)	21-Week Reject %, (*n*)
U.S. male trainer	84.1% (58)	15.9% (11)	62.1% (41)	37.9% (25)
U.S. female trainer	83.7% (41)	16.3% (8)	50% (24)	50% (24)
GT male trainer	100% (46)	0% (0)	68.2% (30)	31.8% (14)
GT female trainer	89.4% (42)	10.6% (5)	28.9% (13)	71.1% (32)
Control	100% (18)	0% (0)	70.6% (12)	29.4% (5)
Total	89.5% (205)	10.5% (24)	54.5% (120)	45.5% (100)

Table 3 provides a descriptive summary of the participants' adoption of agribusiness recordkeeping practices when analyzed by the trainer's gender. A chi-square test of independence showed that no statistically significant relationship existed between initial adoption and the trainer's gender at six weeks post-training (χ2 (2, N = 229) = 3.17, $p = 0.205$). However, the 21-week post-training relationship between long-term adoption and the trainer's gender was statistically significant (χ2 (2, N = 220) = 14.37, $p < 0.001$). A medium effect size was noted (Cramer's V/phi = 0.256).

Table 3. Adoption rates of agribusiness recordkeeping practices by trainer gender.

Treatment	6-Week Adopt %, (*n*)	6-Week Reject %, (*n*)	21-Week Adopt %, (*n*)	21-Week Reject %, (*n*)
Male trainer	90.4% (104)	9.6% (11)	64.5% (71)	35.5% (39)
Female trainer	86.5% (83)	13.5% (13)	39.8% (37)	60.2% (56)
Control	100% (18)	0% (0)	70.6% (12)	29.4% (5)

Table 4 summarizes the participants' adoption of agribusiness recordkeeping practices when analyzed by the trainer's nationality. At six weeks post-training, a statistically significant (χ2 (2, N = 229) = 8.66, $p = 0.013$) relationship existed between initial adoption and the trainer's nationality. A small effect size was noted (Cramer's V/phi = 0.195). However, at 21 weeks post-training, the relationship between long-term adoption and the trainer's nationality was not statistically significant (χ2 (2, N = 220) = 3.44, $p = 0.179$). A small effect size was noted (Cramer's V/phi = 0.125).

Table 4. Adoption rates of agribusiness recordkeeping practices by trainer nationality.

Treatment	6-Week Adopt %, (*n*)	6-Week Reject %, (*n*)	21-Week Adopt %, (*n*)	21-Week Reject %, (*n*)
U.S. trainer	83.9% (99)	16.1% (19)	57.0% (65)	43.0% (49)
GT trainer	94.6% (88)	5.4% (5)	48.3% (43)	51.7% (46)
Control	100% (18)	0% (0)	70.6% (12)	29.4% (5)

3.2. Logistic Regressions: Effect of Educator–Learner Gender and Nationality Homophily on Participants' Adoption of Agribusiness Recordkeeping Practices

Logistic regression was used to analyze the relationship between the participants' literacy, age, and community, and the trainers' gender and nationality and how this relationship affected the likelihood of the participants' initial adoption of agribusiness logbooks in the short-term (six weeks post-training) (Table 5). The logistic regression model was statistically

significant (χ^2 (7, N = 229) = 55.92, $p < 0.001$). The model explained 44.3% (Nagelkerke R^2) of the variance in adoption and correctly classified 90.4% of adoption–rejection decisions. The literate participants were 4.22 times more likely to adopt agribusiness recordkeeping practices than the illiterate participants. The participants in Chochal were 31.11 times more likely to adopt agribusiness logbooks than those in Cinco Arroyos or El Potreros. Neither trainer gender nor nationality was associated with the likelihood of adopting agribusiness recordkeeping practices in the short-term.

Table 5. Logistic regression model at six weeks post-training.

Variable	B	SE	Wald	df	Sig	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Participant literacy	1.439	0.592	5.907	1	0.015	4.218	1.321	13.467
Participant age	0.001	0.037	0.001	1	0.982	1.001	0.930	1.077
U.S. male trainer	−17.249	9202.507	0.000	1	0.999	0.000	0.000	
U.S. female trainer	−6.780	9202.507	0.000	1	0.999	0.000	0.000	
GT male trainer	0.052	10,854.660	0.000	1	1.000	1.053	0.000	
GT female trainer	0.048	12,840.895	0.000	1	1.000	1.049	0.000	
Chochal	3.438	1.068	10.351	1	0.001	31.113	3.832	252.609
Cinco Arroyos	−6.416	8955.581	0.000	1	0.999	0.000	0.000	
Constant	16.976	9202.507	0.000	1	0.999	23,589,800.683		

Logistic regression was used to analyze the relationship between the participant's literacy, age, and community, and the trainer's gender and nationality, and how this relationship affected the likelihood of adopting and maintaining agribusiness logbooks in the long-term (21 weeks post-training). Short-term adoption may not result in long-term sustained adoption; therefore, the necessity to examine both short- and long-term are essential to better understand the effect of homophily on dependent variable(s). The logistic regression model (Table 6) was statistically significant (χ^2 (7, N = 220) = 17.93, $p = 0.012$). The model explained 10.5% (Nagelkerke R^2) of the variance in adoption and correctly classified 64.1% of adoption–rejection decisions. The differences (44.3% in the short-term vs. 10.5% in the long-term) demonstrate that a combination of significant variables in the educator–learner homophily effect tends to dissipate with time and/or other unknown variables take precedence in the explanation of variance in adopting and maintaining agribusiness logbooks in the long-term. The participants who received training from a female instructor were 0.441 times less likely to adopt and maintain agribusiness logbooks in the long-term. Nationality was not associated with the likelihood of adopting agribusiness recordkeeping practices in the long-term.

Table 6. Logistic regression model at 21 weeks post-training.

Variable	B	SE	Wald	df	Sig	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Participant literacy	0.196	0.324	0.366	1	0.545	2.295	0.645	2.295
Participant age	0.015	0.022	0.419	1	0.518	1.060	0.971	1.060
U.S. male trainer	−0.277	0.615	0.202	1	0.653	2.533	0.227	2.533
U.S. female trainer	−0.723	0.658	1.208	1	0.272	1.762	0.134	1.762
GT male trainer	−0.126	0.625	0.041	1	0.840	3.002	0.259	3.002
GT female trainer	−0.807	0.761	5.642	1	0.018	0.729	0.037	0.729
Chochal	0.367	0.392	0.875	1	0.350	3.114	0.669	3.114
Cinco Arroyos	0.273	0.788	0.120	1	0.729	6.154	0.281	6.154
Constant	0.028	0.915	0.001	1	0.976	1.028		

4. Discussion

The results contradict the concept that the educator–learner homophily effect may mediate the flow and adoption of information. The study participants—all Guatemalan

female small-scale farmers—were less likely to adopt the technology long-term if trained by a female. Trainer nationality did not affect the short- or long-term adoption of agribusiness recordkeeping practices.

Gender Homophily: Given that all the participants were female, they shared a homophilous characteristic with female trainers. However, the participants who received training from a female trainer were less likely to adopt the agribusiness logbooks over the long-term. Therefore, gender homophily did not affect behavior change, as noted in earlier studies [2–4].

One explanation could be associated with deeply ingrained cultural norms. In Mam culture, women occupy a position of authority in the domestic realm [32]. While they assume responsibility for animals' daily care and maintenance and may participate in the trading of animals, typically, males control the purchase and sale of animals [32]. More broadly, economic power continues to be concentrated among males in Huehuetenango [33]. Given these cultural norms, consciously or subconsciously, Mam women may view female financial advisors (i.e., female extension agents or trainers) as less credible than male financial advisors. The participants considered the U.S. volunteers to be highly credible due to their reliability and past performance in development projects. Anecdotally, one oyster mushroom producer from San Andrés Semetabaj, Guatemala, stated, "The international volunteers are formal and punctual. . . our local extension agents are not reliable. . . there is one agent this month, but four months later, it is a different agent, and you start over" (G2M).

Notably, the effect of the trainer's gender on behavior change was not statistically significant at six weeks. The discrepancy between the gender homophily effect at 6 and 21 weeks may be due to technology. Agribusiness logbooks do not have immediate observable benefits. Participants need to track expenses and earnings for months before identifying patterns that help them make decisions to maximize earnings. Trainer credibility has a more negligible effect on one's willingness to adopt an innovation initially but a more prominent effect on one's willingness to continue trialing an innovation despite having no immediate observable benefits.

Future research should explore these dynamics more extensively, including studying the training results pertaining to technologies with immediate observable benefits traditionally associated with the female or a neutral domain. In addition, the study could be replicated in a cultural context with more egalitarian gender roles to enhance the understanding of relationships between gender homophily and technology adoption in agriculture.

Nationality Homophily: The Guatemalan trainers were from the same geographic department, Huehuetenango, as the participants. However, the participants who received training from a Guatemalan trainer were not more likely to adopt agribusiness recordkeeping practices in the short- or long-term. This result was unexpected, given that research finds nationality homophily (i.e., being from the same "hometown") generates strong levels of trust between two individuals [4]. However, this research [4] was conducted during the nascent stages of the internet and globalization [34]. Radical change in connectedness produced by the internet and globalization may render geographic origin homophily less relevant. Therefore, studies should reevaluate earlier findings.

The participants felt connected to the international volunteers based on shared experiences, which superseded the differences between their respective countries of origins. The participants explained that the U.S. volunteers established their credibility by making recommendations that resulted in demonstrable improvements. For example, one farmer who received pruning and grafting training said, "We have 100 percent confidence in the volunteers. They brought knowledge that we did not have. They helped us improve our varieties. They brought a variety [of cacao] we did not have before. . . We are still growing [that variety]" (DR19F). Further, the fact that the "volunteers were farmers themselves" gave them more credibility in the workshop attendees' eyes (DR23M). Hence, further quantitative studies could test the effect of nationality homophily between more dissimilar or unfamiliar educators and participants. For example, Guatemalans may be less familiar

with Koreans or Kenyans (or any other culture) than with U.S. citizens, and gaps in the educator–learner nationality homophily may become more prominent.

Participant Literacy: Initially, the literate participants were more than four times as likely to adopt agribusiness recordkeeping practices than the illiterate participants. This result comports with a common-sense expectation that using agribusiness logbooks requires literacy and numeracy skills. Rogers stated that characteristics of an innovation that make it adoptable include compatibility with the potential adopter's life and lifestyle. Additionally, the innovation must not be too complex to understand or use [8]. The literate participants might perceive agribusiness recordkeeping practices as being more compatible with their lifestyle and less complex than did their illiterate counterparts.

Nonetheless, the illiterate participants adopted the innovation at a rate of 81% (64/79) and 52.7% (39/74) at 6- and 21-weeks post-training, respectively. In addition, by 21 weeks post-training, literacy was no longer a statistically significant predictor of adoption. This finding supports research suggesting that individuals with no or low literacy operating under severe resource constraints in subsistence environments develop complex, sophisticated skills to cope with market challenges [35]. The fact that non-literate individuals were open to adopting agribusiness recordkeeping practices may defy common assumptions about the kind of training and extension appropriate for low-literacy communities. Additional research, design, and development of simpler agribusiness logbooks and training modules might reduce the complexity barrier for illiterate participants.

Participant Community: The community in which an individual lived was highly predictive of initial adoption at six weeks post-training. Participants from Chochal were more than 30 times as likely to adopt agribusiness recordkeeping practices than participants in Cinco Arroyos or El Potreros. A larger portion of the six-week sample (n = 229) came from Chochal (63.3%, 145) than Cinco Arroyos (12.2%, 28) and El Potreros (24.5%, 56). While Chochal is slightly more populated than Cinco Arroyos or El Potreros, all have similar sociodemographic variables.

However, during the 6- and 21-week data collection, the researchers observed highly active community leaders in Chochal organizing the community members. The researchers speculate that these community leaders may have served as opinion leaders [8], encouraging adoption of agribusiness recordkeeping practices. A more in-depth study evaluating the relationship between a community organization and innovation adoption in Chochal compared to other communities could yield valuable insight and illustrate a practical example of Rogers' innovation adoption and diffusion theory.

Limitations: Although the researchers invited a diverse mix of male and female participants, the sample consisted exclusively of female small-scale farmers due to self-selection. Nine men attended the training sessions, but their data were excluded, given their small representation in the sample. Additionally, the training program targeted a group of beneficiaries from the goat-husbandry project, where a disproportionate representation of women in the sample was consistent with ethnographic descriptions of gender roles in Mam culture. In traditional Mam culture, women are typically responsible for the daily management of animals [32].

While attrition at 6 and 21 weeks was minimal, most was due to migration. Research indicates that Huehuetenango is a primary origination point for Guatemalan migrants to the U.S. [36]; therefore, replicating the study in different locales may produce lower attrition rates.

The research design initially contemplated in-person training, which was complicated by the ongoing COVID-19 pandemic. Using training videos helped standardize the training because all the trainers used the same script, and the participants could not ask contemporaneous questions. However, it is unclear how the perception of homophily may be affected by in-person versus video-based training.

5. Conclusions

The impacts and critical phenomena of change agent homophily to farmer social system networks in the innovation decision process of farm entrepreneurs' adoption of new information, new customers, new technology, and achieving net zero through climate change mitigation cannot be overstated. Change agents can provide innovation information attributes, identify niche customers and markets, develop farmers' entrepreneurial skills through education and training, and serve as a conduit between farmers and customers, thus benefiting both groups and impacting SDGs 1–4, 8–9, and 12 locally. Our results indicate these SDG outcome achievements may be realized through organizational policy changes to increase the employment of change agents who share homophilic characteristics with their targeted audiences.

The multitude of the United Nations' agricultural development initiatives, programs, and agencies, as well as non- and not-for-profit organizations, should use our results to form or reform policies promoting shared homophilic characteristics between change agents and targeted audiences. Teaching others about innovative solutions to improve environmental and social impacts of food production and consumption may not be realized if the shared characteristics between farmers and change agents are not shared. Contrarily, farmer–agent shared characteristics will maximize the rate of adoption and positively influence the diffusion of effective and efficient agribusiness management practices that improve sustainable farming practices.

We conclude that homophily, although primarily a subconscious phenomenon, can be challenging when attempting to discern which subtle cues alert or influence one's ability to learn or retain new information. However, based on the data and previous literature, it is plausible to hypothesize that attire, attitude, education level, and/or language may serve as cues to the homophily effect. We expected the farmers would perceive the local extension agents as being more credible than the U.S. volunteers because the local extension agents would have greater shared levels of cultural, background, and geographic homophily with the participants than would the U.S. volunteers; however, our findings show that the U.S. volunteers were perceived as having greater subject matter expertise than the local extension agents. Furthermore, the participants overwhelmingly described the international volunteers as more credible and reliable than the local extension agents.

There are several conclusions from these findings. First, multiple assumptions about the variables could account for the discrepancy between the results and the conceptual model. The theoretical model holds that perceived credibility is a composite of competence credibility and perceived trustworthiness. The participants may have attributed greater competence credibility to the U.S. volunteers relative to the local extension agents because the U.S. volunteers had significantly higher levels of education and greater familiarity with technological advances. If gaps in competence were wide between the volunteers and the local extension agents, any homophily effect on the perception of trustworthiness could be rendered irrelevant. This raises a question for more research and exploration: if local agents and international volunteers had similar subject matter expertise, would homophily increase perceived credibility? Through additional study, we may better understand some of the variables (e.g., motivation, self-efficacy, attitude toward agricultural production, off-farm income) that affect smallholder farmers' innovation tendencies, entrepreneurial attitudes, or likelihood of adopting technological advances in food and fiber production. We can design more effective interventions and policies that foster agricultural innovation and promote entrepreneurship after future educator–learner homophily research studies.

Our results contradict the concept that the educator–learner homophily effect may mediate the flow and adoption of information, with several caveats. Although gender and nationality homophily did not regulate the participants' adoption of agribusiness recordkeeping practices, other dimensions of educator–learner homophily exist. This study did not test for the effect of other educator–learner homophilous characteristics, such as values, ethnicity, attitudes, behavior, profession, social class, or education level. Further research is necessary to understand if these and/or other educator–learner homophily

characteristics significantly influence the perceived educator credibility, learner knowledge retention, and adoption of farm management practices.

Additionally, due to unanticipated challenges associated with low literacy rates, this study did not capture the participants' perceptions of educator–learner homophily. We conclude that the participants perceived gender homophily with the female trainers and nationality homophily with the Guatemalan trainers. Do farmers from Huehuetenango perceive greater homophily with U.S. farmers who share similar educational backgrounds or university-educated extension agents from Guatemala City? Further research using homophily scale instruments would yield data about how learners perceive educators and allow for a more robust analysis of the homophily effect.

Nonetheless, the findings have practical implications for designing and implementing agriculture extension programs in Huehuetenango. The study indicates that participants might view female financial advisors as less credible, particularly in male-dominated topics with limited immediate observable benefits. Thus, when planning future sustainable agricultural training programs in Huehuetenango, administrators should consider including Mam cultural norms to increase the extension trainers' perceived credibility and participant behavior change for topics with limited immediate observable benefits.

Conversely, when introducing recent technology with immediate observable benefits, program administrators in Huehuetenango should consider targeting well-organized communities. Participants in Chochal, a well-organized community, were more likely to adopt the recent technology immediately. However, being a well-organized community did not increase the long-term adoption of a technology with limited immediate observable benefits. Therefore, targeting well-organized communities might be a viable strategy for introducing technologies with immediate observability, such as using a specific pesticide to control a new pest or disease and/or other farm management practices.

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