International Journal of Learning, Teaching and Educational Research
Vol. 23, No. 5, pp. 139-157, May 2024
https://doi.org/10.26803/ijlter.23.5.8
Received Mar 25, 2024; Revised May 18, 2024; Accepted May 23, 2024

Cultivating Entrepreneurial Skills in Organic Farming with Design Thinking and Community-Based Education

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Abstract. Traditional agricultural training programs often fall short in cultivating the comprehensive entrepreneurial skill set necessary for navigating the challenges of modern organic farming. Moreover, the potential synergies between community-based learning approaches and design thinking principles in agricultural education are yet to be fully explored. This study investigates the impact of a training approach integrating community-based learning and design thinking to enhance entrepreneurship competencies among organic farmers in Khon Kaen province, Thailand. Using a quasi-experimental design involving sixty participants, the study employs pre- and post-training assessments to evaluate changes in entrepreneurship competencies, including innovation, risk management, business planning, and financial literacy. Preliminary findings indicate significant improvements in all competency areas post-training, highlighting the potential of combining the two approaches in agricultural education. This research contributes to the broader goals of sustainable agriculture and rural development in Thailand, offering insights for educators, policymakers, and practitioners aiming to empower the organic farming community.

Keywords: community-based learning; design thinking; entrepreneurship competencies; organic farming; community-based education

1. Introduction

In Thailand, organic farming is more than a practice; it's also a movement toward sustainable and health-conscious food production, underscored by its potential for environmental conservation, reduction of chemical inputs, and the enhancement of food sovereignty and ecological balance (Jiumpanyarach, 2021; Lee, 2021; Taki et al., 2022). However, despite the growing domestic and

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international demand driving an increase in organic cultivation areas, Thai organic farmers are still confronting formidable challenges, such as limited market access, the economic viability of their produce compared to conventional counterparts, and the rigorous demands of maintaining sustainable practices which require deep understanding, substantial initial investment, and patience (Azam et al., 2019; Jouzi et al., 2017; Patle et al., 2020; Pattanapant & Shivakoti, 2013; Rahmann et al., 2017; Seerasarn et al., 2020). In addressing these challenges, innovative training methodologies that blend community-based approaches with the principles of design thinking are required, offering organic farmers a transformative catalyst to equip then with the essential skills, mindset, and creativity needed to thrive in an evolving agricultural landscape (Opolot et al., 2018; Seerasarn, 2015; Seerasarn et al., 2020; Ulvenblad et al., 2020).

In light of the above, the entrepreneurship competencies of individual farmers are critically vital for the sustainability and success of organic farming enterprises in Thailand Entrepreneurship in this context transcends the mere act of farming; it encompasses the ability to innovate, market effectively, manage resources efficiently, and adapt to changing market and environmental conditions (Pratita et al., 2019). However, the traditional agricultural training programs employed in Thailand have often fallen short in equipping farmers with such comprehensive skill sets (Pliakoura et al., 2020). As such, there exists a pressing need for innovative training approaches, ones that not only impart technical knowledge but also foster critical thinking, problem-solving, and the adaptive management skills essential for entrepreneurial success in organic farming (Nesterenko et al., 2021). In recognizing the multifaceted nature of the challenges faced by organic farmers, it becomes evident that a novel approach to training and development is required—one rooted in the principles of community engagement and enriched by the creative problem-solving ethos of design thinking. Such an approach promises not only to enhance organic farmers' entrepreneurial competencies but also to catalyze a broader transformation promoting sustainable and resilient agricultural practices in Thailand.

However, despite the crucial need for entrepreneurial skills in navigating the complexities that organic farming entails, there is a significant gap in research and practices related to developing these competencies among farmers. Notably, traditional agricultural training programs tend to focus on technical and production-oriented skills, neglecting the entrepreneurial abilities essential for modern organic farmers (Pratita et al., 2019; Sampedro-Hernández & Vera-Cruz, 2017). Furthermore, although community-based training is valued for its participative and relevant learning environment, the integration of such approaches with innovative methodologies like design thinking—and its proven ability in enhancing problem-solving and adaptability—remains underexplored in agriculture (Prada-Segura, & Medina-Roncancio, 2023; Sigauke, 2020). This lack of comprehensive training programs that merge community-based methods with design thinking underscores a critical research gap. Addressing this gap, is not merely an academic exercise, but a critical and essential intervention which, through empirical investigations into training models that cater to the unique aspects of organic farming in Thailand, not only for empowering farmers with

the skills necessary to survive and prosper but also for advancing sustainable agricultural systems (Sisang, 2019).

This study aims to fill this gap by exploring the impacts of a novel training approach that integrates community-based learning with the principles of design thinking, specifically tailored to enhance the entrepreneurship competencies of organic farmers (Dias et al., 2019). By doing so, it seeks to provide a comprehensive framework that not only empowers farmers with the necessary skills to innovate and adapt but also contributes to building a more resilient and sustainable agricultural sector.

The significance of this research transcends the individual farmer, offering potential advantages to an extensive network of stakeholders in the organic farming and agricultural education ecosystems. Enhanced entrepreneurship competencies are key in ensuring organic farmers have greater resilience against market and environmental challenges, thereby fostering opportunities for innovation and growth (Arumugam & Manida, 2023; Milone & Ventura, 2019). The study will afford agricultural educators and policymakers insights into effective, scalable training models adaptable to diverse contexts, thereby enriching the educational landscape for sustainable agriculture (Baptista et al., 2021).

The research seeks to evaluate the impact of community-based training and design thinking on the entrepreneurship competencies of organic farmers in Thailand. This objective is grounded in the premise that equipping farmers with a blend of entrepreneurial skills and innovative problem-solving capabilities can significantly elevate their ability to navigate the complexities of organic farming, leading to more sustainable and successful agricultural enterprises. The implications of this study are particularly resonant in the Thai context, where agriculture plays a pivotal role in the economy and the livelihoods of rural communities. Adopting specifically tailored training programs to enhance the entrepreneurship competencies of organic farmers can catalyze a shift toward more sustainable agricultural practices, thus bolstering Thailand's position in the global organic market.

2. Literature Review

Organic Farming in Thailand

Organic farming in Thailand represents a significant segment of the country's agricultural landscape, characterized by its commitment to environmentally sustainable practices and the production of chemical-free produce (Thongplew et al., 2016). This farming approach aligns with global trends toward sustainability and health-conscious consumption, offering a promising avenue for Thai farmers to tap into both the demand for organic products by both local and international markets (Irianto et al., 2023; Punwaree, 2020). The crucial transition to organic agriculture in Thailand is supported by a combination of government initiatives, non-governmental organizations, and a growing network of farmers who are increasingly aware of the benefits of organic farming, not only for the environment but also for public health and economic resilience (Lee, 2021).

Despite its potential, however, organic farming in Thailand faces several challenges. These include limited access to markets, where organic products often compete with conventional produce in terms of price and availability; the need for specialized knowledge and skills in organic farming techniques; and the substantial initial investment required to convert conventional farms to organic, which can be prohibitive for small-scale farmers (De Zoysa & Waisundara, 2022). Additionally, certification and compliance with organic standards pose their own set of challenges, requiring meticulous documentation and adherence to strict agricultural practices (Kubalek et al., 2022).

In addressing these challenges, it mandates a holistic approach, one that not only focuses on the technical aspects of organic farming but also fosters an entrepreneurship mindset among farmers. This involves equipping them with the skills to innovate, effectively manage their businesses, and navigate the complexities of the organic market (Yoon et al., 2021). By enhancing their entrepreneurship competencies, farmers can better position their organic product in the market, ensuring the sustainability and growth of their enterprises. As such, the integration of community-based learning and design thinking into agricultural education presents an innovative pathway to achieve this, promising to empower Thai organic farmers with the necessary tools to thrive in a competitive and ever-evolving agricultural landscape (Sims, 2017).

Community-based Education

Community-based education (CBE) is a strategy that involves active participation of the community in the educational process, moving beyond being a mere setting for learning to being a collaborator in defining educational experiences. The primary goal of CBE is to deliver education that is directly applicable to the specific needs and circumstances of the community, enhancing their capabilities by ensuring that education is both tailored to local needs and addresses them promptly. This generally entails actively engaging the community in the process of designing, implementing, and assessing educational programs (Strand et al., 2003; Villani & Atkins, 2000). By implementing a community-based approach into entrepreneurial education, especially in areas such as organic farming in Thailand, can improve the significance and effectiveness of educational programs. The approach highlights the importance of community involvement, with members of the community, especially leaders and local experts, actively participating in the creation and implementation of education initiatives.

This engagement guarantees that the curriculum and instructional approaches are customized to align entrepreneurial training with the local culture, available resources, and unique obstacles encountered by the community (Gamboa et al., 2023). In engaging the community in the educational process, CBE has the potential to increase the likelihood of creating sustainable and prosperous entrepreneurial businesses.

However, although, CBE has the ability to promote sustainable development in communities, facilitating the advancement of realistic solutions and encouraging community members to actively participate in their own development by

addressing local challenges and needs via education (Strand et al., 200, as in the case of CBL, CBE also encounters difficulties in guaranteeing ongoing community engagement and managing the competing community interests with the educational goals.

This study aims to impart a thorough knowledge of how community engagement in education might enhance long-term venture sustainability and community development by investigating the influence of both CBL and CBE in increasing entrepreneurship among Thai organic farmers.

Entrepreneurship in Agriculture

Entrepreneurship is fundamental to the agricultural sector's innovation, economic growth, and the advancement of sustainable practices, bringing to light the critical role of entrepreneurial skills—innovation, risk management, and strategic planning—in enhancing the resilience and competitiveness of agricultural enterprises (Dias et al., 2019). Particularly in organic farming, these competencies are vital for navigating unique challenges like regulatory standards, market variability, and sustainable resource utilization.

Innovation stands out as a key trait, enabling organic farmers to adopt sustainable practices, diversify product offerings, and explore novel marketing avenues, thus gaining a competitive edge (Suess-Reyes & Fuetsch, 2016). Effective risk management strategies are, thus, essential for coping with organic farming's uncertainties, such as fluctuating yields and environmental shifts. Furthermore, robust business and financial planning are pivotal for the sector's economic sustainability, guiding investment and diversification decisions critical for long-term viability (Iakovidis et al., 2023).

However, while the importance of entrepreneurial skills in agriculture is well-documented, the literature calls for further research on fostering these abilities among farmers, especially those in organic farming. This includes exploring effective training and support systems to cultivate an entrepreneurial mindset and equip farmers for success in a constantly evolving agricultural landscape (Herman et al., 2018). Additionally, investigating how to enhance entrepreneurial competencies in agriculture can offer insights into promoting environmental sustainability and social welfare, addressing both immediate operational challenges and contributing to broader societal goals (Gholamrezai et al., 2021).

Design Thinking in Agricultural Education

Design thinking, a methodology traditionally associated with the fields of design and engineering, has increasingly found relevance in educational programs, particularly within the agricultural sector. The literature on design thinking in agricultural education emphasizes its user-centered approach (Alao et al., 2022), which encourages learners to empathize with end users, define problems more effectively, ideate creatively, prototype rapidly, and test solutions in iterative cycles. This approach fosters a mindset geared toward innovation and adaptability, crucial competencies in the ever-evolving agriculture landscape (Alao et al., 2022; Sigauke, 2020).

In agricultural education, design thinking has been applied to tackle complex, real-world problems ranging from sustainable farming practices to supply chain optimization (Sigauke, 2020). Studies have highlighted how incorporating design thinking into curricula can lead to innovative solutions that are both practical and sustainable, addressing not only immediate agricultural challenges but also considering broader environmental and social impacts (Nowell et al., 2020). Moreover, design thinking's emphasis on adaptability and iterative learning resonates well with the unpredictable nature of farming, where conditions and challenges can change rapidly (Bender, 2020). By preparing students to think flexibly and embrace a trial-and-error approach, design thinking equips future agricultural professionals with the resilience to adapt to new challenges as they arise (Nettle et al., 2015). However, as reflected in the literature, the application of design thinking in agricultural education is still an emerging area, with opportunities for further research to explore its full potential and best practices for implementation (Park et al., 2023).

In synthesizing the reviewed literature, it becomes evident that, although community-based learning and design thinking individually show promise in enhancing entrepreneurship competencies within agricultural contexts, there exists a significant gap in research regarding their combined impact (Simon, 2023; Vogl et al., 2017). The literature largely treats these approaches in isolation, with scant exploration of how their integration could synergize to foster a more profound development of entrepreneurial skills among organic farmers. This oversight underscores a critical need for empirical research to examine integrated training programs that meld the immersive, contextual learning offered by community-based approaches with the iterative, user-centered problem-solving framework of design thinking.

Carella et al. (2022) explored how unlocking the significant ability related to the 'Diverging and Converging' design thinking principle is the best way to generate ideas. Therefore, the idea generation techniques adopted correspond to the main criteria theorized for the creative divergent stage to discover unconventional business ideas. De Oliveira et al. (2022) suggested that the utilization of design thinking strategies in the development of the decision support system for farmers highlights the importance of involving end-users in the process. This approach ensures that the technology meets the specific needs and challenges faced by farmers, thereby increasing the likelihood of successful adoption and implementation in agricultural practices.

Addressing this gap, the current study proposes to investigate the efficacy of a novel training model that harmonizes community-based learning with design thinking principles, specifically tailored to the organic farming sector in Thailand (Panpakdee, 2023). By doing so, this research aims to not only bridge the identified gap in the literature but also to contribute valuable insights into the design and implementation of more holistic and effective training programs. Such programs have the potential to significantly enhance the entrepreneurial competencies of organic farmers, thereby supporting the broader objectives of sustainable agricultural development and rural entrepreneurship. This study's findings could offer pivotal guidelines for educators, policymakers, and

agricultural practitioners aiming to cultivate a new generation of innovative, adaptable, and entrepreneurially-minded organic farmers, ultimately contributing to the resilience and sustainability of the agricultural sector.

3. Research Methodology

Research Design

This study adopts a quasi-experimental design, specifically the one-group pretest-posttest design, to evaluate the impact of a community-based training and design thinking program on the entrepreneurship competencies of organic farmers in Khon Kaen province. Using purposive sampling, 60 organic farmers with varied experience levels were selected, thus ensuring a diverse representation of the farming community. The six-week training program, developed with local agricultural experts, covered innovative farming practices, market analysis, and sustainable business models. Operational definitions for key constructs like 'entrepreneurship competencies' were established in consultation with agricultural economists and seasoned farmers, ensuring relevance to Thai agriculture. External factors such as market conditions and seasonal variations were controlled for, with ethical considerations and informed consent prioritized throughout the study.

Participants

Participants were purposively sampled from Khon Kaen's organic farming community, ranging in age from 25 to 65 years, with diverse educational backgrounds and 1 to 20 years of farming experience. Criteria included a minimum of one year of organic farming experience. Farmers engaged in conventional farming or those previously enrolled in similar training were excluded. Recruitment was facilitated through local cooperatives, with all participants providing informed consent. A power analysis determined the sample size was sufficient to detect significant competency changes, with stipends provided to minimize dropout and ensure engagement.

Data Collection

In this study, the data collection methodology was meticulously crafted to ensure the robust assessment of entrepreneurship competencies among organic farmers in Khon Kaen province. The selection of the 20 question items was grounded in a comprehensive review of the literature on entrepreneurship in agriculture, ensuring each item directly corresponded to key competencies such as innovation, risk management, business planning, and financial literacy. Prior to their implementation, these items underwent a rigorous validation process, including a pilot study among a small cohort of farmers and a review by subject matter experts to confirm their relevance and clarity. The assessment tool utilized a 5-point Likert scale, with detailed scoring guidelines developed to quantify the levels of competency, ensuring consistency and accuracy in interpretation.

To prepare participants for the assessment, an introductory session was conducted, elucidating the purpose and importance of the evaluation and providing clear instructions on how to respond to the items. Pre-training assessments were administered one day before the training commenced, and

post-training assessments were conducted immediately after the training concluded, minimizing external influences on participant responses. Data handling protocols were strictly adhered to, with all responses anonymized and securely stored to maintain confidentiality. The analysis was conducted using advanced statistical software, with measures in place to mitigate potential biases, such as randomization of question order. Ethical considerations were paramount, with informed consent obtained for all assessment-related activities, and participants were assured of their right to withdraw at any stage without any adverse consequences.

Training Program Description

The training program tailored for organic farmers in Khon Kaen province emerged from an in-depth curriculum development process initiated by a thorough needs assessment. This evaluation, conducted alongside local agricultural experts and farming associations, pinpointed crucial areas for enhancement, such as sustainable farming practices, market access strategies, and financial management skills. The program's foundation was thus laid with a clear focus on addressing the real-world needs and challenges faced by the farming community, ensuring its relevance and effectiveness.

Over a period of six weeks, the training blended traditional classroom instruction with dynamic, interactive elements. Workshops, field visits to successful organic farms, and collaborative group projects were designed to foster active participation and peer learning. The choice of instructional methods was informed by their proven success in adult education and appropriateness for the curriculum, aiming to engage farmers fully in the learning process. To support this hands-on learning experience, facilitators—comprising experienced organic farmers and academic experts in sustainable agriculture—were selected for their expertise and ability to convey complex concepts in practical terms. At the program's start, each participant was equipped with a comprehensive resource kit, including a detailed training manual, access to an online learning platform, and a set of tools for business and financial planning, enhancing the applicability of learned concepts to their farming operations.

A distinctive aspect of the training was its adaptive feedback mechanism, enabling participants to continuously assess and influence the progress of their learning journey. This approach allowed for real-time refinement of the program, ensuring it remained closely aligned with participant needs and industry trends. By fostering a supportive educational environment, the program not only aimed to improve participants' entrepreneurship competencies but also sought to cultivate a robust learning community among organic farmers in Khon Kaen. This community was envisioned to propel individual and collective growth in innovation and sustainable agricultural practices, laying a solid foundation for future advancements in the sector.

Measures of Engagement and Competencies

To evaluate the impact of the training program on participant engagement and the development of entrepreneurship competencies, a multifaceted measurement approach was employed. Engagement was assessed through a

combination of quantitative and qualitative indicators, including session attendance rates, active participation in discussions and workshops, completion rates of assigned projects, and peer interaction during group activities. These indicators were meticulously tracked throughout the program to provide a comprehensive picture of participant involvement.

The development of entrepreneurship competencies was measured using a bespoke assessment tool, designed in alignment with the key competencies identified in the initial needs assessment. This tool comprised 20 targeted question items, each mapped to specific domains such as innovation, risk management, business planning, and financial literacy. The tool was validated through a pilot study involving a subset of the participant group and refined based on feedback to ensure clarity and relevance.

Assessments were conducted at two critical junctures: immediately before the commencement of the training to establish a baseline and upon its conclusion to evaluate competency development. The Likert-scale format of the question items allowed for nuanced responses, facilitating a detailed analysis of competency growth. Additionally, to benchmark participant competencies against broader industry standards, comparisons were made with regional competency data where available, providing context to the competency levels observed post-training.

By employing this comprehensive measurement strategy, the study aimed to not only assess the direct impact of the training program on entrepreneurship competencies but also to understand the role of engagement in facilitating this development, offering insights into the effectiveness of the training approach.

Data Analysis

The analysis of the data collected through pre- and post-training assessments was conducted using a robust quantitative approach, specifically employing utilizing SPSS software to perform paired t-tests to compare pre-training and post-training competency scores. This approach allowed us to statistically discern the impact and effectiveness of the training program on the entrepreneurship competencies of organic farmers in Khon Kaen., paired t-tests were employed to compare pre-training and post-training competency scores.

To explore the relationship between participant engagement and competency development, correlation analyses were conducted, with engagement indicators serving as independent variables and changes in competency scores as dependent variables. This analysis helped to identify which aspects of engagement were most strongly associated with improvements in entrepreneurship competencies.

To ensure data integrity, a conservative approach managed missing data, with sensitivity analyses safeguarding the study's robustness. The reliability of the assessment tool was confirmed via Cronbach's alpha, validating the measurements' credibility. This careful analysis aims to offer valuable insights

into effective agricultural training, enhancing the educational framework for organic farming in Thailand.

4. Results

Participant Demographics

The study effectively engaged 60 organic farmers from Khon Kaen province, achieving a diverse participant group with a gender distribution of 70% male and 30% female. The ages of participants ranged from 25 to 65 years, with a median age of 40 years, reflecting a broad spectrum of life stages and experiences within the farming community. Most participants (70%) had between 1 to 10 years of experience in organic farming, while the remaining 30% had over 10 years of experience, indicating a mix of relatively new and seasoned organic farmers.

In terms of educational background, the cohort was varied: 15% of the participants had no formal education, 40% had completed primary education, 30% had secondary education, and 15% had attained tertiary education. This diversity in educational levels provided a rich context for examining the training program's impact across different knowledge bases and learning abilities.

Participants managed organic farms of various sizes, from small plots less than 1 rai to larger farms over 5 rais, with the majority (60%) managing farms between 1 to 3 rais. The types of organic produce varied widely among participants, including rice, vegetables, fruits, and herbs, offering a comprehensive view of the organic farming landscape in the region (Table 1).

Table 1: Participant demographics

Demographic Feature	Description
Gender	Male: 70% Female: 30%
Age Range	25-65 years Median Age: 40 years
Farming Experience	1-10 years: 70% >10 years: 30%
Education Level	No Formal Education: 15% Primary Education: 40% Secondary Education: 30% Tertiary Education: 15%
Organic Farm Size	<1 rai: 10% 1-3 rais: 60% >3 rais: 30%
Types of Produce	Rice, Vegetables, Fruits, Herbs

Note: "Rai" is a traditional Thai unit of land area measurement. 1 rai is approximately equal to 0.16 hectares or 0.4 acres.

Pre- and Post-Training Competency Scores

The impact of the community-based training and design thinking program on participants' entrepreneurship competencies was evaluated through a detailed analysis of pre- and post-training scores across four key competency areas: innovation, risk management, business planning, and financial literacy.

Table 2: Pre- and post-training competency scores

Competency Area	Pre-Training Mean (SD)	Post-Training Mean (SD)	p-value
Innovation	3.2 (0.8)	4.1 (0.7)	<0.01
Risk Management	2.9 (0.9)	3.8 (0.8)	<0.01
Business Planning	3.0 (1.0)	4.2 (0.6)	<0.01
Financial Literacy	2.8 (0.9)	3.9 (0.7)	<0.01

Note: SD = Standard Deviation

As illustrated in Table 2, all competency areas showed significant improvements following the training program. The most notable increases were observed in 'Business Planning' and 'Financial Literacy,' with mean score improvements of 1.20 and 1.10 points, respectively. Paired t-tests confirmed that these improvements were statistically significant ($p < 0.01$), indicating a strong impact of the training program on enhancing these competencies among participants.

The positive changes in 'Innovation' and 'Risk Management' competencies, though slightly lower, were equally significant, reflecting the comprehensive effectiveness of the training in fostering a broad range of entrepreneurial skills essential for the success of organic farming enterprises.

The statistical analysis revealed significant improvements in all measured entrepreneurship competencies among participants following the community-based training and design thinking program. Paired t-tests were conducted to compare pre- and post-training scores across the competency areas, yielding the following results:

Innovation: Participants demonstrated a substantial increase in innovation scores, with the mean score rising from 3.2 to 4.1. The t-test for this competency area yielded a t-value of 6.45, with a p-value of <0.01, indicating a highly significant improvement.

Risk Management: The mean score for risk management competencies increased from 2.9 pre-training to 3.8 post-training. The t-value for this comparison was 5.88, and the p-value was <0.01, further underscoring the significant impact of the training.

Business Planning: A notable enhancement was also observed in business planning competencies, with mean scores advancing from 3.0 to 4.2. The t-test resulted in a t-value of 7.02 and a p-value of <0.01.

Financial Literacy: The financial literacy scores improved from a pre-training mean of 2.8 to a post-training mean of 3.9, with the t-test yielding a t-value of 6.33 and a p-value of <0.01.

Correlation Analysis between Participant Engagement and the Development of Entrepreneurship Competencies

The analysis further explored the link between participant engagement in the training program and the development of entrepreneurship competencies.

Engagement was quantified based on attendance records, active participation in sessions, and completion of practical assignments. A composite engagement score was calculated for each participant, which was then correlated with the magnitude of improvement in their entrepreneurship competencies.

The correlation analysis revealed a positive relationship between engagement levels and competency development across all measured areas. Specifically, participants with higher engagement scores demonstrated more significant increases in their post-training competency scores. For instance, the Pearson correlation coefficient between engagement and innovation competency improvement was 0.53 ($p < 0.01$), indicating a moderate positive correlation. Similar patterns were observed for risk management ($r = 0.48$, $p < 0.01$), business planning ($r = 0.58$, $p < 0.01$), and financial literacy ($r = 0.50$, $p < 0.01$).

These findings suggest that participant engagement plays a crucial role in the effectiveness of the training program, with more engaged individuals experiencing greater enhancements in their entrepreneurship competencies. This underscores the importance of fostering an engaging and interactive learning environment to maximize the training's impact on competency development (Table 3).

Table 3: Correlation between participant engagement and competency development

Competency Area	Pearson Correlation Coefficient (r)	p-value
Innovation	0.53	<0.01
Risk Management	0.48	<0.01
Business Planning	0.58	<0.01
Financial Literacy	0.50	<0.01

Note: All p-values are significant at the 0.01 level.

As shown in Table 3, there is a statistically significant positive correlation between participant engagement and improvements in all entrepreneurship competency areas, with business planning showing the strongest correlation. These findings highlight the importance of engagement in the training process and its impact on the effectiveness of competency development.

The statistical analysis and correlation findings offer compelling evidence of the community-based training and design thinking program's positive impact on enhancing entrepreneurship competencies among organic farmers in Khon Kaen province. The significant improvements observed across all competency areas post-training, as highlighted in Table 2, underscore the effectiveness of the integrated training approach in fostering critical entrepreneurial skills such as innovation, risk management, business planning, and financial literacy.

Moreover, the positive correlations presented in Table 3 between participant engagement and competency development emphasize the critical role of engagement in the learning process. The moderate to strong correlations across competency areas suggest that the more actively participants engaged with the

training content and activities, the greater the improvements in their entrepreneurial skills. This finding highlights the importance of interactive and participatory training methods in maximizing learning outcomes and suggests that fostering high levels of engagement can significantly enhance the training's impact on competency development.

5. Discussion

The observed improvements in entrepreneurship competencies among organic farmers post-training provide strong evidence for the efficacy of the community-based training and design thinking program implemented in Khon Kaen province. This significant enhancement across areas such as innovation, risk management, business planning, and financial literacy underscores the program's comprehensive approach to addressing the multifaceted needs of organic farmers. These findings align with existing literature that advocates for experiential and participatory learning methods in agricultural education, which emphasize real-world applicability and learner engagement (Nagchaudhuri et al., 2022; Skaltsa et al., 2022; Tomlinson & Rhiney, 2018).

Moreover, the positive correlation between participant engagement and competency development corroborates the theory that active involvement in learning processes leads to more profound and lasting educational outcomes (Stephenson et al., 2020). This insight is particularly relevant to the context of organic farming in Thailand, suggesting that the success and sustainability of agricultural practices may be influenced by farmers' ability to adapt and innovate in response to evolving environmental and market challenges.

Contrasting with some prior studies that reported mixed results on the impact of design thinking in agricultural settings (De Oliveira et al., 2023; Masinde, 2022), our findings suggest that, when design thinking principles are effectively integrated with community-based approaches, they can significantly enhance learning outcomes. This discrepancy in findings may be attributed to the contextual tailoring of our training program, which was specifically designed to meet the unique challenges and opportunities faced by organic farmers in the region.

The significant improvements in entrepreneurship competencies post-training have profound implications for various stakeholders within the agricultural sector, particularly in the context of organic farming in Thailand. For organic farmers, the enhanced competencies in innovation, risk management, business planning, and financial literacy equip them with the necessary tools to navigate the complexities of organic farming more effectively. This not only contributes to the sustainability and profitability of their farming enterprises but also promotes the adoption of more innovative and environmentally friendly farming practices.

From an educational perspective, the findings underscore the value of incorporating community-based learning and design thinking into agricultural training programs. By demonstrating the positive impact of these approaches on competency development, the study provides a compelling case for agricultural

educators and institutions to rethink traditional teaching methodologies. Integrating experiential learning opportunities that engage farmers directly with real-world challenges can lead to more meaningful and impactful learning outcomes.

Furthermore, the positive correlation between participant engagement and competency development emphasizes the importance of designing training programs that actively involve participants and cater to their specific needs and contexts. This insight is crucial for program designers and facilitators aiming to maximize the effectiveness of educational interventions in agriculture.

The study boasts several strengths that lend credibility to its findings. The integration of community-based learning with design thinking principles, tailored specifically for the organic farming context in Khon Kaen province, represents a novel approach to agricultural education. Likewise, the rigorous quantitative methodology, encompassing pre- and post-training assessments and statistical analyses, provides a robust framework for evaluating the training program's impact on entrepreneurship competencies. Furthermore, the high level of participant engagement, as evidenced by attendance and active participation, underscores the program's relevance and effectiveness in meeting the farmers' learning needs.

However, despite these strengths, the study is not without limitations. The geographic focus on Khon Kaen province, while providing in-depth insights into this particular context, may limit the generalizability of the findings to other regions or agricultural settings. The reliance on self-reported measures for assessing entrepreneurship competencies could also introduce bias, as participants may overestimate their abilities or the training program's impact. Additionally, the absence of a control group limits the ability to attribute changes in competencies solely to the training program, as external factors may also have influenced the outcomes.

To mitigate these limitations and enhance the robustness of future research, it is recommended that subsequent studies include a broader geographic scope and a more diverse participant base. Employing a mixed-methods approach could enrich the data, providing a more nuanced understanding of the training program's impact. Incorporating objective measures of competency development and including a control group would further strengthen the research design and the validity of the findings.

Building on the insights garnered from this study, several avenues for future research emerge. To address the limitations related to the generalizability of the findings, subsequent studies could explore the impact of community-based training and design thinking programs across different regions in Thailand and other countries with significant organic farming sectors. This would help ascertain the universal applicability of these training approaches and identify any regional-specific adaptations that might enhance their effectiveness.

Longitudinal research is also recommended to examine the sustained impact of such training programs on the entrepreneurship competencies of organic farmers. Tracking participants over an extended period could provide valuable data on the long-term retention of competencies and the continued application of learned skills in their farming practices.

Additionally, incorporating qualitative research methods, such as interviews and focus groups, would complement the quantitative data and provide a deeper understanding of participants' experiences, motivations, and the contextual factors influencing the effectiveness of the training program. Lastly, studies involving control groups would enhance the ability to draw causal inferences regarding the training program's impact, providing a more rigorous assessment of its effectiveness compared to traditional training methods.

6. Conclusion

In conclusion, this study provides compelling evidence of the positive impact of community-based training and design thinking on enhancing the entrepreneurship competencies of organic farmers in Khon Kaen province. The findings underscore the value of innovative and participatory educational approaches in agricultural training, highlighting their potential to contribute significantly to the sustainability and success of organic farming enterprises. By fostering a deeper understanding of these training methodologies and their application in the agricultural sector, this research contributes to the ongoing efforts to support organic farmers in navigating the challenges of modern agriculture and capitalizing on the opportunities it presents.

7. Acknowledgment

The authors extend their sincere gratitude for the invaluable support and contributions that made this research possible. This work is a part of the research project entitled "Development of Community-based Learning Model with Design Thinking Approach to Enhance Entrepreneurship Skills among Organic Farmers in Khon Kaen Province." We are profoundly grateful for the financial support provided by the Office of the Permanent Secretary, Ministry of Higher Education, Science, Research and Innovation, under the Research Grant for New Scholar (RGNS), Grant No. RGNS 64-046. We also extend our heartfelt thanks to the organic farmers in Khon Kaen province, whose participation and willingness to share their experiences were invaluable to the success of this research. Their insights and contributions have not only enriched this study but also shed light on the practical implications and benefits of the community-based learning model with a design thinking approach in the realm of organic farming.

8. References

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