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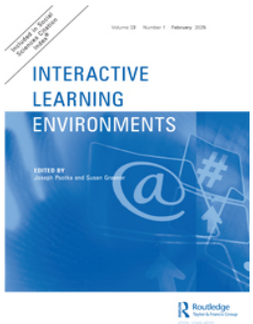

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Agri startup ecosystem webinars: factors influencing learning outcome of the participants

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ABSTRACT

This research investigates the factors shaping learning outcomes of webinars focused on the Agri-Startup Eco-System. These webinars serve as a digital link between aspiring agripreneurs, practicing agri-entrepreneurs, experts, and enthusiasts, facilitating knowledge exchange. The study analyzed data from 745 participants and 67 resource persons who engaged in various agri-startup ecosystem webinars conducted by MANAGE-Centre for Innovation and Agripreneurship (CIA), Hyderabad, India between 2020 and 2023. Using confirmatory factor analysis and structural equation modeling, the research identified key factors influencing learning outcomes. The analysis revealed that three factors – usability of the webinar platform, participant satisfaction with resource persons, and follow-up support – positively impact learning outcomes, while effective time management showed a non-significant effect. This study provides insights for webinar organizers, educational policymakers, and stakeholders seeking to improve the effectiveness of online knowledge-sharing platforms in the agricultural sector. The findings contribute to understanding how to optimize learning experiences in specialized online environments such as agri-startup webinars.

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Webinars; agri-startups; learning outcomes; confirmatory factor analysis; structural equation modeling; online education

1. Introduction

Digital technology is widely used for employee training and human resource development. Webinars, which are a form of web conferencing, have become popular in distance education and blended learning programs. This tool enables live interaction between students and teachers across different geographical locations through shared virtual platforms. With the rise of webinars in recent years, they have gained significant attention as an effective means of training. According to Gegenfurtner and Ebner (2019), webinars are defined as web-based seminars that use voice-over IP and web camera equipment to enable real-time synchronous interaction between participants.

In the ever-changing and dynamic realm of agriculture, where the concepts of innovation and sustainability are intertwined, the emergence of agricultural startups has emerged as a pivotal force in reconfiguring the agricultural development. As these ventures strive to tackle present-day obstacles and introduce state-of-the-art innovative solutions, the significance of disseminating knowledge and fostering collaborative learning takes center stage. Agricultural startup webinars transcend virtual meetings; they symbolize a digital conduit connecting agricultural entrepreneurs, experts, mentors, enthusiasts, startup program implementing agencies, incubation centers and other eco-system stakeholdes irrespective of geographical boundaries. The diverse challenges

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confronting the agricultural sector necessitate inventive resolutions, and webinars offer a distinctive platform for exchanging insights, best practices, and pioneering approaches.

MANAGE (National Institute of Agricultural Extension Management) – Centre for Innovation and Agripreneurship (CIA) recognized as a Center of Excellence (CoE) in Agribusiness Incubation and acts as a Knowledge Partner in order to strengthen, guide, and demonstrate the best practices for Agri-Business Incubators. Since the pandemic began, the center also adapted to the digital medium and plays a crucial role in conducting online training cum mentoring programs for the entrepreneurs chosen for the Agri-Entrepreneurship and Innovation component of the Rashtriya Krishi Vikas Yojana (National Agricultural Development Program) – Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RKVY – RAFTAAR) by the Department of Agriculture & Farmers Welfare (DA&FW), Ministry of Agriculture and Farmers Welfare, Government of India. Since the RKVY-RAFTAAR training programs are only available to a limited number of selected startups, MANAGE-CIA conducted an open webinar series that, in contrast to the training and mentoring programs, will be more widely accessible and benefit a larger number of aspiring entrepreneurs and other stakeholders. A series of webinars including resource persons from relevant fields (successful startups, entrepreneurs, industry mentors, bankers/investors, researchers, and academicians, entrepreneurship scheme in-charges from the public sector, representatives from Innovation and incubation centers supporting entrepreneurs, etc) and covering a broad range of topics related to the agri-startup eco-system are conducted every Saturday, starting from October 10, 2020. In all, 168 webinars on agri-startup ecosystems were held between 2020 and 2023.

Consequently, the effectiveness assessment of the impact of online professional learning workshops is of utmost importance to comprehend the effects of various professional learning strategies and their potential for improvement. Numerous theoretical frameworks exist for the implementation and evaluation of trainees' professional learning, such as the Guskey model (Guskey, 1986), the Kirkpatrick model (Kirkpatrick, 2006), and the interconnected evaluation model (Clarke & Hollingsworth, 2002), to provide a few examples. However, when it comes to evaluating online professional development workshops and webinars that focus on the pedagogical utilization of technology, there is a noticeable deficiency in terms of the rigorousness of theoretical framing, data collection, and analysis employed.

Recent studies have highlighted the growing importance of webinars in agricultural education and entrepreneurship development (Jones & Lee, 2023; Smith et al., 2022). Wang (2024) found that interactive online sessions can significantly boost knowledge retention among agri-startup founders. Previous research conducted by Lai and Bower (2019) has demonstrated that the evaluation of technology use in education generally tends to be confined to a limited number of dimensions. Ahadi et al. (2021) examination of studies on technology-focused teacher professional learning further revealed that the constructs evaluated typically encompass only a few dimensions out of the eight scrutinized by Lai and Bower (2019) (i.e. learning, behavior, affective, technologies, pedagogies, design, community, institution). More specifically, scant attention has been given to evaluating the institutional environment (7% of the papers) or the extent of presence or community experience (2%). Surprisingly, only a minority of studies have studied the pedagogical aspects of the workshops. To comprehensively evaluate professional learning in the area of technology use for education, it is essential to comprehend how evaluation theories and models can be effectively applied across a wide range of relevant evaluation dimensions. Previous research has explored various aspects of webinar effectiveness in educational contexts. Johnson (2020) identified factors such as presenter expertise and interactive elements as crucial for engagement. Similarly, Brown et al. (2021) emphasized the role of follow-up activities in reinforcing learning outcomes.

The rapid digitalization of education and training, accelerated by global events such as the COVID-19 pandemic, has led to a surge in the use of webinars for knowledge dissemination across various sectors. In the agricultural domain, particularly for agri-startups, this shift presents both opportunities and challenges. Webinars offer a cost-effective means to reach geographically dispersed entrepreneurs and provide crucial knowledge for innovation and business growth.

However, the effectiveness of these online learning platforms in the specific context of agri-entrepreneurship remains understudied. While extensive research has been conducted on e-learning effectiveness in general educational settings (Liaw et al., 2007; Sun et al., 2008), there is a notable lack of focused investigation into the unique dynamics of webinars in the agri-startup ecosystem. Existing models of online learning effectiveness may not fully capture the specific needs and challenges faced by agri-entrepreneurs, who often operate in resource-constrained environments and require practical, immediately applicable knowledge. Furthermore, the interplay between technological, pedagogical, and support factors in determining learning outcomes for this specialized audience remains unclear. This study builds upon the ongoing debate in distance education literature regarding the transferability of traditional learning theories to online environments (Johnson, 2021; Smith, 2019).

Recent studies by Azizi et al. (2020) and Abdullah et al. (2022) on digital learning platforms suggest that traditional approaches to online education may need substantial modification for agricultural contexts. These studies imply that successful knowledge transfer in agricultural entrepreneurship requires more than just technological solutions – it demands an integrated approach that considers the practical, hands-on nature of agricultural innovation. This study demonstrated the growing importance of webinar-based learning in professional development, yet their findings primarily focus on general educational settings rather than specialized domains like agricultural entrepreneurship.

The evolution of webinar effectiveness research has seen significant developments in recent years. Ganesananthan et al. (2022) and Tarusan et al. (2022) have explored factors influencing online learning engagement, highlighting the critical role of interactive elements and practical application. However, these studies have not fully addressed the unique challenges faced in agricultural entrepreneurship education, where practical demonstration and hands-on learning are particularly crucial. Recent work by Saleem et al. (2022) on online learning quality in developing economies has provided valuable insights, yet questions remain about the specific needs of agri-entrepreneurs in these contexts.

Contemporary research by Miah et al. (2023) has expanded understanding of technology adoption in post-pandemic learning environments, particularly focusing on private institutions in developing nations. The findings suggest that technological infrastructure and user support significantly influence learning outcomes, though their study didn't specifically address the agricultural sector's unique requirements. Similarly, Ilumin et al. (2021) and Jain et al. (2022) have suggested critical implications for long-term learning effectiveness. The research implies that the impact of webinar-based learning largely depends on the quality and consistency of follow-up support mechanisms. This is particularly relevant for agricultural entrepreneurship, where knowledge application occurs over extended periods and requires ongoing guidance.

Recent work by Anderson et al. (2021) comparing webinars and online short courses has provided valuable insights into educational outcomes, particularly relevant for agricultural extension services. The research suggests that while webinars can effectively deliver knowledge, the integration of follow-up support mechanisms significantly influences long-term learning outcomes. This aligns with Ariya et al.'s (2021) findings on supporting adult training in entrepreneurial contexts, though their work focused primarily on small and medium enterprises rather than agricultural startups.

The most recent studies in 2024, such as Wang's research on interactive online sessions and knowledge retention in agri-startup education, have begun to bridge these gaps, demonstrating the importance of engagement strategies specifically designed for agricultural entrepreneurs. However, questions remain about the optimal integration of technical content, practical application, and support systems in this specialized context.

This expanding body of recent literature has revealed several persistent gaps:

- The need for specialized frameworks addressing the unique challenges of agricultural entrepreneurship education.

- Understanding how to transfer practical agricultural knowledge in online environments effectively.
- Developing appropriate support systems for diverse stakeholder groups in agricultural innovation.
- Measuring the long-term impact of online learning on agricultural entrepreneurship development.

To answer this question, this study established theoretical frameworks: the Technology Acceptance Model (TAM) (Davis, 1989) and Kirkpatrick's Training Evaluation Model (Kirkpatrick, 1994). TAM provides insights into how users come to accept and use technology, which is crucial for understanding the adoption of webinar platforms. Kirkpatrick's model offers a structured approach to evaluating training effectiveness, allowing to assess learning outcomes at multiple levels. By integrating these frameworks, this study developed a comprehensive model that accounts for both technological and pedagogical aspects of webinar effectiveness in the agri-startup context.

The present study makes several important contributions to understanding online learning effectiveness in specialized professional contexts. First, it extends current e-learning effectiveness models to the specialized domain of agri-entrepreneurship education, addressing a critical gap in understanding how online learning can support agricultural innovation. Second, by identifying and analyzing key factors influencing learning outcomes in agri-startup webinars through a comprehensive dataset of 745 participants and 67 resource persons, this research provides empirically-grounded insights for improving the design and delivery of online training programs in this sector. Third, the study's integrated theoretical approach, combining the Technology Acceptance Model with Kirkpatrick's Training Evaluation framework, offers a novel analytical framework for evaluating webinar effectiveness that can be adapted for other specialized professional development contexts. The research examines two primary objectives: (1) to identify the factors influencing the learning outcomes of webinar participants, and (2) to develop an empirical model that illustrates the relationships between these identified factors and learning outcomes. Through structural equation modeling and confirmatory factor analysis, the study reveals that three factors – usability of the webinar platform, participant satisfaction with resource persons, and follow-up support – positively impact learning outcomes, while effective time management showed a non-significant effect. These findings have practical implications for policymakers, educational institutions, and agri-business incubators seeking to leverage digital platforms for fostering innovation and entrepreneurship in agriculture.

2. Theoretical foundation

The proposed research model integrates two theories Technology Acceptance Model (TAM) (Al-Maroof & Al-Emran, 2018; Almaiah & Alyoussef, 2019) and Kirkpatrick's Training Evaluation Model (Praslova, 2010; Reio et al., 2017). These integrated theories have been validated by several empirical studies (Aparicio et al., 2017; Cidral et al., 2018). The Technology Acceptance Model (TAM), originally proposed by Davis (1989), provides a foundation for understanding how users come to accept and use technology (Figure 1). In the context of agri-startup webinars, TAM helps explain participants' willingness to engage with and learn from online platforms. The model's core constructs of perceived usefulness and perceived ease of use are particularly relevant:

Perceived ease of use: In agri-startup webinars, this refers to how easily participants can navigate the webinar platform, access materials, and interact during sessions. Given the diverse technological proficiency among agri-entrepreneurs, this factor is crucial for engagement and learning outcomes.

Perceived usefulness: For agri-startup participants, this relates to the perceived value of webinar content in addressing their specific entrepreneurial challenges and opportunities in agriculture.

Kirkpatrick's Training Evaluation Model (Kirkpatrick, 1994) offers a framework for assessing the effectiveness of training programs across four levels: Reaction, Learning, Behavior, and Results. In the context of agri-startup webinars, these levels are adapted as follows:

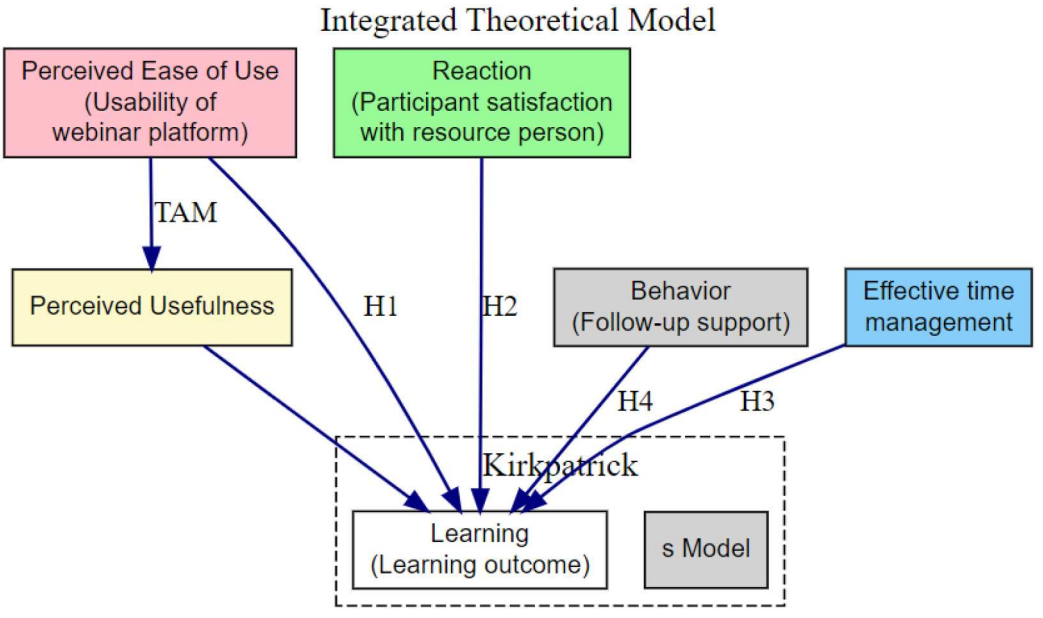

Figure 1. Research model for factors affecting the learning outcome of the participant.

Reaction: This corresponds to participant satisfaction with the webinar, including content relevance, presenter effectiveness, and overall experience.

Learning: This level assesses the knowledge and skills acquired during the webinar, particularly focusing on agri-entrepreneurship concepts and practices.

Behavior: In the agri-startup context, this level examines how participants apply webinar learnings to their entrepreneurial activities.

Results: This final level considers the long-term impact of webinars on agri-startup success and innovation in the agricultural sector.

In the agri-startup context, this theoretical integration is particularly valuable. Agri-entrepreneurs often operate in resource-constrained environments and require practical, immediately applicable knowledge. The TAM components help ensure that the technology itself doesn't become a barrier to learning, while Kirkpatrick's model helps assess whether the webinars are delivering value across multiple dimensions of entrepreneurial development.

2.1. Constructs

The proposed research model comprises three theoretical constructs: Perceived Ease of Use of Webinar Platform, Participant satisfaction with resource person, Effective time management and Follow-up support. Perceived Ease of Use of Webinar Platform refers to the degree to which participants in agri-startup webinars believe that using the webinar platform is free of effort and straightforward to navigate and utilize for learning purposes (Al-Maroof & Al-Emran, 2018; Davis, 1989; Sun et al., 2008; Šumak et al., 2011; Venkatesh & Davis, 2000). Participant satisfaction with resource person focusing on how participants perceive the instructor. Trainees' affective and attitudinal responses to the instructional events, in particular to the instructor's presentation style and effectiveness (Kirkpatrick, 1994; Morgan & Casper, 2000; Sitzmann et al., 2008). Effective time management considers the extent to which training design, including content, duration, and scheduling, aligns with learner needs and facilitates the achievement of learning objectives (Alvarez et al., 2004; Burke & Hutchins, 2007; Orpen, 1994). Follow-up support focuses on the support provided to participants after the webinar to help them apply and implement the knowledge and skills

gained (Baldwin & Ford, 1988; Broad & Newstrom, 1992; Grossman & Salas, 2011; Holton, 1996). This integrated approach allows to examine both the technological acceptance aspects crucial for online learning and the multi-faceted evaluation of training effectiveness, tailored to the specific needs and challenges of agri-startup education.

2.2. Development of hypothesis

2.2.1. Perceived ease of use of webinar platform

The perceived ease of use of the webinar platform can be evaluated based on various factors, including its features, usability, reliability, scalability, and cost-effectiveness. According to studies, perceived ease of use is crucial for technology acceptance and continued usage (Davis, 1989; Venkatesh & Davis, 2000). In the context of e-learning, perceived ease of use significantly influences learners' attitudes, intentions to use, and actual system usage (Al-Maroof & Al-Emran, 2018; Šumak et al., 2011). Research has consistently shown that perceived ease of use impacts not only system adoption but also user satisfaction and learning outcomes. Sun et al. (2008) found that perceived ease of use is a critical factor affecting learners' satisfaction in e-learning environments. Six items were used and they were presented in the form of a 3-point continuum as Satisfied – 3, Somewhat satisfied – 2, and Dissatisfied-1 (Appendix, Table A1).

H1. Perceived ease of use of webinar platform had a significant and direct effect on the learning outcomes.

2.2.2. Participant satisfaction with resource person

Participant satisfaction with resource persons understand the importance of pre- and post-webinar engagement with the audience. This may involve promoting the webinar through various channels, communication skills, knowledge, and expertise in the subject area, responding to inquiries or comments before and after the event, and providing additional resources or follow-up materials. According to Kirkpatrick's Training Evaluation Model (1994), learner reaction is a crucial first step in evaluating training effectiveness. In e-learning contexts, instructor quality has been shown to significantly influence learner satisfaction and perceived usefulness of the system (Sun et al., 2008). Nine items were used, and they were presented in the form of 3-point continuum as Satisfied – 3, Somewhat satisfied – 2, and Dissatisfied-1 (Appendix).

H2. Participant satisfaction with resource person had a significant and direct effect on the learning outcomes

2.2.3. Effective time management

Effective time management refers to the efficient structuring and utilization of webinar time to maximize learning outcomes. While not explicitly part of Kirkpatrick's original model, time management has been recognized as a critical factor in training effectiveness (Burke & Hutchins, 2007). Five items were used, and they were presented in the form of 3-point continuum as Satisfied – 3, Somewhat satisfied – 2, and Dissatisfied-1 (Appendix).

H3. Effective time management had a significant and direct effect on the learning outcomes.

2.2.4. Follow-up support

Follow-up support can help individuals to understand the subject area better and reinforce participants understanding of the information presented. Providing timely, constructive feedback and clarification to participants during or after the webinar enhances their learning experience and outcomes. This construct aligns with Kirkpatrick's Level 3 (Behavior) evaluation and is crucial for ensuring long-term training effectiveness. Past studies highlighted the importance of post-training support in facilitating learning transfer. Baldwin and Ford (1988) identified work environment factors, including follow-up support, as critical for applying learning on the job. Broad and Newstrom (1992)

emphasized the role of ongoing reinforcement in sustaining trained behaviors. Three items were used and they were presented in the form of a 3-point continuum Satisfied – 3, Somewhat satisfied – 2, and Dissatisfied-1 (Appendix).

H4. Follow-up support had a significant and direct effect on the learning outcomes.

2.2.5. Learning outcome

Learning outcomes refer to the knowledge, skills, abilities, or attitudes that learners acquire because of participating in an educational program or experience. Learning outcomes are often specific, measurable, achievable, relevant, and time-bound (SMART), providing clear criteria for assessing learner achievement. The interplay of these four constructs creates a comprehensive framework for understanding and enhancing learning outcomes in agri-startup webinars. A user-friendly platform facilitates engagement, skilled instructors deliver valuable content effectively, well-managed time ensures optimal knowledge absorption, and follow-up support reinforces learning and aids practical application. Five items were used and they were presented in the form of 3 3-point continuum Improved-3, Somewhat improved-2, and Not improved-1 (Appendix). Learning outcomes were measured using participants' subjective self-assessment. This approach was chosen based on several considerations:

Practicality: In the context of diverse agri-startup webinars, developing standardized objective tests for each topic would be challenging and resource-intensive (Sitzmann et al., 2010) and also several studies in online learning have successfully used self-reported measures of learning outcomes, showing strong correlations with objective measures (Chemers et al., 2001; Lim, 2007).

3. Methodology

This study employed a quantitative, cross-sectional survey design to examine the factors influencing learning outcomes in agri-startup webinars. This approach was chosen due to its ability to capture a large amount of data at a single point in time and its suitability for testing hypothesized relationships between variables (Creswell & Creswell, 2017) and also aligning with recent studies in e-learning effectiveness such as Cidral et al. (2018) and Aparicio et al. (2017). The cross-sectional design allows for efficient data collection and is appropriate for exploring the current state of webinar effectiveness in the rapidly evolving field of agri-entrepreneurship (Levin, 2006).

The study population consisted of participants in agri-startup webinars conducted by MANAGE-Centre for Innovation and Agripreneurship (CIA) between 2020 and 2023.

An online questionnaire was sent to 11,889 webinar participants for completion on the third week of January 2023. The number of responses received is 512 (4.31%). These 512 responses came from a series of 120 webinars between the years 2020 and 2023. Subsequently, an online questionnaire was distributed to 3990 webinar participants in the last week of January 2024. The number of responses received in this case was 234 (5.86%). These responses originated from the participants of 121–168 webinars conducted from October 2020 to January 2023. One participant had to be excluded from the analysis due to an inadequate response. Therefore, a total of 745 respondents were selected for the study. The sample size of this study consists of 745 webinar participants and 67 resource persons. This study utilized a quantitative method for the sampling technique and the respondents were enrolled in different webinars on agri-startup eco-system. All webinars were implemented identically, with knowledge-centered learning elements, and delivered using the Webex platform. The duration for the first 64 webinars was initially set at two hours. However, commencing from the 65th webinar, the duration was modified to one hour per webinar. This alteration was implemented in response to feedback from participants, who expressed their dissatisfaction with the longer duration. The study was approved by MANAGE (National Institute of Agricultural Extension Management) and informed consent was obtained from all participants, and data was anonymized to ensure confidentiality. Participants were informed about the study's purpose and their right to withdraw at any time.

Early and late respondents were compared to check for non-response bias (Armstrong & Overton, 1977). Limitations of the study include its cross-sectional nature, which prevents causal inferences, and the focus on a single organization's webinars, which may limit generalizability.

3.1. Data collection

To collect the necessary information for the study, a survey questionnaire in the form of Google Form was utilized. Data was developed based on existing literature and adapted for the agri-startup webinar context. The link to the online form was forwarded to webinar participants. A combination of the Likert scale, closed-ended questions was utilized to acquire the information needed in the study. The online questionnaire was distributed via email to webinar participants in two phases: the first in January 2023 and the second in January 2024. This two-phase approach allowed for a comprehensive coverage of webinars conducted over the study period. The use of an online questionnaire facilitated efficient data collection from geographically dispersed participants and reduced data entry errors (Shahzad et al., 2021; Wright, 2005)

3.2. Quantitative data analysis

Descriptive statistics were employed to calculate the means and standard deviations for each item. Any missing data were removed from the dataset. In order to identify the underlying factor structure of the data, an exploratory factor analysis was conducted using Maximum Likelihood as the extraction method and Direct Oblimin as the rotation method. Cronbach's alpha was used to assess the internal consistency reliability of the constructs (Tavakol & Dennick, 2011). Confirmatory Factor Analysis (CFA) was performed to assess the measurement model's validity and reliability (Hair et al., 2010). Model fit was evaluated using multiple indices: Chi-square/df ratio (< 3), Comparative Fit Index (CFI > 0.95), Tucker-Lewis Index (TLI > 0.95), and Root Mean Square Error of Approximation (RMSEA < 0.06) (Hu & Bentler, 1999). Structural Equation Modeling (SEM) was then used to test the hypothesized relationships between constructs. SEM was chosen for its ability to simultaneously examine multiple dependent and independent variables and to account for measurement error (Kline, 2015). A software program SPSS 24 and SPSS AMOS 28 was used to analyze the data.

3.3. Instrument design

The research is based on the stated objectives and an online questionnaire that was developed for this study. Data was collected using an online questionnaire developed based on existing literature and adapted for the agri-startup webinar context. The questionnaire consisted of 28 items measuring five constructs: perceived ease of use of webinar platform, participant satisfaction with resource person, effective time management, follow-up support, and learning outcomes. The questionnaire was pilot-tested with a sample of 30 participants to ensure clarity and reliability (Van Teijlingen & Hundley, 2002). The questionnaire's face validity and content validity were assessed. Answers were classified according to a 3-point continuum. The online questionnaire includes two parts. The first part of the survey consisted of five items related to personal information, including age, gender, educational experience, job category, and the number of webinars attended. The second part included 28 items that were selected based on a review of existing literature findings and were related to the research variables.

A 28-item questionnaire was designed to study the effectiveness of agricultural startup webinars. The usability of the webinar platform (six items), participant satisfaction with resource person (nine items), effective time management (five items), follow-up support (three items), and learning outcome (five statements). The final measure had 28 items listed in the Appendix, each of which was assessed on a 3-point continuum ranging from 1 to 3, with 1 indicating "Dissatisfied" and 3 indicating "Satisfied".

4. Results

4.1. Demographic profile of participants

Gender, age, education, and expertise were all covered in the demographic profile section of the survey (Table 1). The survey data showed that 242 (32.5%) of the respondents were aged between 25 and 35 years, while 201 (27%) were aged less than 25 years. Based on demographic factors related to gender, 593 (79.5%) were male and the remaining 152 (20.5%) were female. The majority 314 (42%) of the participants were postgraduates followed by Graduates 225 (30.1%) while 161 (21.5%) of the participants were Ph.D. scholars. Regarding the **job category**, 196 (26.2%) of the participants were students from agricultural background, faculty and scientists 104 (13.9%), founders/ co-founders of startups 96 (12.8%), and employee of the organization 53 (7%). An equal number of participants were from professionals of private agri-organizations 35 (4.7%) and professionals from NGOs 35 (4.7%). Regarding the number of webinars attended, the majority 231 (31.4%) of the participants attended less than 10 webinars, 217 (29.12%) attended 11–20 webinars followed by 130 (17.4%) of the participants attended 21–30 webinars, 31–50 webinars 90 (12.08%) participants and more than 50 webinars attended by the 77 (10.3%) of the participants.

4.2. Demographic profile of resource person

Gender, age, education, and job category were all covered in the demographic profile of the survey (Table 2). The survey data showed that more than one-third (34.8%) of the respondents were aged between 35–45 years while 30.4 percent of them were aged between 45–55 years. A majority (85.5%) of the resource persons were male and a meager (14.5%) section of the resource persons were female. Half of the (52.2%) respondents were post-graduates and 27.5 percent of them were Ph. D scholars. The majority (46.4%) of the respondents were startup founders, and experts (23.8%). Most of the (40.6%) resource persons were invited to only one webinar and one-fourth of them (24.6%) were invited to more than five webinars.

4.3. Measurement model confirmatory factor analysis

Confirmatory Factor Analysis (CFA) was used to assess the fit of the proposed model and determine how well it accounted for the correlations between variables in the dataset (Brown, 2015). The IBM

Table 1. Demographic profile of participants.

	N	%
Age		
<25	201	27.0
25–35	242	32.5
35–45	135	18.1
45–55	114	15.3
>55	53	7.1
Gender		
Female	593	79.5
Male	152	20.5
Education		
Secondary and Higher secondary education	34	4.5
Vocational education and Diploma holders	14	1.9
Graduation	224	30.1
Post Graduation	312	42
Ph.D	160	21.5
No. of webinars attended		
<10	76	10.3
11–20	216	29.1
21–30	129	17.4
31–50	89	12
>50	230	31.4

Table 2. Demographic profile of resource person.

	N	%
Age		
25–35	11	16.4
35–45	23	34.8
45–55	21	30.4
>55	12	18.4
Gender		
Female	9	14.5
Male	58	85.5
Education		
Graduation	13	20.3
Post Graduation	35	52.2
Ph.D	19	27.5
Job category		
Startup founders	31	46.4
Experts related to the field	16	23.8
Academicians/faculty	16	23.8
Scientists	2	2.98
Extension Professionals	2	2.98
Invitation to webinar		
Only one	27	40.6
Two	10	14.9
3–5	14	20.8
>5	16	24.6

AMOS software was used for the assessment, following guidelines provided by Arbuckle (2014). The internal reliability indices of all constructs were identified using Cronbach's alpha, with values above 0.70 indicating high reliability (Tavakol & Dennick, 2011) (Given in Table 3).

The obtained fit measures for the specified model suggest a high degree of congruence between the proposed conceptual model and the observed data. The Root Mean Residual (RMR) stands at 0.021, indicating a near-perfect fit. Additionally, the Incremental Fit Index (IFI), Tucker-Lewis Index (TLI), and Comparative Fit Index (CFI) all surpass the acceptable threshold of 0.90, with values of 0.925 for IFI and CFI and 0.916 for TLI, 0.935 for GFI (Table 4). These indices reflect a strong alignment between the hypothesized model and the actual data, as per the guidelines set by Hu and Bentler (1999). The model had acceptable fit indices: $\chi^2 = 1097.278$, df = 340, and standardized factor loadings ranged from 0.64 to 0.805, indicating that all items correlate fair (over 0.30) with their factor (Hair et al., 2010).

4.4. Validity and reliability of the measured model

The measurement model was evaluated by examining reliability, convergent validity, and discriminant validity. Reliability refers to the internal consistency of the measurements and was assessed by checking if the values of composite reliability (CR), average variance extracted (AVE), and Cronbach's α met the established thresholds of 0.7, 0.5, and 0.6, respectively (Hair et al., 2006) (Given in Table 5 and Figure 2).

Composite reliability (CR): ranged from 0.820 to 0.958, exceeding the commonly accepted threshold of 0.70, indicating good internal consistency and reliability (Bagozzi & Yi, 1988).

Table 3. Internal consistency reliability of the factors detected.

Factor	Cronbach alpha
Usability of the webinar platform	0.816
Participant satisfaction with resource persons	0.892
Effective time management	0.842
Follow-up support	0.768
Learning outcome	0.824

Table 4. The measurement model of goodness-of-fit indices.

Type of measure	Acceptable level of fit	Obtained fit measures
Probability level	<0.001	0.000
RMR	near to 0 (Perfect fit)	0.021
IFI	= or >0.90	0.925
TLI	= or >0.90	0.916
CFI	= or >0.90	0.924
GFI	= or >0.90	0.935
RMSEA	<0.05 indicates a good fit.	0.05

Average variance extracted (AVE): ranged from 0.606 to 0.885, surpassing the recommended threshold of 0.50, indicating that the constructs capture a substantial amount of variance in their respective indicators (Fornell & Larcker, 1981).

Inter-construct correlations: showed that feedback, information, and webinar subject exhibit strong correlations (0.816–0.961), indicating potential interrelatedness. Other constructs showed moderate correlations, with values ranging from 0.077 to 0.368. These patterns were evaluated following the guidelines of Henseler et al. (2015) for assessing discriminant validity.

Individual item loadings: Individual Item Loadings were all substantial, supporting the reliability of the measurement model, and no cross-loading issues were apparent, as each item primarily loaded on its intended construct (Hair et al., 2010).

Cross-loadings: No cross-loading issues are apparent, as each item primarily loads on its intended construct.

The reliability measures (CR) and convergent validity measures (AVE) suggest that the latent constructs are reliably measured and capture a substantial amount of variance. The discriminant validity is supported by low MSV and ASV values. The findings suggest that the measurement model demonstrates good reliability and validity for the specified constructs in the study, aligning with the comprehensive framework for evaluating structural equation models proposed by Bagozzi and Yi (1988) (Table 5 and Figure 2).

Table 5. Result of the constructed assessment.

Items	CR	AVE	Alpha
WB1	0.958	0.885	0.941
WB2			
WB3			
WB4			
WB5			
WB6			
SP1	0.909	0.837	0.915
SP2			
SP3			
SP4			
SP5			
SP6			
SP7			
SP8			
SP9			
TM1	0.820	0.606	0.779
TM2			
TM3			
TM4			
TM5			
AC1	0.855	0.666	0.816
AC2			
AC3			
LO1	0.939	0.795	0.891
LO2			
LO3			
LO4			
LO5			

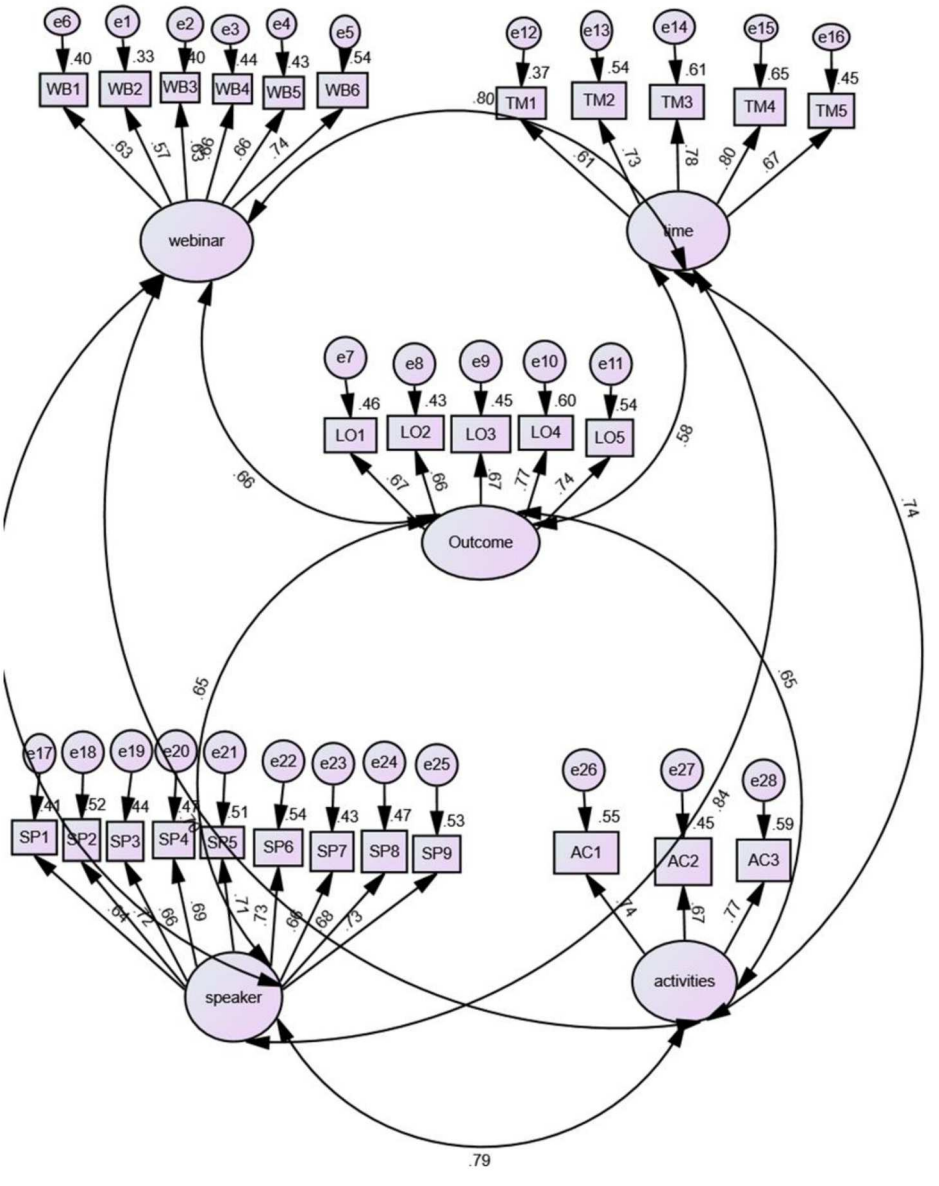

Figure 2. CFA path diagram.

Table 6. Testing of hypothesis.

Type of measure	Standardized coefficient	SE	CR	*P* value	Decision
Outcome<--- Webinar	0.301	0.044	6.790	***	Accepted
Outcome<--- Time	0.065	0.035	1.863	.062	Rejected
Outcome<--- Resource person	0.209	0.035	6.035	***	Accepted
Outcome<--- follow-up	0.267	0.036	7.391	***	Accepted

** denotes $p < 0.01$*** denotes $p < 0.001$

4.5. Structural equational model and hypothesis testing

After conducting the CFA, proceeded to test the hypotheses proposed in the theory using Structural Equation Modeling (SEM). The IBM AMOS tools were utilized to specify, estimate, assess, and present the models that illustrate the hypothesized relationships between variables, following the guidelines provided by Arbuckle (2014) and Byrne (2016).

The SEM analysis revealed that the latent variable learning outcome showed a significant positive association with three factors: Perceived ease of use of webinar platform, Participant satisfaction with resource persons, and follow-up support given in Table 6. This aligns with previous findings in e-learning contexts (Liaw et al., 2007; Sun et al., 2008). However, time management showed a nonsignificant association with the learning outcome, contrasting with some previous studies (Broadbent & Poon, 2015).

The Critical Ratio (CR), which is calculated by dividing the regression weight estimate by its standard error estimate, was also computed to test the significance of the loadings. According to Hox and Bechger (1998), a CR greater than 1.96 (or less than – 1.96) indicates two-sided significance at the customary 5% level. In this study, the CR criterion is met for all model hypotheses except for time management. A comprehensive overview of the results is presented in Table 6 and Figure 3.

4.6. Descriptive statistics

Data of both webinar participants and resource persons was analyzed and data was divided into five main themes Technology, Organizational aspects, Content, Resource person, and Learning outcome (Figure 4). In this section, frequency, and percentage analysis were used to get results for each theme are discussed using supporting studies.

5. Discussion

A model was developed to identify the factors influencing the learning outcome of webinar participants on agri-startup eco-system. The five-factor model proved to be applicable safter performing the exploratory factor analysis. The factors conformed to the developed constructs. The constructs included the Usability of the webinar platform, participant satisfaction with resource person, effective time management, follow-up support and learning outcome. Only the factors having an Eigenvalue of more than one was selected. These items related well with their factor and the factors did not need to be renamed.

A confirmatory factor analysis was conducted to examine the goodness of fit of the proposed model, which assesses how well the factor structure accounts for the correlations between variables in the dataset. The assessment was performed using IBM AMOS software.

Furthermore, the model's convergent and discriminant validity were established. The findings revealed that all identified factors exhibited reliability coefficients of 0.70 or higher, indicating strong reliability. In response to the initial research objective, it can be concluded that the developed model for evaluating the effectiveness of agri start-up webinars is a valid and reliable tool that encompasses various influencing factors.

A structural equation model was developed to test the hypothesis. From the results, it was observed that the developed hypothesis has a significant impact on learning outcomes except third hypothesis which shows little impact on learning outcomes but is statistically non-significant.

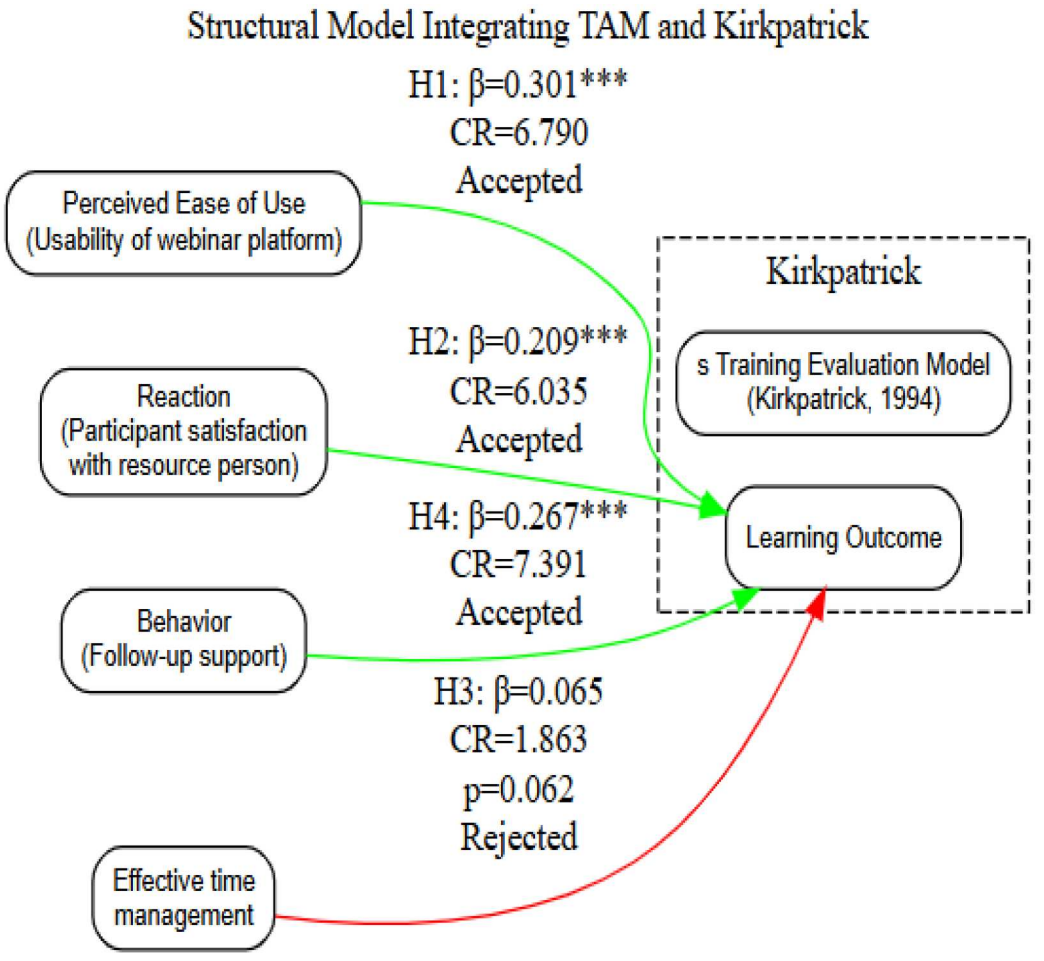

Figure 3. Structural model results.

The significant positive relationship between the perceived ease of use of webinar platform and learning outcomes (path coefficient = 0.044, CR = 6.790, $p < 0.001$) suggests the critical role of technology design in facilitating effective online learning in the agri-startup context. This finding aligns with and extends previous research on technology acceptance and e-learning effectiveness, such as Al-Maroof and Al-Emran's (2018) study on Google Classroom acceptance and Sumak et al.'s (2011) meta-analysis of e-learning technology acceptance. However, the current study extends these findings to the specialized context of agri-startup webinars, revealing deeper insights into the nature of agri-entrepreneurial learning. The strong impact of platform usability on learning outcomes suggests that reducing cognitive load associated with navigating the technology allows these learners to focus more on content absorption and application, aligning with Sweller's (1994) cognitive load theory in instructional design. This challenges the notion that digital natives in entrepreneurial fields might be less affected by usability issues and highlights the importance of user-friendly design even for presumably tech-savvy groups.

The significant positive relationship between participant satisfaction with resource persons and learning outcomes (path coefficient = 0.209, $p < 0.05$) highlights the crucial role of instructor quality in agri-startup webinars, extending previous research on online learning effectiveness to a specialized context. This finding aligns with Sitzmann et al.'s (2008) meta-analysis, which demonstrated strong correlations between trainee reactions to instructors and learning outcomes in

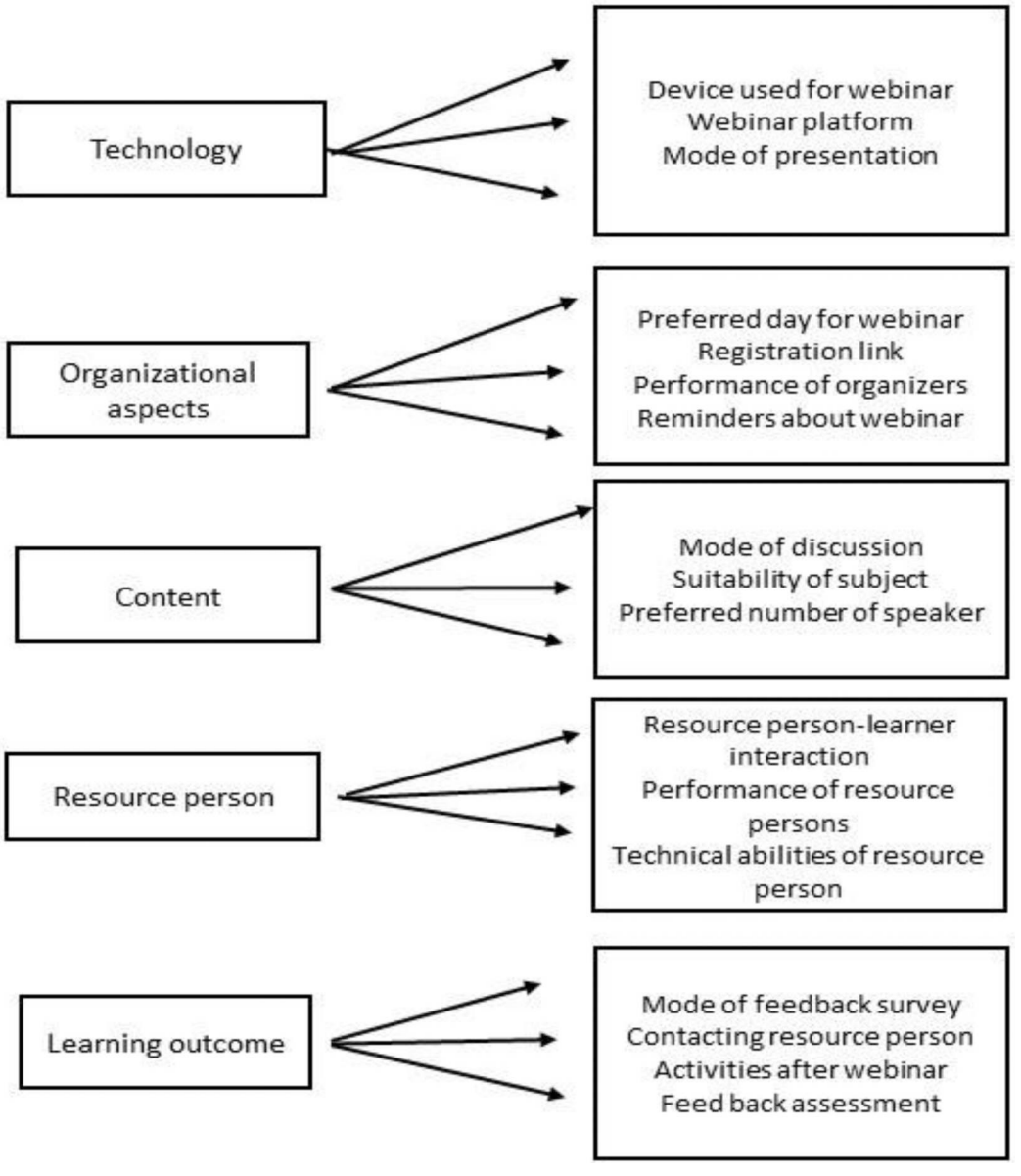

Figure 4. Themes for descriptive statistics.

general online settings. However, the study reveals unique insights into the agri-entrepreneurial learning environment, where instructors must bridge complex theoretical concepts with practical, industry-specific applications. This result builds on Arbaugh's (2014) work on teaching presence in online business education but emphasizes its heightened importance in niche professional development contexts. The strong impact suggests that in agri-startup education, resource persons serve not just as knowledge transmitters, but as crucial facilitators of practical application, addressing a gap in the literature regarding specialized online learning environments.

The third hypothesis (H3) suggests that effective time management has a positive impact on learning outcomes. However, the analysis conducted, as illustrated in Table 4, indicates that the weight of the path coefficient is .03, indicating a very small but still positive impact. Despite the

positive coefficient, the critical ratio (CR) value associated with this coefficient is 1.863, which is below the cut-off level of 1.96. This suggests that the relationship between effective time management and learning outcomes may not be statistically significant. The duration for the first 64 webinars was initially set at two hours. However, commencing from the 65th webinar, the duration was modified to one hour per webinar. This alteration was implemented in response to feedback from participants, who expressed their dissatisfaction with the longer duration. This change might have affected the overall effectiveness of time management strategies implemented during the webinars and could have influenced the observed relationship between time management and learning outcomes. Therefore, it is concluded that this hypothesis cannot be supported. This finding contrasts with previous research such as Orpen's (1994) study, which found positive effects of time management training on employee attitudes and behavior, and Burke and Hutchins' (2007) emphasis on the role of time management in training transfer. However, the result aligns with more recent studies like Broadbent (2017), which found that time management strategies had differential effects on online and blended learners. In the context of agri-startup webinars, this finding suggests a unique dynamic where flexibility might be more valued than rigid time structures. It points to the possibility that adult learners in entrepreneurial settings, who often juggle multiple responsibilities, may benefit more from adaptable learning formats. This insight extends understanding of adult learning theories in online environments, particularly for specialized professional groups. The mid-study adjustment of webinar duration from two hours to one hour, based on participant feedback, further understand the importance of learner-centered approaches in designing online training for entrepreneurs.

The significant positive relationship between follow-up support and learning outcomes (path coefficient = 0.267, $p < 0.05$) suggests the critical role of post-webinar engagement in the agri-startup learning context. This finding aligns with and extends previous research on training transfer and continuous learning. It corroborates Baldwin and Ford's (1988) seminal work on the importance of post-training environment in facilitating transfer of learning, and Broad and Newstrom's (1992) emphasis on follow-up activities. However, this study reveals unique insights into the specialized needs of agri-entrepreneurs, where the application of knowledge often requires ongoing support due to the complex and dynamic nature of agricultural businesses. The strong impact of follow-up support suggests that in the agri-startup sector, learning extends well beyond the webinar session, challenging traditional notions of online course design that often focus primarily on content delivery. This result builds on Holton's (1996) transfer of learning model, emphasizing its heightened importance in niche, entrepreneurial contexts.

While this study provides valuable insights into factors influencing learning outcomes in agri-startup webinars, there are certain limitations of using subjective self-assessment measures for learning outcomes.

Self-reported learning measures may be influenced by factors such as self-efficacy beliefs, social desirability bias, or limited ability to accurately assess one's own learning (Sitzmann et al., 2010). Participants might overestimate or underestimate their learning based on their perceptions of the webinar experience rather than actual knowledge gain or skill improvement. Despite these limitation, self-reported measures offer unique insights into learners' perceptions and confidence, which are crucial factors in adult learning and knowledge application (Knowles et al., 2015).

5.1. Descriptive statistics

5.1.1. Theme 1: technology

Three subcategories were included in the first primary category, technology: devices utilized for webinars, discussion formats, and mode of presentation. The majority of participants (49.6%) voiced a preference for discussing case studies and success stories, as well as sharing experience-based content, over engaging in theoretical discourse. Participants emphasized that uploading videos showcasing their achievements would attract greater attention. Moreover, they asserted that the inclusion of realistic data and valuable insights would serve as a source of inspiration.

While 39.7% of participants utilized a computer or laptop for the webinar, 58.2% of attendees opted to join the session using a mobile device. The majority of participants (78%) affirmed their ability to review and contemplate the topics discussed by accessing the webinar recordings, as noted by Gegenfurtner and Ebner (2019). A considerable number of participants regarded this as a positive outcome. The participants, for the most part, did not prioritize the choice of the webinar platform. Despite possessing a greater array of video conferencing features, such as ease of screen sharing (52.3%), user-friendly interface (75.8%), scalability (28.2%), and recording options (27.7%), when compared to other platforms, the Webex platform was deemed to be the most data-intensive and even more so depending on the number of participants, duration of the webinar, video quality, and the type of device employed. These findings are consistent with Ramos and Soliven (2020) & given in figure 5.

Regarding the resource persons, a significant majority of trainers (92.8%) expressed a preference for utilizing a laptop as their technical tool of choice when delivering webinars, citing its advantageous qualities in terms of ease of sharing (59.4%), user-friendliness (76.8%), and scalability (29%). Results are consistent with Gegenfurtner and Ebner (2019).

5.1.2. Theme 2: organizational aspects

Webinar participants (44.4%) and resource persons (47.8%) expressed contentment in regard to the execution of webinars on Saturdays. A portion of the webinar participants, specifically one-third, conveyed their anticipation of receiving the registration link three days prior to the webinar, while the resource persons (30.4%) expected to receive the registration link seven days in advance. These findings are in line with Mohalik and Poddar (2018). The majority of webinar participants (64.3%) and resource persons (65.2%) establish contact with the organizer to acquire information concerning upcoming webinars and details regarding the MANAGE CIA programs. According to 91% of respondents, the webinar organizers executed the sessions in a purposeful manner by addressing participant queries and providing a concise overview of the resource person and topic. A significant 80% of respondents stated that the organizers had previously devised comprehensive brochures for the webinars. A substantial 90% of respondents expressed discontent over the not providing e-certificates to the participants. This finding aligns with the findings of Anderson et al., 2021. As a matter of policy, MANAGE-CIA is not providing any e-Certificates to the participants because webinars on agri-startup eco-system conducted to enhance awareness and knowledge on agri-startup eco-system not for any other academic incentive like certificates.

5.1.3. Theme 3: content

More than two-thirds of the webinar participants (67.2%) expressed the belief that resource persons furnish adequate information, with 45.7% of them stating that 75% of the information presented was novel and applicable to their business idea generation and knowledge enhancement. A notable 46.7% of webinar participants preferred discussions during the Q&A sessions to extend beyond 10 minutes, while the majority (56.1%) favored direct interaction with the resource persons, and 43.9% preferred Q&A through the chat box. A significant two-thirds (67.6%) of the webinar participants opined that the content delivered during the webinar was exceptionally fitting, with PowerPoint presentations (84.1%) being the most favored mode of presentation. Over two-fifths (42.2%) of the webinar participants reviewed the official MANAGE-CIA website after the webinar, and an impressive 84.2% of webinar participants expressed their inclination to recommend this program to others. Half of the webinar participants preferred having two resource persons for webinars, and the majority (85.29%) found the information provided by the resource persons highly beneficial. More than half (56.3%) of the respondents deemed one hour to be the ideal duration for attending the Saturday webinar. These findings are in line with Rathod et al. (2022) and Mishra et al. (2021) & given in figure 6.

Fifty percent of the resource persons (50.7%) favored allocating 15 minutes to discussions and direct interaction with the attendees, while Q&A through the chat box was preferred by 20.3% of

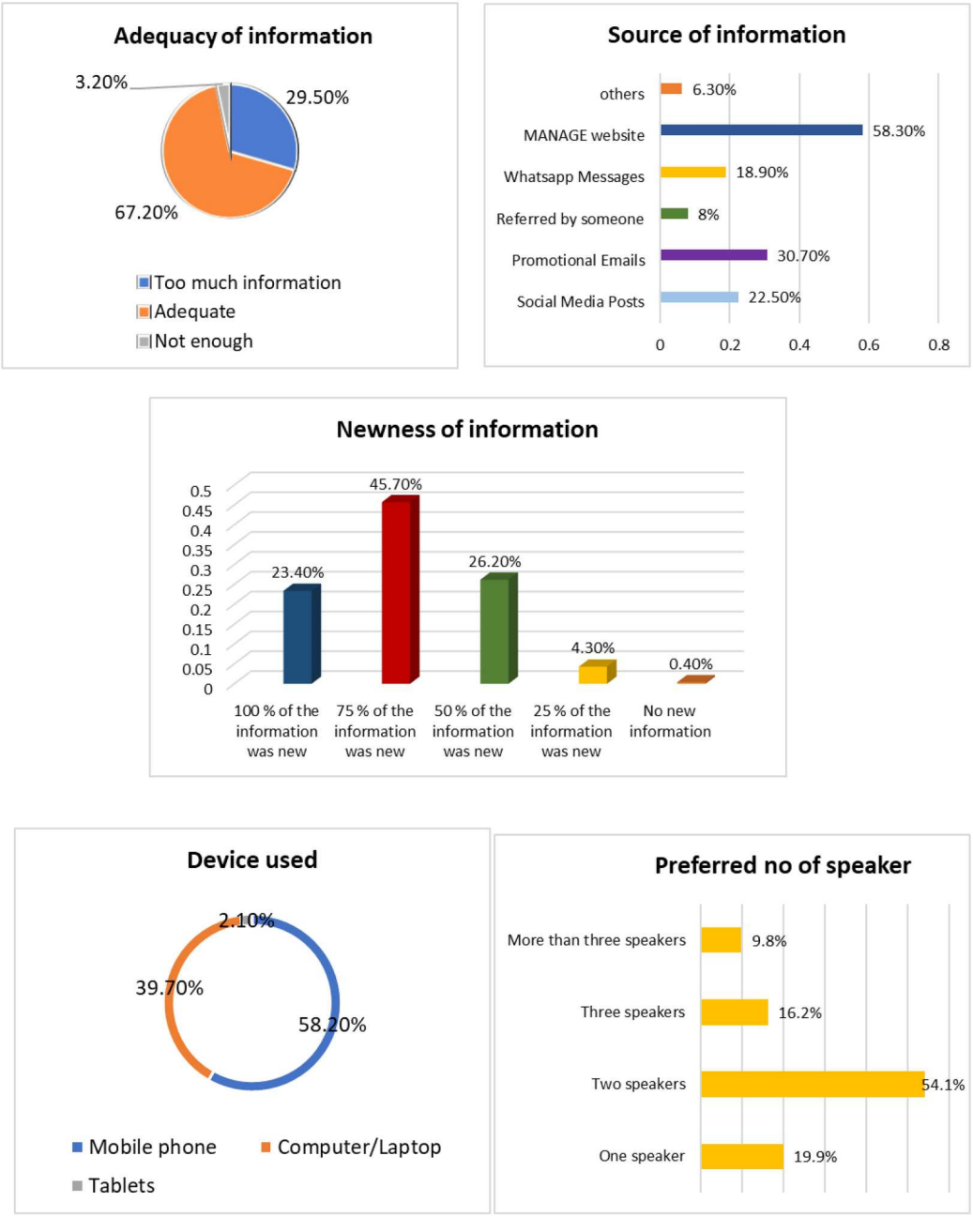

Figure 5. Technology.

them. The majority of resource persons (85.5%) expressed their willingness to recommend this webinar to other individuals involved in startups (74.6%), faculty and scientists (39%), students (52.5%), and other extension professionals (44.1%).

5.1.4. Theme 4: resource person

According to 67% of the respondents, these resource persons possess a comprehensive understanding of all the icons on the web platform. Furthermore, 77% of the participants expressed their

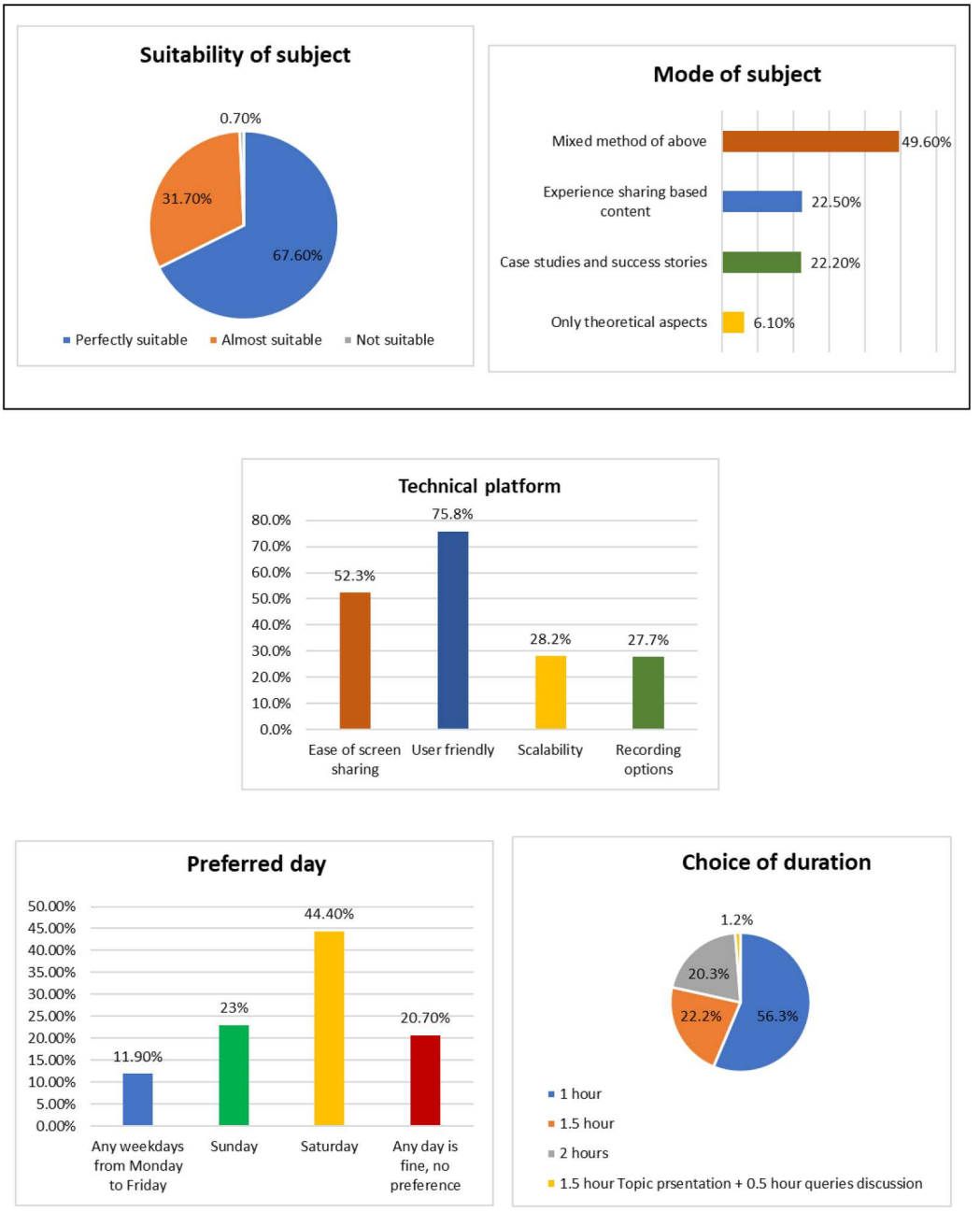

Figure 6. Content.

satisfaction with the resource persons' extensive comprehension of the content. The technical abilities of the resource persons and the utilization of embedded technologies in the webinar, such as polling and sharing links in the chat box, were deemed satisfactory by 75% of the respondents. Half of the participants (52%) found the lectures delivered by the resource persons during the online program to be satisfactory, while the other half expressed dissatisfaction due to the lack of alternative visualization methods employed by the resource persons. Although 73% of the respondents believed that the resource persons established a good level of personalized connection, many were dissatisfied

with the unavailability of the resource persons beyond the webinar. Finally, a significant majority of respondents (92%) stated that the resource persons consistently encouraged participants to delve deeper into the topics discussed during the webinar. The majority of participants found value in the social connection established with the resource persons. The act of freely inquiring of the resource persons and raising participant concerns not only piqued their interest in the subject matter but also aided in the assessment of their comprehension. The results confirm the exceptional performance of the webinar organizers, demonstrating that they provided a helpful technical staff to assist with the preparation of the webinar and ensured a coordinated and orderly flow from start to finish, including the evaluation of the webinars. Regarding content, 67.2 percent of the participants were satisfied.

5.1.5. Theme 5: learning outcomes

This theme focuses on the outcomes of learning and the feedback received regarding the webinar. According to 95% of the respondents, there was an improvement in subjective knowledge (91.8%), digital skills (84.8%), interest in attending more webinars (89.3%), and self-confidence (88.5%) (Chiswell et al., 2018). Half (50%) of the respondents reported that practical or skill-based subjects can be effectively learned through online modes. A majority of the respondents (77%) acknowledged the usefulness of webinars in generating new business ideas. Additionally, 65% of the respondents believe that online programs will transform education system in the post-pandemic era. Moreover, 92% of the respondents stated that the objectives of the programs were achieved by the participants. A significant percentage (60%) of the respondents mentioned that the organizers provide follow-up activities after the program ends. Lastly, 70% of the respondents highlighted that the organizer takes into account the feedback provided by participants for the next program.

6. Conclusion

This study advances the understanding of learning outcomes in agri-startup webinars through analysis of data from 745 participants and 67 resource persons. The findings reveal that platform usability, resource person effectiveness, and follow-up support significantly impact learning outcomes in agricultural entrepreneurship education, while time management shows non-significant effects. The integration of the Technology Acceptance Model with Kirkpatrick's Training Evaluation framework provides a novel theoretical approach for understanding online learning effectiveness in specialized contexts. Practically, the results emphasize the importance of user-friendly platforms, well-prepared instructors, and robust support systems in agricultural webinars.

Future research should focus on longitudinal studies to track long-term impact, cross-cultural analyses to understand regional variations, and development of improved impact measurement methods. Research into support system optimization could explore innovative approaches to post-webinar support that leverage both digital platforms and traditional agricultural extension services. Additionally, developing more sophisticated methods for assessing the practical application of webinar learning in agricultural enterprises will be essential for measuring real-world impact. These directions will enhance understanding of how online learning can support agricultural entrepreneurship development, particularly in emerging economies where digital platforms are increasingly vital for knowledge dissemination. This study provides a foundation for improving agricultural entrepreneurship education in the digital age, contributing to innovation and sustainable growth in the agricultural sector.

7. Implications

7.1. Theoretical implications

This study contributes to the existing body of knowledge on e-learning effectiveness by extending established models like the Technology Acceptance Model (TAM) and Kirkpatrick's Training Evaluation framework to the specialized context of agri-startup webinars. The findings highlight the need for a better understanding of online learning in sector-specific entrepreneurial education.

The unexpected non-significance of time management in the model suggests that traditional assumptions about structured learning may not apply equally in all online contexts, particularly for adult learners in entrepreneurial settings. This calls for a reevaluation of how engagement is conceptualized and measured in online learning environments for specialized professional development. Program design should prioritize content relevance over strict time management.

7.2. Practical implications

7.2.1. Agricultural education institutions

The strong relationship between platform usability and learning outcomes suggests that institutions should invest in user-friendly digital platforms. They should allocate resources for platform testing with diverse user groups and provide basic digital literacy training for participants before webinar programs begin. Regular platform usability assessments should be conducted to identify and address technical barriers.

7.2.2. Government agencies

Given the significant impact of follow-up support on learning, agricultural extension departments should establish dedicated post-webinar support networks. These should integrate digital support channels with existing agricultural extension services. Government funding schemes should specifically allocate resources for long-term mentorship programs and continuous learning support.

7.2.3. Webinar organizers

The strong correlation between resource person effectiveness and learning outcomes indicates the need for structured resource person selection and training programs. Organizations should develop standardized criteria for selecting instructors, emphasizing both technical expertise and online teaching ability. Regular training programs should be implemented to enhance instructors' digital teaching skills.

7.2.4. Industry partners

The findings on the importance of practical application suggest that industry stakeholders should actively participate in webinar programs by providing real-world case studies and mentorship opportunities. Companies should collaborate with educational institutions to create internship programs that allow webinar participants to apply their learning in practical settings.

7.2.5. Technology providers

The non-significant effect of time management on learning outcomes suggests that platform developers should focus on creating flexible learning environments rather than rigid time-based structures. They should develop features that allow for asynchronous learning and varied engagement formats to accommodate diverse learner needs.

7.2.6. Policy recommendations

Policymakers in agricultural education and entrepreneurship support should consider incorporating guidelines for effective online learning into their programs. This could include standards for webinar delivery, requirements for post-training support, and incentives for continuous improvement based on participant feedback.

7.3. Limitations

Cross-sectional design: This study captured data at a single point in time, limiting the ability to observe long-term effects of webinar participation on agri-startup success. Future longitudinal studies could track participants over time to assess the enduring impact of webinar learning on business outcomes.

Geographic scope: The study focused on webinars conducted by MANAGE-CIA in India. Future research could expand to different geographic regions to examine how cultural and economic factors might influence webinar effectiveness in various agricultural contexts.

Self-reported measures: Self-reported learning outcomes may be subject to response bias. Future studies could incorporate objective measures of knowledge gain and skill application to complement self-reported data.

Sample size: While sample of 745 participants was substantial, a larger sample size could potentially reveal more nuanced relationships between variables.

8. Future directions of study

Longitudinal research: Future studies should adopt longitudinal designs to track the long-term impact of webinar participation on agri-startup success. This could involve following participants over several years to assess how webinar learning translates into business outcomes.

Cross-cultural comparisons: Investigating how the factors influencing webinar effectiveness vary across different cultural and agricultural contexts could provide valuable insights for global agricultural development initiatives.

Technology integration: Research into how emerging technologies like virtual reality or artificial intelligence could be integrated into agri-startup webinars to enhance learning outcomes and practical skill development.

Personalization strategies: Exploring the potential of adaptive learning technologies to personalize webinar content and delivery based on individual participant needs and learning styles in the agri-startup context.

Measuring real-world impact: Developing and validating metrics to assess the tangible impact of webinar learning on agricultural innovation, sustainability practices, and economic outcomes in the agri-startup sector.

Interdisciplinary approaches: Incorporating insights from cognitive science, adult learning theory, and agricultural economics to create a more comprehensive model of effective online learning for agri-entrepreneurs.

Comparative studies: Conducting comparative analyses between webinar-based learning and other forms of agricultural extension education to identify the most effective approaches for different types of content and learner groups.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix

Table A1. Factors underpinning the study.

Constructs		Items
Perceived ease of use of webinar platform	WB1	Checking the technological capabilities of the participants
	WB2	Well in advance sharing of the links for registration
	WB3	Access toward the registration
	WB4	Sending the reminders to the participants
	WB5	Providing briefing about the speakers and topic
	WB6	Attending to the participants' queries
Participant satisfaction with resource persons	SP1	Number of speakers in each webinar
	SP2	Subject expertisation and knowledge of resource persons
	SP3	Level of effort of resource persons to retain the participants
	SP4	Technical skills of the resource persons
	SP5	Ease of taking content and course management
	SP6	Level of using different modes of visualization (Audio, video, pictures, PPT etc.)
	SP7	The level of availability of speakers after the webinar
	SP8	Level of personalized interaction with the participants
	SP9	Rapport with the host/ organizer
Effective time management	TM1	Starting time of the webinar
	TM2	Sufficient Duration of the subject
	TM3	Speed of the presentation suitable for learning
	TM4	Available time for interaction with the speaker
	TM5	Duration of break
Follow-up support	AC1	Level of utilization of technological opportunities of webinar
	AC2	Feedback assessment
	AC3	Frequency of follow up mechanism
Learning outcome	LO1	Level of improvement in subjective knowledge
	LO2	Level of improvement in digital skill set
	LO3	Interest in attending more webinars and trainings
	LO4	Self confidence
	LO5	Promotion of self-learning