Iran Agricultural Research 43 (2) 64-74.

Shiraz University

Iran Agricultural Research

Journal homepage: https://iar.shirazu.ac.ir

Review Article

A comparative analysis of models for assessing the effectiveness of agricultural training courses

Khadijeh Bazrafkan*, Hassan Alipour

Department of Socio-Economic and Agricultural Extension Research, Agricultural Research, Education & Extension Organization (AREEO), Tehran, I. R. Iran

ARTICLE INFO

Keywords:
Agricultural training courses
Comparison criteria
Return on investment
Effectiveness assessment

ABSTRACT- Assessing the effectiveness of agricultural training courses has long been a crucial subject for planners and decision-makers. A significant gap in the literature exists due to the lack of recognized models and frameworks for evaluating the effectiveness of these courses. In this context, the present study aimed to conduct a scoping review and comparative analysis of existing models for assessing the effectiveness of agricultural training programs. The study identified 17 models used for evaluation and established eight criteria for comparing these frameworks. The scoring and ranking of these models revealed that the Phillips Return on Investment model is among the most optimal for assessing the effectiveness of agricultural training courses. Based on the criteria established in this study, the Phillips model offers a more realistic approach for evaluating the effectiveness of agricultural training courses. Notably, the findings indicate that, apart from the Phillips model, none of the other frameworks explicitly consider Return on Investment, while it is not possible to assess the effectiveness of agricultural training without calculating the Return on Investment.

INTRODUCTION

The diverse and context-specific needs and challenges in agricultural areas necessitate tailored management approaches for training beneficiaries (Khodaverdian, 2023). The demand for education that is both contextually relevant and needs-oriented, particularly in rural agricultural regions, remains one of the primary challenges confronting the country's agricultural education system (Fazeli et al., 2015). Therefore, a thorough and continuous understanding of infrastructural and developmental factors is essential for effective planning to enhance both the quantity and quality of factors influencing agricultural education and training. This, in turn, directly impacts agricultural production and sectoral development (Saifi Hosseinabadi, 2015). An active and goal-oriented educational system in agricultural training is crucial for cultivating a skilled workforce. Such a system must align with both current demands and future prospects of the agricultural and rural sectors. However, agricultural beneficiary training has been experiencing a decline due to its inefficient and ineffective structure. This raise concerns that agricultural training programs may have been overlooked (Fathi Vajargah & Dibavajari, 2016). Despite this, agricultural extension and its associated educational programs remain vital mechanisms for knowledge transfer, ultimately enhancing productivity in the agricultural sector (Azizi Khalkhili, 2016). Agricultural training courses serve as a fundamental component of professional development for agricultural beneficiaries worldwide (Peter et al., 2021). In many countries, including Iran, these training programs are considered prerequisites for achieving sustainable development. This underscores the notion that sustainable development goals—such as food security and natural resource conservation—cannot be fully realized without empowering agricultural beneficiaries. One key strategy to attain these objectives involves educational programs that facilitate the transfer of both specialized and general skills to farmers (Edham Maleki et al., 2021; Hajimirrahimi, 2022). Providing training programs alongside other production factors and facilities enables users to reach an optimal and efficient level of production through the appropriate application of technology (Enayati rad et al., 2009). In other words, technical education and the facilitation of skill application through structured training courses form the foundation of agricultural development (Mirgohar & Movahhed-Mohammadi, 2009; Abbasi Rostami et al., 2016).

Studies conducted in developing countries indicate that many educational programs have failed to achieve their intended goal of empowering beneficiaries in the agricultural and rural sectors (Oreszczyn et al., 2010). Fundamentally, an educational course is considered valuable only when there is visible, reliable, and valid evidence demonstrating its effectiveness in enhancing

* Corresponding author: Postdoctoral Researcher, Department of Socio-Economic and Agricultural Extension Research, Agricultural Research, Education & Extension Organization (AREEO), Tehran, I. R. Iran
E-mail address: khbazrafkan@yahoo.com
https://doi.org/10.22099/iar.2025.51602.1645
Received 05 November 2024; Received in revised form 24 December 2024; Accepted 27 December 2024
Available online 25 February 2025

learners' performance. In this context, evaluating the effectiveness of beneficiary training programs is a critical component of professional development initiatives in the agricultural sector (Abili et al., 2016). Various organizations and institutions, including the Iran Ministry of Agriculture Jihad, allocate resources for training and human resource development through educational programs for agricultural beneficiaries. However, the assumption that the mere establishment of a training course guarantees high effectiveness and desirability is flawed. The true value of an educational program can only be determined when it provides observable and valid evidence of its impact on participants' performance and demonstrates a positive return on investment (Iran Ministry of Agriculture Jihad, 2019). One of the primary obstacles to assessing the effectiveness and return on investment of agricultural training programs has been the inherent difficulty of conducting such evaluations. More critically, researchers often refrain from undertaking these assessments due to the challenge of selecting an appropriate framework or model for evaluating training effectiveness. To the best of our knowledge, no standardized basis exists for determining the most suitable model for assessing both the effectiveness and return on investment of agricultural training courses. Additionally, in some cases, the absence of well-defined or appropriate criteria for comparing evaluation models presents a significant limitation for researchers. Given these challenges, this study aims to conduct a comparative analysis of models used to evaluate the effectiveness of agricultural training programs and assess their applicability to beneficiary training courses. To achieve this objective, three specific goals were identified:

1. Identifying models for evaluating the effectiveness and return on investment of educational courses for agricultural beneficiaries
2. Identifying and introducing criteria for comparing and evaluating models for evaluating the effectiveness and return on investment of educational courses for agricultural beneficiaries
3. Comparing models for evaluating the effectiveness and return on investment of educational courses for agricultural beneficiaries based on the identified criteria and introducing a better model

MATERIALS AND METHODS

This study employed a systematic review of information and documents (scoping review) related to the evaluation of the effectiveness of educational and extension courses. The scoping review is one of several systematic review methodologies. Systematic review functions as an overarching framework encompassing various review methods, including scoping review, literature content analysis, bibliometric analysis, and meta-analysis. However, it is important to note that all systematic review methods involve a lower degree of quantification compared to meta-analysis. Consequently, comparing meta-analysis with other systematic review approaches, such as scoping review, is more appropriate than comparing scoping review with other systematic review methods. Several key differences distinguish systematic review methods, such as scoping review, from meta-analysis. The first major distinction lies in the stringency of inclusion and exclusion criteria. In meta-analysis, these criteria are more specific and rigorous than those in other systematic review methods, including scoping review. The second difference pertains to the type of data and information utilized. Meta-analysis relies predominantly on quantitative data extracted from the literature, producing quantitative results. In contrast, other systematic review methods, such as scoping review, do not extract quantitative data directly from the literature. Instead, they employ coding and counting techniques to assign a quasi-quantitative nature to descriptive data. The third difference concerns the assessment of the risk of bias. In meta-analysis, evaluating the risk of bias in data and results is an essential and unavoidable step. However, in systematic review methods such as scoping review, this assessment is not mandatory. The fourth distinction relates to the comprehensiveness of database searches. In meta-analysis, database searches primarily focus on identifying sources that report relationships between variables. By contrast, systematic reviews aim to explore different dimensions of a central keyword from multiple perspectives across various databases (Crocetti, 2016; Ahn & Kang, 2018; Munn et al., 2018; Linde & Willich, 2003).

The present scoping systematic review was conducted in three phases. In the first phase, databases such as Google Scholar, Scopus, and Web of Science were systematically searched. To retrieve relevant information, keywords related to the evaluation of training course effectiveness were used. The search process was conducted in three stages. Initially, key phrases such as "Evaluation of the effectiveness of training courses", "Measuring the effectiveness of training courses", and "Return on investment of training courses" were employed. These keywords were selected based on input from experts with experience in evaluating training course effectiveness. Subsequently, individual searches were conducted for terms such as "models", "patterns", "methods", "strategies", "theories", "approaches", and "paradigms" to ensure a more precise identification of their dimensions and criteria. To further validate the comprehensiveness of the search, additional queries were performed using the terms "meta-analysis" and "systematic review" in combination with "educational effectiveness evaluation models". This process ensured that nearly all relevant models and frameworks for assessing training course effectiveness were identified. In the second phase, all collected sources pertaining to the evaluation models were thoroughly reviewed and analyzed. This step allowed the researchers to gain a deeper understanding of the models and frameworks used for evaluating training course effectiveness, as well as to define their key dimensions and criteria. Additionally, this phase facilitated the identification of the strengths and weaknesses of each model. In the third phase, the identified models were scored and ranked based on the criteria established in the previous phases. To achieve this, a simple scoring system developed by Talukder and Blay-Palmer (2017) was employed. In this method, a model received a score of one if it met a given criterion and a score of zero if it did not. The simplicity of this approach was a key factor in its selection. Following the initial scoring, a panel of experts was consulted to assign weights to the evaluation criteria based on their perceived importance. The

selection of these experts was guided by two key criteria. First, they possessed extensive teaching and research experience in the evaluation of agricultural education programs, with strong and relevant publications in the field. Second, each expert was approved by two internationally recognized scholars in the subject area. The weighting process involved assigning scores ranging from 1 (low importance) to 10 (high importance). The final step involved multiplying each criterion's score by its assigned weight. The total scores for each effectiveness evaluation model were then summed to provide an overall assessment based on all criteria.

It is important to note that the initial database search yielded approximately 689 documents. In the subsequent stage, the titles, keywords, and abstracts of all retrieved documents were carefully reviewed to exclude irrelevant studies. As a result, 76 documents that appeared closely aligned with the objectives of this study were selected for further examination. In the next phase, these 76 documents were meticulously analyzed, leading to the identification of 17 documents that provided the necessary information for this study. These 17 documents were then studied multiple times to extract relevant comparison criteria. It is also noteworthy that the present study included various types of sources, such as review studies, doctoral dissertations, books, and any other documents that introduced evaluation models and contributed to identifying the comparison criteria.

RESULTS AND DISCUSSION

Models for evaluating the effectiveness of agricultural training courses

In this section, the identified models for evaluating the effectiveness of training courses were introduced. In general, the search engines revealed 17 effectiveness evaluation models, the names and general descriptions of which are presented case-by-case in Table 1.

Identifying and introducing criteria for comparing models for evaluating the effectiveness of training courses

At this stage, the most important evaluation criteria for assessing models used to evaluate the effectiveness of agricultural training courses were identified. Eight key criteria were selected, including user-friendliness, classification of assessment, classification of evaluation study results, consideration of dynamic relationships between assessment levels, ability to calculate cost-benefit, consideration of the courses' impact on the environment and society, need assessment for evaluation implementation, and calculation of return on investment (ROI). These criteria are presented in detail in Table 2.

Table 1. Models for evaluating the effectiveness of agricultural training courses

Num.	Model	General description	Sources
1	Cost benefit analysis model	The purpose of the cost-benefit analysis model is to ensure that society has maintained an optimal level of efficiency in resource allocation. The cost-benefit analysis model is one of the oldest methods of evaluating investment in education. This process compares the costs of the courses with their benefits by dividing the benefits by the cost of the course.	Khorasani and Rashtiani (2012)
2	Kirkpatrick model	This framework is one of the most well-known frameworks for evaluating the effectiveness of educational courses. Kirkpatrick's model has also been used in the field of education of agricultural activities. This model evaluates educational activities in four levels of reaction, learning, behavior (application), and results (impacts).	Kirkpatrick (2013), Gulu et al. (2017), and Elfiky et al. (2021)
3	Coffman Approach	Kaufman and Keller (1994) developed the original four-level model of Kirkpatrick into five levels; with the argument that the goal of Kirkpatrick's model is educational evaluation and now the organization is looking for evaluation of various development events. Coffman expanded the definition of level 1 and added a fifth level which is about social issues. This level of evaluation is beyond the organization and by looking at how the society is affected by the intervention and how the courses affect the surrounding environment of the organization.	Coffman et al. (2015)
4	CIRO assessment model	Warr et al. (1970) presented a four-level model, which is abbreviated as the CIRO framework. CIRO consists of four words: Context, Input, Reaction, and Output. Warr et al. (1970) believed that before evaluating results and outputs, background and input analysis should be done. In this framework, context assessment refers to the current operational situation to help determine educational goals and needs. Input evaluation focuses on information about possible educational methods or techniques that can be used to choose the best educational method option. Reaction (response) evaluation refers to gathering the opinions and suggestions of learners about the implemented educational course. Evaluation of results or outputs also refers to the results of education at the immediate, intermediate, and final levels.	Gomez (2003), Yanti and Azhariyah (2020) and Abao et al. (2022)
5	CIPP assessment model	The CIPP assessment model was proposed by Stufflebeam in 1971 and provides a framework for course objectives, content and instructional facilities, course implementation, and course outcomes. The CIPP refers to context, input, process, and product. Context assessment: helps to plan and develop educational course goals and the various stages of educational course development. Process assessment is focused on the implementation of the course and providing feedback regarding the materials, facilitation, and presentation of the educational course. Product assessment refers to the evaluation of the course's achievements according to outputs and results.	Stufflebeam (1971) and Stufflebeam and Zhang (2017)

Table 1. Continued

Num.	Model	General description	Sources
6	Input-Process-Output (IPO) assessment model	McGrath's (1984) as the developer of this model state that this model includes stages of input, process, output. The input is focused on evaluating the system of implementation and guidelines such as trainee characteristics, accessibility to tools and equipment, educational opportunities, etc. The process includes course learning, design, development, and delivery of educational courses. Output refers to the collection of information from the results of educational interventions.	Mansikka et al. (2017)
7	Training valuation system	Srivastava and Walia (2018) state that this model includes situational steps (gathering information prior to training to achieve common levels of performance or organization and explaining a desired level of future performance), factors involved (identifying the reason for the gap between present and future and finding an appropriate answer to the question: Is training the right solution?, Impact (evaluating the difference between information before and after training), and value (the amount of difference in quality, production, service, and sales. In this step, the priority of investment should also be identified).	Srivastava and Walia (2018)
8	Business impact instructional systems design (ISD) model	Molenda (1996) made a classification of educational course evaluation based on six layers. This method was based on Kirkpatrick's model; but they added two layers to it. The first layer was added before the reaction and calculates the activity, volume, and number of participants in the courses. The sixth layer was added after the fourth step of Kirkpatrick's model and examines social influence. This layer tries to measure the changed performance of the organization in the society.	Pershing and Lee (2000), Pershing (2006), and Pershing (2000), and Molenda (1996)
9	Utility analysis model	Utility analysis is a process in which expected results and cost of decision are calculated. Specific results are determined and the relative importance of efficiency is determined.	Khorasani and Rashtiani (2012)
10	The balanced scorecard (BSC) method	It is a common method at the strategic reporting level of the organization. The Balanced Scorecard provides a framework for an organization's vision from four perspectives (financial, customer, internal business processes, and learning and growth). The purpose of the balanced scorecard is to set up a strategy for a business unit such as the training function.	Brown (2012), De Jesus Alvares Mendes Junior and Alves (2023), Hladchenko (2015), Ayele and Singh (2024)
11	Knowledge and skill evaluation model	This four-stage model evaluates knowledge and skills. The first stage of the evaluation model separates knowledge and skills. The first level measures the attitude and feelings of learners. The second level measures knowledge using pen-paper tests. The third level evaluates skills and knowledge through capability assessment and evaluates the standards of job activities. The fourth level measures the transfer of education. The fifth level also measures organizational effectiveness and return on investment.	Marshall and Peters (1985) and Marshall (2012)
12	Educational model of Noe	This model was developed in 1986 by Noe. In this model, the locus of control affects the four factors of reaction to evaluation, job participation, career characteristics, and reactive behavior. These things together affect the motivation of people before training. This motivation along with reaction to education affect learning. In the next step, the motivation after education is raised, which itself leads to educational effectiveness and performance improvement along with learning.	Bagherabadi (2013)
13	Baldwin and Ford's educational effectiveness model	This model was first proposed by Baldwin and Ford in 1988. In this model, students' characteristics (ability, personality, and training), educational design (learning principles, sequence, content), and the characteristics of the work environment (support and application opportunities) affect learning. Also, the characteristics of the trainees and the work environment directly affect the effectiveness of training.	Baldwin and Ford (1988), Suleiman et al. (2016), and Rahayu and Paerah (2022)
14	The educational effectiveness model of Fico	In this model, learning motivation has a central effect and factors such as the support of subordinates, colleagues, supervisors and management, organizational commitment, career characteristics, coercion, job incentives, and the value of education affect learning motivation. Based on this model all the mentioned variables have an effect on learning motivation and thereby indirectly provide the causes of educational effectiveness. Learning motivation and support from subordinates, colleagues, management, and coercion also directly affect educational effectiveness.	Khorasani and Rashtiani (2012)

Table 1. Continued

Num.	Model	General description	Sources
15	The success case method	The successful case study process has two parts: the first part emphasizes on the most successful learners and the most unsuccessful learners in applying the knowledge and skills acquired in the training course. The second part of the process involves drawing a sample of the most successful and unsuccessful cases. One of the most successful cases will be interviewed that describes the exact nature and degree of success. A sample of the unsuccessful ones is also selected and he/she is interviewed about the reason for their lack of success in acquiring new knowledge and skills.	Brinkerhoff (2005)
16	Transitional model	In the transitional model, the individual, educational, and organizational characteristics that affect the educational results are determined. Overall, this model states that these sets of features are directly related to learning and transfer performance. The basic assumption in this effectiveness assessment method is that the effectiveness of the training should be measured based on the transfer of the learnings obtained from the training to the real work environment. Therefore, the aspects affecting the application of trainings in the real work environment have been evaluated.	Grigal et al. (1997)
17	Return on investment	Until the 1990s, there was not enough attention to the return on investment of training courses. Kirkpatrick believed that the evaluation of training courses should extract and present all the works and results that a training course leaves in the organization at the fourth level. In the meantime, there was no difference between the financial and non-financial effects of the implementation of the educational course, and it was emphasized that they were the same. According to some drivers and conditions in the financial and economic field, Phillips separated the issue of return on investment and financial resources spent on education, and with some changes in the multiple levels proposed in Kirkpatrick's model, the issue of return on investment was added to the Kirkpatrick's model as the fifth level this model. The focus of this model is on the results and effects of educational courses. Therefore, this model is among the result-oriented models. Among the various results of an educational course at the individual and organizational level, the emphasis of this model is on estimating the resulting financial benefits. Therefore, all data collected at different levels of response, learning, application, and impact are finally used to calculate return on investment.	Phillips & Phillips (2009); Phillips (2012)

Table 2. Extracted criteria for comparing models for assessing the effectiveness of training courses

Num.	Criteria	General description
1	User-friendliness	Simplicity in the implementation and use of models for assessing the effectiveness of training courses is one of the most important comparison criteria.
2	Classification of assessment	Because the classification of different stages of assessment can help facilitation of endeavor, this case was considered as one of the evaluation criteria.
3	Classification of results of evaluation studies	The results of the studies can be effective at different levels, for example, some of the results of the studies can be practical and others persuasive. In fact, a model that can pay attention to both of these results can be more effective in evaluating the effectiveness of educational courses. In some models assessing the effectiveness of educational courses, factors such as learning, attitude, etc. are emphasized, which are generally persuasive factors. But in some cases, factors such as behavior and results are considered which can be observed and measured. These factors are practical results.
4	Considering the dynamic relationship between assessment levels	One of the most important principles that is of great importance in the assessment of educational courses is to pay attention to the relationship between different levels of assessment. This issue has not been considered in the most of assessment models for effectiveness of educational courses. Meanwhile, assessing the effectiveness of educational courses at different levels is meaningless without communication between these levels. For example, participants' reaction and behavior are considered as different levels of assessment in many effectiveness assessment courses of agricultural education. But there is a significant relationship between the participants' reaction to the course and their behavior. This type of communication actually shows the dynamics of communication between different levels of assessing the effectiveness of agricultural education courses. Therefore, considering the dynamic relationship between assessment levels can be considered as a criterion for comparing the models for assessing the effectiveness of education courses in the field of agriculture.
5	Ability to calculate cost-benefit	Every educational course has costs and benefits. These costs and benefits may not always be monetary. In other words, all the costs and benefits of educational courses cannot be measured and assessed quantitatively. Nevertheless, the evaluation models of education courses must consider the possibility of calculating the costs and benefits of the course. Of course, this calculation is mostly for things that can be measured. Because not paying attention to the calculation of the cost and benefits of the courses can be a serious weakness for the models assessing effectiveness of educational courses, this factor was taken into consideration as a criterion for comparing the types of effectiveness assessment models.
6	Considering the impacts of programs on the environment/society	Assessment today is not just about providing specialized information to the target groups on a specific topic. Many thinkers consider assessment beyond organization. In other words, assessment reflects how the society is influenced by the intervention and the impact of the courses in the surrounding environment of the organization

Table 2. Continued

Num.	Criteria	General description
7	Need assessment for evaluation implementation	Need means the difference between what is and what should be, and needs assessment is the process of identifying the differences. In general, the complex of actions that organizations take to identify and solve needs or gaps within their set is called needs assessment. In fact, without needs assessment, there is no justification for evaluating educational courses. Evaluation models that have forgotten needs assessment cannot lead to convincing and compelling results. Because, even if the results are correct, the agents of courses may be accused that the need to evaluate the course came from evaluators and not from the audience. Therefore, it can be understood that paying attention to needs assessment is considered as one of the most important criteria for comparing evaluation patterns of agricultural education courses. Another important point in this field is that evaluation models must provide the methodology of this work as well.
8	Calculation of return on investment (ROI)	ROI measurement is the most accurate, valid, and widely used process for demonstrating the impact of education. If the benefits of the course (expressed in the form of monetary values) exceed the costs, then it can be claimed that the course had a return on investment. If a training course effectiveness evaluation model can calculate this return on investment, it can provide recommendations and insights that will convince decision-makers whether a course should be abandoned or modified. Such results can convince decision-makers to continue the course. Therefore, in evaluating the effectiveness of the educational course, calculating return on investment is considered as an important criterion. It should also be noted that models for evaluating the effectiveness of agricultural training courses must provide methods for calculating return on investment.

The comparison of effectiveness models for agricultural training courses was conducted in two parts. In the first part, the extent to which each model fulfilled the predefined evaluation criteria was assessed. Specifically, this phase aimed to determine which criteria were more commonly addressed and which were less frequently considered in the effectiveness assessment models (Fig. 1). The findings revealed that the first criterion, user-friendliness, was met by all models, indicating that each model was designed to be accessible and practical for users. Additionally, out of the 17 models analyzed, three of them did not meet the criterion of assessment classification, i.e., the balanced scorecard, utility analysis model, and cost-benefit analysis. Classification of assessment results ranked third in terms of fulfillment, with 11 educational effectiveness assessment models incorporating this criterion. Furthermore, the analysis showed that several critical criteria, including the consideration of dynamic relationships between assessment levels, the ability to calculate cost-benefit, the impact of courses on the environment and society, the need for assessment in evaluation implementation, and the calculation of ROI, were met by fewer than five models. Notably, the calculation of ROI, regarded as one of the most important criteria for evaluating the effectiveness of training courses, was fulfilled by only one model, the Phillips assessment model (Fig. 1).

In the second phase of the analysis, the 17 identified models were systematically compared based on their fulfillment of the predefined evaluation criteria (Fig. 2). This comparative assessment enabled researchers to rank the models according to their overall effectiveness in meeting the criteria. In other words, this stage provided a comprehensive evaluation of which models demonstrated the highest alignment with the established assessment standards (Table 3). The results indicated that the Phillips ROI model was the only model that successfully met all eight identified criteria, making it the most comprehensive and effective framework for evaluating the effectiveness of agricultural training courses. Based on these findings, the Phillips ROI model was ranked as the most suitable evaluation model. Following the Phillips model, four other models—Kirkpatrick, Coffman, CIRO, CIPP, business impact instructional systems design (ISD), and knowledge and skill evaluation—were ranked in fourth place. Each of these frameworks met four of the eight criteria. Conversely, the cost-benefit analysis, Noe, Fico, success case, and transitional models demonstrated the least fulfillment of the evaluation criteria, with each addressing only two out of the eight established criteria (Fig. 2).

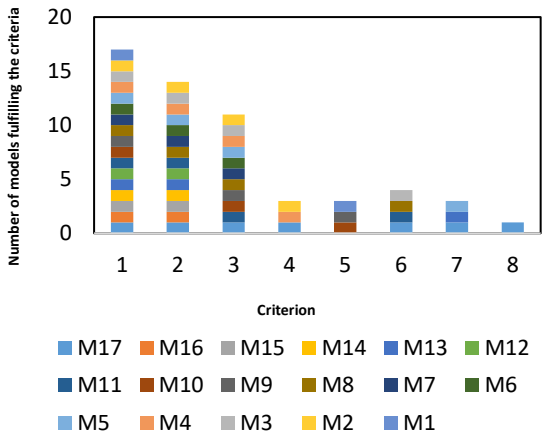

Fig. 1. Number of fulfillment criteria in the effectiveness assessment model.

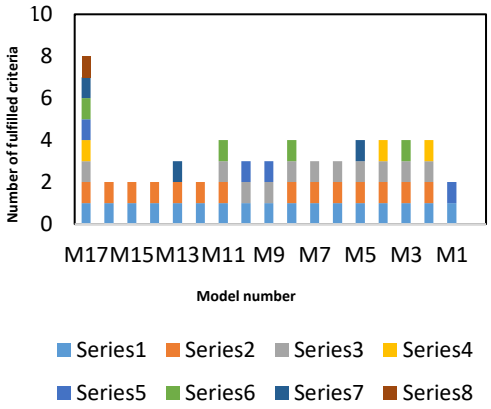

Fig. 2. Ranking the effectiveness assessment models in terms of fulfilling the criteria.

Table 3. Comparison of effectiveness models of agricultural training courses in terms of criteria

Num.	Model	User-friendliness	Classification of assessment	Classification of results of evaluation studies	Considering the dynamic relationship between assessment levels	Ability to calculate cost-benefit	Considering the impact of programs on the environment/society	Need assessment for evaluation implementation	Calculation of return on investment (ROI)
1	Cost benefit analysis model	1	0	0	0	1	0	0	0
2	Kirkpatrick model	1	1	1	1	0	0	0	0
3	Coffman Approach	1	1	1	0	0	1	0	0
4	CIRO assessment model	1	1	1	1	0	0	0	0
5	CIPP assessment model	1	1	1	0	0	0	1	0
6	Input-Process-Output (IPO) assessment model	1	1	1	0	0	0	0	0
7	Training valuation system	1	1	1	0	0	0	0	0
8	Business impact instructional systems design (ISD) model	1	1	1	0	0	1	0	0
9	Utility analysis model	1	0	1	0	1	0	0	0
10	The balanced scorecard (BSC) method	1	0	1	0	1	0	0	0
11	Knowledge and skill evaluation model	1	1	1	0	0	1	0	0
12	Educational model of Noe	1	1	1	0	0	1	0	0
13	Baldwin and Ford's educational effectiveness model	1	1	0	0	0	0	1	0
14	The educational effectiveness model of Fico	1	1	0	0	0	0	0	0
15	The success case method	1	1	0	0	0	0	0	0
16	Transitional model	1	1	0	0	0	0	0	0
17	Return on investment	1	1	1	1	1	1	1	1

Since each of the eight identified criteria for evaluating training course effectiveness carries a different level of importance (weight), the next step involved weighting the values obtained for each model based on these criteria (Table 2). As described in the methodology section, the weighting process was conducted using expert opinions gathered through a closed-ended questionnaire. The results of this weighting process are presented in Fig. 3. The findings revealed that calculating the ROI was considered the most crucial factor in evaluating the effectiveness of training courses, receiving the highest weight of 0.81 on a scale from 0 to 1. The ability to calculate cost-benefit ranked second in importance, with a weight of 0.74. Additionally, experts regarded the criterion of considering the dynamic relationship between assessment levels as highly significant in evaluating training effectiveness, as it was assigned a weight of 0.61. Conversely, the criteria of classification of assessment, classification of results of assessment, considering the impact of education on the environment/society, and need assessment received the lowest weights. This indicates that, from the perspective of experts, these factors are relatively less crucial in assessing the effectiveness of agricultural training courses (Fig. 3).

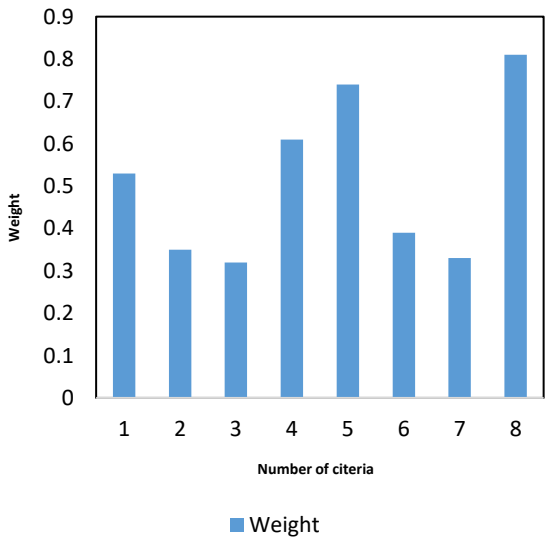

Fig. 3. Weights of criteria for evaluating effectiveness assessment models of agricultural training courses.

In the final stage, the models for evaluating the effectiveness of agricultural training courses were ranked according to the frequency with which they fulfilled the identified criteria after the application of their respective weights. This ranking process took into account both the number of criteria each model fulfilled and the weight of those criteria, thus providing a more nuanced and accurate assessment of the models. The results of this phase revealed that the Phillips return on investment (ROI) model ranked first, as it fulfilled all eight criteria. Notably, the weighting process did not alter its ranking position. In second place, the Kirkpatrick and CIRO assessment models were ranked, with each fulfilling four of the eight criteria. Before the application of weighting, six models were ranked in the second position. Four models, i.e., the business impact instructional systems design (ISD) model, utility analysis model, balanced scorecard (BSC) method, and knowledge and skill evaluation model, were ranked third, with near-identical scores. In contrast, before the weighting, the input-process-output (IPO) assessment model, training valuation system, business impact ISD model, BSC method, and Baldwin and Ford's educational effectiveness model had all been ranked equally in third place. The difference in rankings after weighting can be attributed to the varying importance or weight of the criteria they fulfilled. Finally, the educational models of Noe, Fico's educational effectiveness model, the success case method, and the transitional model were ranked the lowest. These models were able to fulfill fewer criteria than the other models and, as such, received the lowest rankings (Fig. 4).

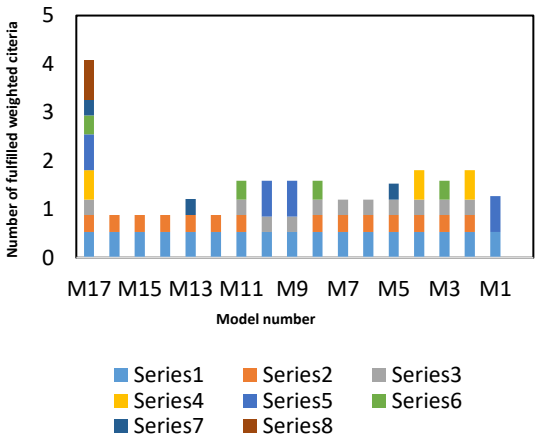

Fig. 4. Ranking the effectiveness assessment models in terms of fulfilling the criteria after weighting.

CONCLUSION

This study represents the first attempt to compare models for assessing the effectiveness of training courses for agricultural operators. To the best of our knowledge, no other study has been conducted in this field. Several important conclusions can be drawn from the research. First, by introducing various models for evaluating the effectiveness of educational courses, this study broadens the perspective of researchers and evaluators. By presenting a range of models, the research encourages other scholars to focus on specific models and to use those most appropriate for different circumstances. Second, by proposing eight criteria, the study provides a framework for comparing different effectiveness assessment models, thus offering researchers and practitioners a tool for evaluating these models more effectively. Third, the study highlights the Phillips ROI model as particularly well-suited for assessing the effectiveness of training courses for agricultural operators. Based on the criteria outlined in the study, the Phillips ROI model appears to offer more realistic outcomes regarding the effectiveness of educational courses for agricultural operators. However, it is important to note that this does not imply the Phillips ROI model is universally applicable. In certain contexts, other models may prove more suitable for evaluating the

effectiveness of agricultural training courses. Fourth, this study introduces a new intellectual and methodological approach for selecting and applying models to assess the effectiveness of training courses for agricultural operators, an approach that has not been addressed in previous research. Nevertheless, this study also has limitations that should be considered in future research. The first limitation is the lack of reference data on the effectiveness of the models used to evaluate agricultural training courses. The availability of such data would enable researchers or evaluators to validate theoretical comparison results with practical evidence. For example, while this study concluded that the Phillips ROI model is superior to other assessment models, it remains uncertain whether field data supporting this conclusion would yield similar results. Therefore, it is recommended that future studies employ multiple models to assess the effectiveness of agricultural training courses, allowing for the collection of reference data to compare the application of each model in practice. The second limitation is the absence of a follow-up study to evaluate the real-world application of the findings from this systematic review. Although the study identified the Phillips ROI model as the most suitable based on the established criteria, its practical use in evaluating the effectiveness of training courses is still uncertain. Future research should assess the feasibility and policy relevance of this model through real-world applications. These practical considerations, including the feasibility of implementation and policy alignment, were not explored due to time and financial constraints, and future researchers should aim to address this gap by examining the application of the Phillips ROI model in the field.

FUNDING

This research was funded by Iran National Science Foundation and Agricultural Research, Education and Extension Organization (AREEO), grant number 4020299".

CRediT AUTHORSHIP CONTRIBUTION STATEMENT

Conceptualization: Khadijeh Bazrafkan and Hassan Alipour; Methodology: Khadijeh Bazrafkan and Hassan Alipour; Software: Khadijeh Bazrafkan and Hassan Alipour; Validation: Khadijeh Bazrafkan and Hassan Alipour; Formal analysis: Khadijeh Bazrafkan and Hassan Alipour; Investigation: Khadijeh Bazrafkan and Hassan Alipour; Resources: Khadijeh Bazrafkan and Hassan Alipour; Data curation: Khadijeh Bazrafkan and Hassan Alipour; Writing—original draft preparation: Khadijeh Bazrafkan and Hassan Alipour; Writing—review and editing: Khadijeh Bazrafkan and Hassan Alipour; Visualization: Khadijeh Bazrafkan and Hassan Alipour; Supervision: Hassan Alipour; Project administration: Khadijeh Bazrafkan; Funding acquisition: Khadijeh Bazrafkan and Hassan Alipour.

DECLARATION OF COMPETING INTEREST

The authors declare no conflicts of interest.

ETHICAL STATEMENT

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Agricultural Research, Education and Extension Organization (AREEO) (Date2023.06.23/No: 4020299).

DATA AVAILABILITY

The data utilized in this study are outlined within the article.

ACKNOWLEDGMENTS

Iran National Science Foundation and Agricultural Research, Education and Extension Organization (AREEO) are thanked for the financial support of this project.

REFERENCES

Abao, E., Isidro, M. A., Bacus, R., Balo, V., Boholano, H., Bustamante, J., Mananay, J., & Navarro, T. M. (2022). CIRO model: A monitoring and evaluation framework in developing global Filipino teachers' program. *Neuro Quantology*, *20*(16), 1502. https://doi.org/10.14704/NQ.2022.20.16.NQ880147

Abbasi Rostami, A., AhmadPour, A., & Sharifzadeh, M. S. (2016). Analysis of eeffectiveness of extension education activities on promoting tobacco growers' knowledge level in Mazandaran province with structural equation mmodelling. *Iranian Journal of Agricultural Economics and Development Research*, *47*(3), 695-706. https://doi.org/10.22059/ijaedr.2016.60250

Abili, K., Gholamali lavasani, M., Gholami, K., & Hosseini, S. J. (2016) The study of effectiveness training courses supervisions and suggestions suitable solutions in order to its improvement (case study: National Iranian gas company). *Strategic Studies in the Oil and Energy Industry*, *7* (27), 51-74.

Edham Maleki, M., Khosravipour, B., & Soltani, F. (2021). Participatory management of groundwater resources in agriculture (case study: Inhibitory and promotional factors in (Murghab Plain, Khuzestan province). *Geography and Human Relationships*, *3*(4), 419-423. https://doi.org/10.22034/gahr.2021.279993.1526

Ahn, E., & Kang, H. (2018). Introduction to systematic review and meta-analysis. *Korean Journal of Anesthesiology*, *71*(2), 103-112. https://doi.org/10.4097/kjae.2018.71.2.103

Ayele, N. F., & Singh, M. (2024). Integrating sustainability with performance: Effect of social and environmental dimensions of the balanced scorecard on the performance of financial institutions in Ethiopia, moderated by management commitment. *Business Strategy & Development*, *7*(3), e414. https://doi.org/10.1002/bsd2.414

Azizi-Khalkheili, T. (2017). Investigating the effectiveness of farmers occupational training the case of: Vermicompost production training in Pasargad township. *Journal of Entrepreneurial Strategies in Agriculture*, *4*(7), 39-47. https://doi.org/10.29252/jea.4.7.39

Bagherabadi, G. H. (2013). I*nvestigating the evaluation and effectiveness of training courses of the teacher*

training centre and technical and professional research based on the first and second level of the Kirkpatrick model. Tehran: Technical and Vocational Education Organization Press: Tehran, Iran. (In Persian).

Baldwin, T. T., & Ford, J. K. (1988). Transfer of training: A review and directions for future research. *Personnel psychology*, *41*(1), 63-105. https://doi.org/10.1111/j.1744-6570.1988.tb00632.x

Brinkerhoff, R. O. (2005). The success case method: A strategic evaluation approach to increasing the value and effect of training. *Advances in Developing Human Resources*, *7*(1), 86-101. https://doi.org/10.1177/1523422304272172

Brown, C. (2012). Application of the balanced scorecard in higher education: Opportunities and challenges. *Planning for Higher Education*, *40*(4), 40-50.

Coffman, S., Doolen, J., & Llasus, L. (2015). Program development and evaluation of the concierge model of simulation. *On-Line Journal of Nursing Informatics*, *19*(2), 8-27.

Crocetti, E. (2016). Systematic reviews with meta-analysis: Why, when, and how? *Emerging Adulthood*, 4(1), 3-18. https://doi.org/10.1177/2167696815617076

De Jesus Alvares Mendes Junior, I., & Alves, M. D. C. (2023). The balanced scorecard in the education sector: A literature review. *Cogent Education*, *10*(1), 2160120. https://doi.org/10.1080/2331186X.2022.2160120

Elfiky, A., Arous, S., Ahmed, G., & Abouraia, M. (2021). Measuring the outcomes of training programs in the Egyptian hotels: An analytical study. *Journal of the Faculty of Tourism and Hotels-University of Sadat City*, *5*(1), 138-155.

Enayati rad, M., Ajili, A., Rezaei Moghaddam, k., & Bijani, M. (2009) Factors influencing knowledge Corn growers in about sustainable agriculture in the West North of Khuzestan, *Journal of Agricultural Extension and Education*, *5*(2), 68-59.

Fathi Vajargah, K., Dibavajari, T. (2016). *Assessing the effectiveness of training courses*. Tehran: Aeezh. (In Persian).

Fazeli, S., Forouzani, M., Yazdanpanah, M., & Abdeshahi, A. (2016). A quality evaluation of IPM/FFS training courses using QFD. *Journal of Agricultural Extension and Education Research*, *9*(1), 69-75.

Gomez, A. K. (2003). *An analysis of the evaluation practices of employer-sponsored training in the financial services industry* (Doctoral Dissertation, Texas A&M University, Texas, The United States of America). Retrieved from: https://core.ac.uk/download/pdf/147123094.pdf

Grigal, M., Test, D. W., Beattie, J., & Wood, W. M. (1997). An evaluation of transition components of individualized education programs. *Exceptional Children*, 63(3), 357-372. https://doi.org/10.1177/001440299706300305

Gulu, K., Celik, O., Gulu, T., & Bayram, H. (2017). A research on internal marketing and motivation: Employee evaluation of training and development programmes in banking sector. *Business & Management Studies: An International Journal*, *5*(1), 162-173. http://dx.doi.org/10.15295/bmij.v5i1.104

Hajimirrahimi, S. D. (2022). Evaluating the socio-economic impacts of training, extension, and research tours of progressive farmers in Alborz province; application of Kirkpatrick model. *Iranian Agricultural Extension and Education Journal*, *18*(1), 143-159. https://doi.org/10.52547/jea.9.18.1

Hladchenko, M. (2015). Balanced scorecard-a strategic management system of the higher education institution. *International Journal of Educational Management*, *29*(2), 167-176. https://doi.org/10.1108/IJEM-11-2013-0164

Iran Ministry of Agriculture Jihad. (2019). *Disseminatable findings of the agriculture and natural resources sector in 2019 of the agricultural research, education and extension organization (Volume 2)*. Tehran: Agricultural Research, Education, and Extension Organization Press.

Khodaverdian, M. R. (2023). *Principles and foundations of evaluating educational and promotional programs*. Tehran: Agricultural Research, Education and Extension Organization Press.

Khorasani, A., & Rashtiani, B. (2012). *Comprehensive approach to the effectiveness of education (a step-by-step guide to implementing the ROI model)*. Tehran: Iran Industrial Education and Research Publishing Center.

Kirkpatrick, D. L. (2013). Kirkpatrick four levels audio recordings study guide. Georgia: Kirkpatrick Partners. https://doi.org/10.1515/9781580468619

Linde, K., & Willich, S. N. (2003). How objective are systematic reviews? Differences between reviews on complementary medicine. *Journal of the Royal Society of Medicine*, *96*(1), 17-22. https://doi.org/10.1177/014107680309600105

Mansikka, H., Harris, D., & Virtanen, K. (2017). An input-process-output model of pilot core competencies. *Aviation Psychology and Applied Human Factors*, *7*, 78-85. https://doi.org/10.1027/2192-0923/a000120

Marshall, J., & Peters, M. (1985). Evaluation and education: The ideal learning community. *Policy Sciences*, *18*(3), 263-288. https://doi.org/10.1007/BF00138912

Marshall, S. P. (2012). Assessing schema knowledge. In *Test theory for a new generation of tests* (pp. 155-180). Routledge.

McGrath, J. (1984). *Groups: Interaction and performance (Vol. 14)*. NJ: Prentice-Hall, Englewood Cliffs.

Mirgohar, M., & Movahed Mohamady, H. (2008) study of extension and training needs assessment of agricultural with using of measure differences in the level of technical knowledge and its application Azrvykrd. *Journal of Agricultural Extension and Education*, *4*(1), 72-61.

Molenda, M. (1996). *Designing instructional systems. Training and development handbook (4th ed.).* New York: Mcgraw-Hill.

Munn, Z., Peters, M. D., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing

between a systematic or scoping review approach. *BMC Medical Research Methodology*, *18*, 1-7. https://doi.org/10.1186/s12874-018-0611-x

Oreszczyn, S., Lane, A., & Carr, S. (2010). The role of networks of practice and webs of influencers on farmers' engagement with and learning about agricultural innovations. *Journal of Rural Studies*, *26*(4), 404-417. https://doi.org/10.1016/j.jrurstud.2010.03.003

Pershing, J. A. (2000). Business impact ISD model: Indiana University. *The Culture and Change Management Conference of the International Society for Performance Improvement*, Washington DC, The United States of America.

Pershing, J. A. (2006). Human performance technology fundamentals. Handbook of human performance technology: Principles, practices, and potential (3rd Edition). John Wiley & Sons, Inc: Hoboken, New Jersey, The United States of America.

Pershing, J. A., & Lee, S. H. (2000). Transfer evaluation of knowledge and skill development: A case study of an instructional systems development training program. *Performance Improvement Quarterly*, *13*(1), 7-29. https://doi.org/10.1111/j.1937-8327.2000.tb00154.x

Peter, K., John, V., George, G., Luke, H., Shawn, M., and Spencer, G. (2021). Impact of calf housing improvement and farmer training on finances, management and animal welfare perceptions of Kenyan smallholder dairy farmers. *Journal of Development and Agricultural Economics*, *13*(2), 119-129. https://doi.org/10.5897/JDAE2021.1259

Phillips, J. J. (2012). *Return on investment in training and performance improvement programs.* UK: Routledge. https://doi.org/10.4324/9780080516257

Phillips, P. P., and Phillips, J. J. (2009). Return on investment, in Watkins, R. and Leigh, D. (Eds), *Handbook of Improving Performance in the Workplace*, (pp. 823-846). Hoboken, NJ: John Wiley & Sons. https://doi.org/10.1002/9780470592663.ch53

Rahayu, E. S., & Paerah, A. (2022). Learning transfer perceived from the Baldwin & Ford theory: An empirical study on the alumni of pre-service training in East Java. *Enrichment: Journal of Management*, *12*(4), 3232-3241. https://doi.org/10.35335/enrichment.v12i4.791

Saifi Hosseinabadi, M. (2015). Evaluating the effectiveness of the executive management training course at Iran National Gas Company based on the Kirkpatrick model. *Training and Development of Human Resources*, *2*(4), 1-16.

Srivastava, V., & Walia, A. M. (2018). An analysis of various training evaluation models. *International Journal of Advance and Innovative Research*, *5*(4), 276-282.

Stufflebeam, D. L. (1971). The relevance of the CIPP evaluation model for educational accountability. *Journal of Research and Development in Education*, 5, 19-25.

Stufflebeam, D. L., & Zhang, G. (2017). *The CIPP evaluation model: How to evaluate for improvement and accountability.* New York: Guilford Publications.

Suleiman, W., Dassanayake, M. S., & Othman, A. E. A. (2016). Roles of trainee characteristics and work environment in training transfer: A conceptual extension of Baldwin and Ford model with job attitude factors in Nigerian Context. *Amity Journal of Training and Development*, *1*(1), 20-31.

Talukder, B., & Blay-Palmer, A. (2017). Comparison of methods to assess agricultural sustainability. *Sustainable agriculture reviews*, *25*, 149-168. https://doi.org/10.1007/978-3-319-58679-3_5

Warr, P., Bird, M., & Rackham, N. (1970). *Evaluation of management training: A practical framework, with cases, for evaluating training needs and results*. Princeton: Gower Press.

Yanti, D., & Azhariyah, S. (2020). Development program evaluation on entrepreneurship course in vocational high school west Sumatra. In *1st Progress in Social Science, Humanities and Education Research Symposium (PSSHERS 2019)*, (pp. 19-22). Atlantis Press.